STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610-9544

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

DR. RICHARD D. GARRITY
DISTRICT MANAGER

October 25, 1984

RECEIVE
AIR QUA
DIVISIO

OC 2

Mr. Hubert Dreckmann, V.P. and General Manager
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

Dear Mr. Dreckman:

Re: Pinellas County - AP
Conveyorized Lens Washer

Attached is Permit No. A052-90650. Should you object to the issuance of this permit or the specific conditions of the permit, you have a right to petition for a hearing pursuant to the provisions of Section 120.57, Florida Statutes. The petition must be filed within fourteen (14) days from receipt of this letter. The petition must comply with the requirements of Section 17-103.155 and Rule 28-5.201, Florida Administrative Code, (copies attached) and be filed pursuant to Rule 17-103.155(1) in the Office of General Counsel of the Department of Environmental Regulation at 2600 Blair Stone Road, Tallahassee, Florida 32301. Petitions which are not filed in accordance with the above provisions are subject to dismissal by the Department.

In the event a formal hearing is conducted pursuant to Section 120.57(1), all parties shall have an opportunity to respond, to present evidence and argument on all issues involved, to conduct cross-examination of witnesses and submit rebuttal evidence, to submit proposed findings of facts and orders, to file exceptions to any order or hearing officer's recommended order, and to be represented by counsel.

If an informal hearing is requested, the agency, in accordance with its rules of procedure, will provide affected persons or parties or their counsel an opportunity, at a convenient time and place, to present to the agency or hearing officer, written or oral evidence in opposition to the agency's action or refusal to act, or a written statement challenging the grounds upon which the agency has chosen to justify its action or inaction, pursuant to Section 120.57(2), Florida Statutes.

Sincerely,

Richard D. Garrity

Richard D. Garrity, Ph.D.
District Manager

RDG/JE/rw

Attachment: as stated

cc: PCDEM

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610-9544

BOB GRAHAM
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SECRETARY

DR. RICHARD D. GARRITY
DISTRICT MANAGER

PERMITTEE:
Mr. Hubert Dreckmann
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

PERMIT/CERTIFICATION
Permit No.: AO52-90650
County: Pinellas
Expiration Date: 10/24/89
Project: Conveyorized lens washing systems

This permit is issued under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code Rules 17-2 & 17-4. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents, attached hereto or on file with the department and made a part hereof and specifically described as follows:

For the operation of two conveyorized lens washing systems using trichloroethylene as the solvent.

Location: 4900 Park Street North, St. Petersburg, Pinellas County

UTM: 17-327.5E 3077.8N NEDS NO: 0098 Point ID: 01

Replaces Permit No.: AO52-55878

6. The permittee shall at all times properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit, as required by department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized department personnel, upon presentation of credentials or other documents as maybe required by law, access to the premises, at reasonable times, where the permitted activity is located or conducted for the purposes of;

a. Having access to and copying any records that must be kept under the conditions of the permit:

b. Inspecting the facility, equipment, practices, or operations regulated or required under this permit; and

c. Sampling or monitoring any substances or parameters at any location reasonably necessary to assure compliance with this permit or department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately notify and provide the department with the following information:

(a) a description of and cause of non-compliance; and

(b) the period of non-compliance, including exact dates and times; or, if not corrected, the anticipated time the non-compliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the non-compliance.

The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the department for penalties or revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source, which are submitted to the department, may be used by the department as evidence in any enforcement case arising under the Florida Statutes or department rules, except where such use is proscribed by Section 403.73 and 403.111, Florida Statutes.

10. The permittee agrees to comply with changes in department rules and Florida Statutes after a reasonable time for compliance, provided, however, the permittee does not waive any other rights granted by Florida Statutes or department rules.

11. This permit is transferable only upon department approval in accordance with Florida Administrative Code Rules 17-4.12 and 17-30.30, as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the department.

12. This permit is required to be kept at the work site of the permitted activity during the entire period of construction or operation.

13. This permit also constitutes:

( ) Determination of Best Available Control Technology (BACT)

( ) Determination of Prevention of Significant Deterioration (PSD)

( ) Certification of Compliance with State Water Quality Standards (Section 401. PL 92-500)

( ) Compliance with New Source Performance Standards

14. The permittee shall comply with the following monitoring and record keeping requirements:

a. Upon request, the permittee shall furnish all records and plans required under department rules. The retention period for all records will be extended automatically, unless otherwise stipulated by the department, during the course of any unresolved enforcement action.

14. (con't)

b. The permittee shall retain at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation), copies of all reports required by this permit, and records of all data used to complete the application for this permit. The time period of retention shall be at least three years from the date of the sample, measurement, report or application unless otherwise specified by department rule.

c. Records of monitoring information shall include:

- the date, exact place, and time of sampling or measurements;
- the person responsible for performing the sampling or measurements;
- the date(s) analyses were performed;
- the person responsible for performing the analyses;
- the analytical techniques or methods used; and
- the results of such analyses.

15. When requested by the department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the department, such facts or information shall be submitted or corrected promptly.

SPECIFIC CONDITIONS:

1. Submit for this facility, each calendar year, on or before March 1, an emission report for the preceding calendar year containing the following information as per Chapter 17-4.14, F.A.C.

(A) Annual amount of materials and/or fuels utilized.
(B) Annual emissions (note calculation basis).
(C) Any changes in the information contained in the permit application.

2. The maximum equipment operation time during the first two years of the permit shall be 16 hrs/day, 5 days/wk, and 50 wks/yr. The maximum emissions rate shall be 116 lbs/hr from this source during the first year of the permit. This is to allow the operation of both existing

PERMITTEE:
Silor Optical of Florida, Inc.

Permit/Certification No.: A052-90650
Project: Conveyorized lens washing systems

SPECIFIC CONDITIONS (cont.)

lens washing systems simultaneously until the proposed new system is constructed and phased into operation. The maximum emission rate shall be 58 lb/hr from the source during the 2nd year of the permit. This will allow for operation of one of the current two systems during phase-in of the proposed new system. The maximum emission rate from this source for the remaining period of this permit shall be 58 lbs/hr with a restriction in operating hours of 8 hours per day, 5 days/wk and 50 wks/yr.

3. Every six months this facility shall prepare and maintain sufficient records and documentation for determination of total mass emissions of volatile organic compounds from the operating equipment.

4. A construction permit application shall be submitted to the Department within 3 months from the date of issuance of this operating permit. The application shall specify the type of control equipment, alternate production systems, and/or operating procedures selected to comply with Section 17-2.620(1)(a), F.A.C., in order to reduce and control emissions of volatile organic compounds or organic solvents.

5. Construction of the selected emissions control equipment, alternate production systems, and/or the inition of appropriate operation procedures shall be completed and implemented not later than six months from the date of issuance of the construction permit.

6. This facility shall comply with the "Conveyorized Degreaser Control Technology" guidelines of Section 17-2.650(1)(f) 12.d. (i), (v), (vi), (vii), (viii), (ix), (x) and (xi), F.A.C.

Issued this 25th day of October 1984.

STATE OF FLORIDA DEPARTMENT OF
ENVIRONMENTAL REGULATION

Richard D Garrity

Richard D. Garrity, Ph.D.
District Manager

BEST AVAILABLE COPY

AO52 090650

PAID JUL 31 1984

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT

7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

SOUTH WEST DISTRICT
TAMPA

APPLICATION FOR RENEWAL OF PERMIT TO OPERATE AIR POLLUTION SOURCE(S)

AO52-90650

If major alterations have occurred, the applicant should complete the Standard Air Permit Application Form.

Source Type: Conveyorized Lens Washer

Renewal of DER Permit No. A052-55878

Company Name: Silor Optical of Florida, Inc.

County: Pinellas

Identify the specific emission point source(s) addressed in this application (i.e., Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired):

Source Location: Street: 4900 Park Street North City: St. Petersburg

UTM: East 17-327.5 KME North 3077.8 KMN

Latitude: 27 ° 48 ' 54 "N. Longitude: 82 ° 45 ' 06 "W.

1. Attach a check made payable to the Department of Environmental Regulation in accordance with operation permit fee schedule set forth in Florida Administrative Code Rule 17-4.05.

2. Have there been any alterations to the plant since last permitted? [X] Yes [ ] No
If minor alterations have occurred, describe on a separate sheet and attach. See attached sheet

3. Attach the last compliance test report required per permit conditions if not submitted previously.

4. Have previous permit conditions been adhered to? [ ] Yes [X] No If no, explain on a separate sheet and attach. See attached sheet

5. Has there been any malfunction of the pollution control equipment during tenure of current permit? [ ] Yes [X] No If yes, and not previously reported, give brief details and what action was taken on a separate sheet and attach.

6. Has the pollution control equipment been maintained to preserve the collection efficiency last permitted by the Department? [X] Yes [ ] No

7. Has the annual operating report for the last calendar year been submitted? [X] Yes [ ] No If no, please attach.

8. Please provide the following information if applicable:

A. Raw Materials and Chemical Used in Your Process:

Description	Contaminant Type	%Wt	Utilization Rate	lbs/hr
Trichloroethylene	VOC	100		176.1[1]

B. Product Weight (lbs/hr): ______

[1] Year to date

C. Fuels

Type (Be Specific)	Consumption* Avg/hr*	Max/hr**	Maximum Heat Input (MMBTU/hr)

D. Normal Equipment Operating Time: hrs/day 16; days/wk 5; wks/yr 50*;

hrs/yr (power plants only) ______; if seasonal, describe ______

*This number takes into consideration 10 holidays per year - equivalent to approximately two weeks per year.

The undersigned owner or authorized representative*** of Silor Optical of Florida, Inc. is fully aware that the statements made in this application for a renewal of a permit to operate an air pollution source are true, correct and complete to the best of his knowledge and belief. Further, the undersigned agrees to maintain and operate the pollution source and pollution control facilities in such a manner as to comply with the provisions of Chapter 403, Florida Statutes, and all the rules and regulations of the Department. He also understands that a permit, if granted by the Department, will be non-transferable and he will promptly notify the Department upon sale or legal transfer of the permitted facility.

*During actual time of operation.

**Units: Natural Gas-MMCF/hr; Fuel Oils-barrels/hr; Coal-lbs/hr.

***Attach letter of authorization if not previously submitted

Signature, Owner or Authorized Representative
(Notarization is mandatory)

Hubert Dreckmann, VP & General Manager
Typed Name and Title

4900 Park St. No.
Address

St. Petersburg, Florida 33709
City State Zip

7/27/84
Date

(813) 541-5733
Telephone No.

DER Form 17-1.202(4)
Effective November 30, 1982

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

July 27, 1984

APPLICATION FOR RENEWAL OF PERMIT TO OPERATE AIR POLLUTION SOURCE(S)

(CONTINUED)

<u>Question 2:</u>

An automatic trichloroethylene makeup device has been added to lens washer to maintain required production liquid level.

<u>Question 4:</u>

Increased production requirements.

D.S
PH

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

August 13, 1982

Mr. Hubert Dreckman, V.P.
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

Dear Mr. Dreckman:

RE: Pinellas County AP

Enclosed is Permit Number A052-55878, dated August 13, 1982, to operate the subject pollution source issued pursuant to Section 403.061 (14), Florida Statutes.

Should you object to this permit, including any and all of the conditions contained therein, you may file an appropriate petition for administrative hearing. This petition must be filed within fourteen (14) days of the receipt of this letter. Further, the petition must conform to the requirements of Section 28-5.201, Florida Administrative Code, (see reverse side of this letter). The petition must be filed with the Office of General Counsel, Department of Environmental Regulation, Twin Towers Office Building, 2600 Blair Stone Road, Tallahassee, Florida 32301.

If no petition is filed within the prescribed time, you will be deemed to have accepted this permit and waived your right to request an administrative hearing on this matter.

Acceptance of the permit constitutes notice and agreement that the Department will periodically review this permit for compliance, including site inspections where applicable, and may initiate enforcement action for violation of the conditions and requirements thereof.

Sincerely,

WKHennessey
W. K. Hennessey
District Manager

rb
cc: PCDEM
Enclosure

STATE OF FLORIDA
DEPARTME[illegible] OF ENVIRONMENTAL RE[illegible]ULATION

SOUTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

APPLICANT:
Mr. Hubert Dreckman, V.P.
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

PERMIT/CERTIFICATION NO. A052-55878

COUNTY: Pinellas

PROJECT: Conveyorized lense washing system using VOC's

This permit is issued under the provisions of Chapter 403, Florida Statutes, and Chapter 17-2, Florida Administrative Code. The above named applicant, hereinafter called Permittee, is hereby authorized to perform the work or operate the facility shown on the approved drawing(s), plans, documents, and specifications attached hereto and made a part hereof and specifically described as follows:

For the operation of a conveyorized lense washing system using volatile organic compounds.

Located at 4900 Park Street North, St. Petersburg, Pinellas County.

UTM: 17-327.5 KME 3077.8 KMN

Replaces Permit No.: N/A NEDS No.: 0098 Point ID: 01

Expiration Date: August 5, 1984

PERMIT NO.: A052-55878
APPLICANT: Silor Optical of Florida, Inc.

SPECIFIC CONDITIONS:

1. Submit for this facility, each calendar year, on or before March 1, an emission report for the preceding calendar year containing the following information as per Chapter 17-4.14, F.A.C.

(A) Annual amount of materials and/or fuels utilized.
(B) Annual emissions (note calculation basis).
(C) Any changes in the information contained in the permit application.

2. The units shall not be operated at rates or times in excess of those set forth in the application. The maximum equipment operation time shall be 16 hrs/day, 5 days/wk and 50 wks/yr. The maximum emissions rate shall be 58 lbs/hr from the facility.

3. Every six months this facility shall prepare and maintain sufficient records and documentation for determination of total mass emissions of volatile organic compounds from the operating equipment.

4. This operating permit allows the facility to discharge the amount of volatile organic compounds as specified in the application until specific condition Number 6 is complied with and while complying with the schedule outlined in specific condition Number 5.

5. A construction permit application shall be submitted to the Department within 18 months from the date of issuance of this operating permit. The application shall specify the type of control equipment and/or operating procedures selected to comply with Section 17-2.620(1)(a), F.A.C. in order to reduce and control emissions of volatile organic compounds or organic solvents.

6. Construction of the selected emissions control equipment and/or the initiation of appropriate operation procedures shall be completed and implemented not later than six months from the date of issuance of the construction permit.

7. This facility shall prepar. and submit every six months, from the date of issuance of this permit, a report which describes the facilities progress towards meeting the requirements of this permit. The report shall address, but not be limited to: procedures and/or alternative investigated and results of such trials; status of investigations into utilization of add-on or replacement equipment; prognosis for contract award and/or equipment purchase and/or start of construction and/or operations modifications.

PAID MAY 19 1982

D.E.R.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Conveyorized Lens Washer ☐ New[1] ☒ Existing[1]

APPLICATION TYPE: ☐ Construction ☒ Operation ☐ Modification

COMPANY NAME: Silor Optical of Florida, Inc. **COUNTY:** Pinellas

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peeking Unit No. 2, Gas Fired) Conveyorized lens washer using VOC

SOURCE LOCATION: Street 4900 Park Street North City St. Petersburg

UTM: East ______ North ______

Latitude 27 ° 48 ' 54 "N Longitude 82 ° 45 ' 06 "W

APPLICANT NAME AND TITLE: Hubert Dreckmann, Vice President

APPLICANT ADDRESS: 4900 Park Street North, St. Petersburg, Florida 33709

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Silor Optical of Florida, Inc.

I certify that the statements made in this application for a Operation permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: ______

Hubert Dreckmann, Vice President
Name and Title (Please Type)

Date: [illegible] Telephone No (813) 541-5733

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed: Edgar J Vallar

Edgar J. Vallar
Name (Please Type)

(Affix Seal)

Silor Optical of Florida, Inc.
Company Name (Please Type)

4900 Park Street North
St. Petersburg, Florida 33709
Mailing Address (Please Type)

Florida Registration No. 16156

Date: 12 May 82 Telephone No (813) 541-5733

---

[1] See Section 17-2.02(15) and (22), Florida Administrative Code, (F.A.C.)

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Obtaining operation permit for conveyorized lens washer using VOC

B. Schedule of project covered in this application (Construction Permit Application Only) N/A

Start of Construction ______ Completion of Construction ______

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

N/A

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

NONE

E. Is this application associated with or part of a Development of Regional Impact (DRI) pursuant to Chapter 380, Florida Statutes, and Chapter 22F-2, Florida Administrative Code? ___ Yes _X_ No

F. Normal equipment operating time: hrs/day 16 ; days/wk 5 ; wks/yr 50* ; if power plant, hrs/yr ______ ;

if seasonal, describe: ______

*This number takes into consideration 10 holidays/yr. - equivalent to 2 weeks/1 yr.

G. If this is a new source or major modification, answer the following questions. ([✓ Yes] or No)

1. Is this source in a non-attainment area for a particular pollutant? yes
   a. If yes, has "offset" been applied? no
   b. If yes, has "Lowest Achievable Emission Rate" been applied? no
   c. If yes, list non-attainment pollutants.
      Ozone precusors
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. no
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirements apply to this source? If yes, see Sections VI and VII. no
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? no
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? no

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Trichloroethylene	VOC	100	114 (average)*	See Sketch #1

B. Process Rate, if applicable: (See Section V, Item 1) * Estimated value based on present usage

1. Total Process Input Rate (lbs/hr): N/A (see attached addendum)

2. Product Weight (lbs/hr): N/A

C. Airborne Contaminants Emitted:

Name of Contaminant	Emission[1]		Allowed Emission[2] Rate per Ch. 17-2, F.A.C.	Allowable[3] Emission lbs/hr	Potential Emission[4]		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	
Trichloroethylene	58*	117*	N/A RACT	N/A	58*	117*	See Sketch#1

D. Control Devices: (See Section V, Item 4) *Estimated value based on present usage (see attach
addendum)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles[5] Size Collected (in microns)	Basis for Efficiency (Sec. V, It[5]
N/A RACT				
Controlled Technology				

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g., Section 17-2.05(6) Table II, E. (1), F.A.C. — 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard

[4] Emission, if source operated without control (See Section V, Item 3)

[5] If Applicable

Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
N/A			

Units Natural Gas, MMCF/hr; Fuel Oils, barrels/hr; Coal, lbs/hr

uel Analysis:

ercent Sulfur: ______ Percent Ash: ______

ensity: ______ lbs/gal Typical Percent Nitrogen: ______

leat Capacity: ______ BTU/lb ______ BTU/gal

ther Fuel Contaminants (which may cause air pollution): ______

If applicable, indicate the percent of fuel used for space heating. Annual Average N/A Maximum ______

Indicate liquid or solid wastes generated and method of disposal.

Once or twice a week (or as necessary), this unit is cleaned up and waste liquids and solids are drummed up for shipment to reclaimer

Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: above roof 2.0 ft. Stack Diameter: 1.0 ft.

Gas Flow Rate: 600 (Total 2 fans) ACFM Gas Exit Temperature: ambient °F.

Water Vapor Content: ambient conditions % Velocity: ______ FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq & Gas By-prod.)	Type VI (Solid By-prod.)
Lbs/hr Incinerated	N/A						

escription of Waste ______

otal Weight Incinerated (lbs/hr) ______ Design Capacity (lbs/hr) ______

pproximate Number of Hours of Operation per day ______ days/week ______

lanufacturer ______

ate Constructed ______ Model No. ______

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber	N/A				
Secondary Chamber					

Stack Height: ____________ ft. Stack Diameter ____________ Stack Temp. ____________

Gas Flow Rate: ____________ ACFM ____________ DSCFM* Velocity ____________ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner [ ] Other (specify) ____________

Brief description of operating characteristics of control devices: ____________

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight — show derivation.
2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.,) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).
4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, etc.).
5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3, and 5 should be consistent: actual emissions = potential (1-efficiency).
6. An 8½" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.
7. An 8½" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).
8. An 8½" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. An application fee of $20, unless exempted by Section 17-4.05(3), F.A.C. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit. N/A

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?
☐ Yes ☐ No

Contaminant	Rate or Concentration
N/A	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy) ☐ Yes ☐ No

Contaminant	Rate or Concentration
N/A	

C. What emission levels do you propose as best available control technology?

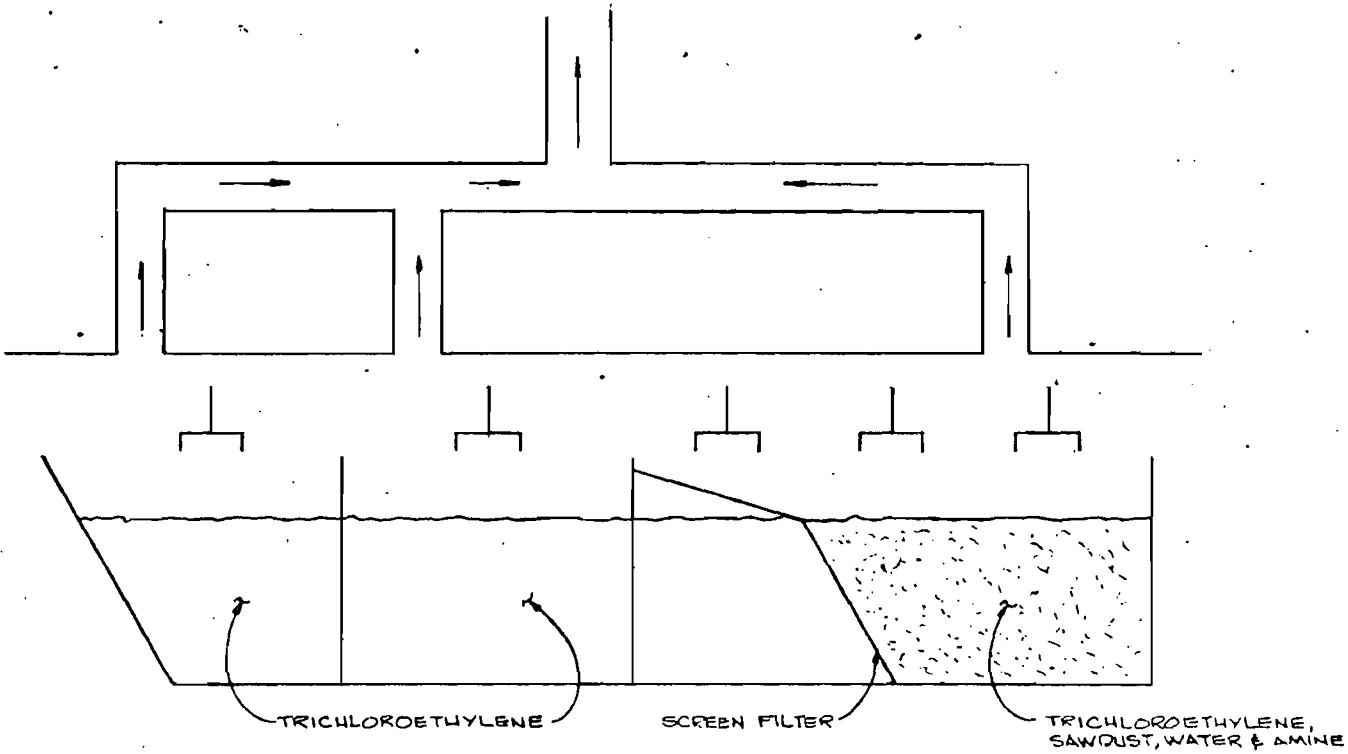
Contaminant	Rate or Concentration
N/A	

D. Describe the existing control and treatment technology (if any).

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:
5. Useful Life:
6. Operating Costs:
7. Energy:
8. Maintenance Cost:
9. Emissions:

Contaminant	Rate or Concentration
N/A	

*Explain method of determining D 3 above.



SCALE NONE	DATE 5-10-82	TITLE LENS WASHER EQUIPMENT & FLOW	REV	DESCRIPTION · DATE
TOLERANCES UNLESS OTHERWISE SPECIFIED	DRAWN BY			*Silor Optical* *of florida, inc.* St. Petersburg, Florida 3370
METRIC - · DECIMAL - · ANGULAR -	APPROVED			DRAWING NO. SKETCH # 1 · REV

ADDENDUM

TO

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO OPERATE/CONSTRUCT

AIR POLLUTION SOURCES

SILOR OPTICAL of Florida, Inc.

MAY 7, 1982

NOTE: Section III Parts A and C

Conveyorized Lens Washer

This equipment produces clean lenses for inspection for flaws. Soiled lenses are conveyorized through various closed chambers. The first chamber scrubs with sawdust and the second and third chambers rinse with Trichlorcethylene resulting in spot free lenses.

FORMULA

Trichloroethylene	52 Gallons
Sawdust	1.5 ft^3 (32 lbs)
Water	5 Gallons
Amine	250 ml

Remarks:

Sawdust absorbs almost an equal volume of Trichloroethylene with $<20\%$ increase in volume of sawdust due to absorption (swelling).

Water and amine are lost from the above formulation during operation. The maximum water/amine content in spent Trichloroethylene would be 5 gallons/drum.

Spent Trichloroethylene

Only 2 drums a week of spent Trichloroethylene contain significant quantities of sawdust, water and amino because the sawdust is changed only once or twice a week (as necessary).

Composition of Spent Drum of Trichloroethylene Containing Sawdust/Water/Amino

87.27% Trichloroethylene in each drum

Material Balance for Time Period 1/4/82 to 4/19/82

Trichloroethylene Used

204 Drums (data taken from trichloroethylene material usage sheet)

Spent Trichloroethylene Generated

104 Drums (data taken from EPA Hazardous Waste records)

Total Spent Trichloroethylene = Spent Trichloroethylene containing sawdust/water/amine (32 drums) + Spent Trichloroethylene containing very small amounts of sawdust/water/amine (72 drums)

Spent Trichloroethylene containing sawdust/water/amine = 32 X 0.8727
= 28 drums net

Total Spent Trichloroethylene
= 28 drums + 72 drums
= 100 drums

Overall Material Balance

	Drums
Total Usage Trichloroethylene	204
Total Spent Trichloroethylene	- 100
Total Trichloroethylene Lost	104

Total Weight Trichloroethylene Lost

104 Drums @ 660 lbs/drum = 68,640 lbs

Total Number Working Days 74 during same time period (1/4/82 to 4/19/82)

$$\text{Emission} = \left(\frac{68{,}640 \text{ lbs}}{74 \text{ days}}\right)\left(\frac{1 \text{ day}}{16 \text{ hrs. operation}}\right)$$

$$= 57.97 \text{ lbs/hr}$$

$$= 58 \text{ lbs/hr}$$

MAXIMUN YEARLY EMISSION (projected for 1982)

$$= \left(\frac{58 \text{ lbs}}{\text{hr}}\right)\left(\frac{16 \text{ hrs operation}}{\text{day}}\right)\left(\frac{252 \text{ working days}}{1 \text{ yr}}\right)$$

= 233,856 lbs/yr

= 116·928 tons/yr

= 117 tons/yr

PF

BOARD OF COUNTY COMMISSIONERS
PINELLAS COUNTY, FLORIDA
315 COURT STREET
CLEARWATER, FLORIDA 33516

COMMISSIONERS

BARBARA SHEEN TODD, CHAIRMAN
JOHN CHESNUT, JR., VICE-CHAIRMAN
GABRIEL CAZARES
CHARLES E. RAINEY
BRUCE TYNDALL

December 19, 1984

Mr. Edgar Vallar
Silor Optical of Florida
4900 Park Street
St. Petersburg, FL 33709-2299

Re: VOC Air Pollution Source Permit Requirement

Dear Mr. Vallar:

The Pinellas County Division of Air Quality in conjunction with the Florida Department of Environmental Regulation has made the following determination regarding your firms proposed modifications.

The proposed cleaning solvent, N-methylpyrrolidone (abbrev. NMP) is considered to be a VOC under the definition described in Chapter 17-2 F.A.C. Thus, this material is regulated and the source requires a permit for construction and subsequent operation under Chapter 17-4 F.A.C. The material is a volatile organic compound with a vapor pressure of 0.30 mm Hg at 20°C. The rules definition states a VOC is "any chemical compound containing carbon or carbon and hydrogen in combination with any other element, which has a vapor pressure greater than 0.10 mm Hg under standard conditions,....."

The proposed source requires a permit to construct and then one to operate as it is a new separate source to be operated simultaneously with, while phasing out the existing trichloroethylene lens cleaning systems.

It is favorably noted that NMP is considered a much less noxious compound then trichloroethylene. Also, due to the much lower volatility and differences in equipment design the proposed system will greatly reduce the emissions of hydrocarbons in the environment. The significant reduction anticipated is acknowledged as exhibiting Silors concern for the communitys environmental betterment.

We look forward to further assisting you in this program. If you have any questions please contact our office at 530-6522.

Sincerely,

Joyce M. Gibbs

Joyce M. Gibbs, Chief
Division of Air Quality

JMG/PH/wn

cc: DER

AC 5/2

Intermediate Chemicals
Chemicals Group

Technical Bulletin

1-METHYL-2-PYRROLIDONE

N-Methylpyrrolidone, abbreviated NMP, is a colorless mobile liquid with a faint amine odor. It is miscible in all proportions with water and conventional organic solvents.

C_5H_9NO

ASSAY	99.5% min. (by GC)
IMPURITIES	0.1% Max. water (typically less than .05%) 0.01% max. methylamine
FLOW POINT	-25°C
BOILING RANGE (5-95 ml)	202.5-205°C
DENSITY d_{25}	1.028 g/ml
FLASH POINT	91°C ASTM D 93-73

10/83

BASF

AC 5/1

BEST AVAILABLE COPY

Intermediate Chemicals
Chemicals Group

Price Schedule

N-METHYLPYRROLIDONE
140641

Minimum order size	Price
Bulk	$1.32/lb.
Truckload	$1.40/lb.
10 - Truckload	$1.44/lb.
1 - 9	$1.49/lb. 706.86

FOB shipping point, freight equalized.

In addition to the above price breaks for drum shipments, the following upcharges apply for shipments from specific warehouses:

Finderne, NJ	$0.04/lb.
Chicago, IL	$0.04/lb.
Houston, TX	$0.05/lb.
Los Angeles	$0.08/lb.

Package: Steel drum
462 lbs. net/512 lbs. gross.

Tank Truck - 4000 gal. min.

6/84

THE PRICES SHOWN ON THIS PRICE SCHEDULE ARE SUBJECT TO CHANGE WITHOUT NOTICE.

BASF Wyandotte Corporation
Intermediate Chemicals
Chemicals Group
100 Cherry Hill Road
Parsippany, New Jersey 07054
(201) 263-3400
800-526-1072

Regional Office
Suite 310, 3845 FM 1960
Houston, Texas 77068
(713) 537-0225

BASF

Material Safety Data Sheet

BASF Wyandotte orporation BASF
Wyandotte, Mich. 48192
313 282-3300

SECTION I

TRADE NAME	Methylpyrrolidone	CHEMICAL NAME	N-methyl-2-pyrrolidone
SYNONYMS		CHEMICAL FAMILY	cyclic amine
FORMULA	$CH_3NCH_2CH_2CH_2CO$	MOLECULAR WEIGHT	

SECTION II — HAZARDOUS INGREDIENTS

NAME	%	TLV UNITS	TOXICOLOGICAL DATA
N-methyl-2-pyrrolidone			Rat, oral LD_{50} 3.5 ml/kg

SECTION III — PHYSICAL DATA

Boiling Point - 760mm Hg (202°C)	395°F		
Vapor Pressure, mm Hg @ 20° C.	.3mm @ 20°C		
Specific Gravity (H_2O = 1)	1.027		
Solubility in Water	complete		
Appearance and Odor	colorless liquid with mild amine odor		

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

FLASH POINT *(TEST METHOD)*	(95°C) 204°F	AUTOIGNITION TEMPERATURE			
FLAMMABILITY LIMITS IN AIR – % BY VOLUME		LOWER		UPPER	
EXTINGUISHING MEDIA	☐ WATER FOG ☒ FOAM (Type) ☒ CO_2 ☒ DRY CHEMICAL ☐ OTHER				
SPECIAL FIRE-FIGHTING PROCEDURES					
UNUSUAL FIRE AND EXPLOSION HAZARDS					

EMERGENCY TELEPHONE NUMBER

(201) 263-0200

This number is available days, nights, weekends, and holidays.

SECTION V — HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE not established

EFFECTS OF OVEREXPOSURE Liquid may cause minor irritation to skin, eyes, mucous membrane, possible carneal clouding. Ingestion may cause gastric upset, diarrhea, difficulty in breathing.

FIRST AID PROCEDURES

EYES FLUSH WITH FLOWING WATER AT LEAST MINUTES	Flush affected skin or eye area with large amount of water. If ingested induce vomiting, consult a physician.	NEVER GIVE FLUIDS OR INDUCE VOMITING IF PATIENT IS UNCONSCIOUS OR HAVING CONVULSIONS

SECTION VI — REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID moisture -- compound is hygroscopic.
	STABLE	X	

INCOMPATIBILITY strong acids

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	DOES NOT OCCUR	X	

SECTION VII — SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE OF SPILLS Absorb spill on sand, vermiculite or paper toweling. Scoop into a carton and remove to chemical incinerator equipped with after burner.

WASTE DISPOSAL METHOD Do not discharge to land areas, waterways or sewer without prior consent of local public health and pollution control authority.

CONSULT LOCAL AND STATE LAWS

SECTION VIII — SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION

VENTILATION	LOCAL EXHAUST ~~preferred~~	SPECIAL
	MECHANICAL (General) may be adequate	OTHER

PROTECTIVE CLOTHING impermeable gloves

EYE PROTECTION goggle

OTHER

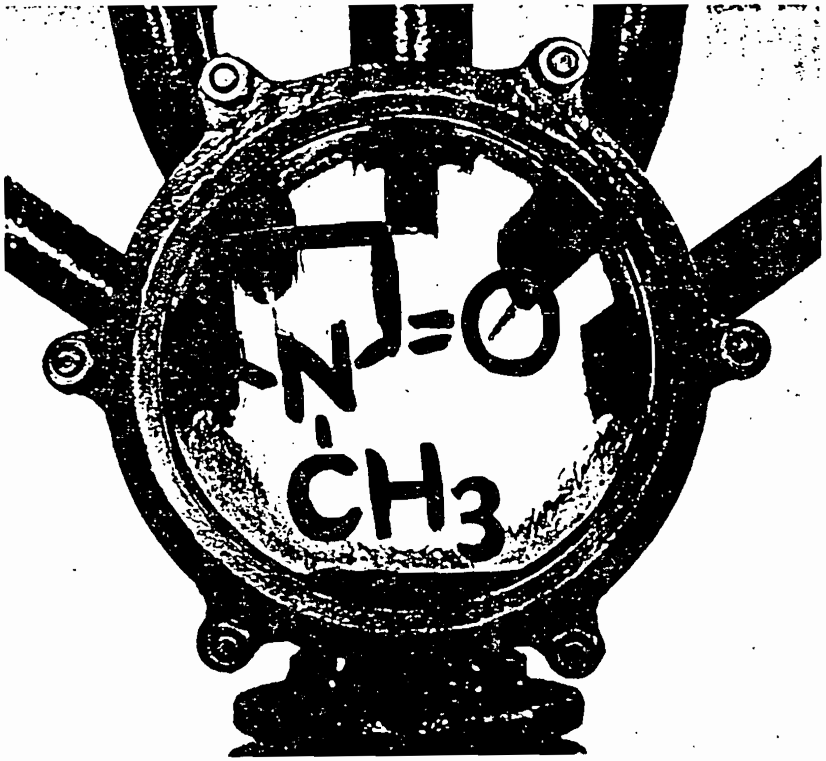
SECTION IX — SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING N-methyl-2-pyrrolidone	CAUTION: May cause irritation of skin, eyes, nose and throat. Harmful if swallowed. Avoid contact with skin, eyes, clothing. Do not take internally.
HANDLING AND STORAGE CONDITIONS	

Return to P.J.S.

BASF Intermediates

N-Methylpyrrolidone

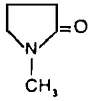


BASF

Contents

1 Nature

1-Methyl-2-pyrrolidinone
C_5H_9NO
Relative molecular mass 99.1



2 Properties

P = 12.[illegible]

N-Methylpyrrolidone, abbreviated NMP, is a colorless mobile liquid with a faint amine odor. It is miscible in all proportions with water and conventional organic solvents.

Assay	at least 99.5% (by gas chromatograph)
Impurities	0.1% max. of water (DIN 51777 corresponding to ASTM D 1364-64)
Flow point	−25°C
Boiling range (5–95 ml)	202.5–205°C (DIN 51751 corresponding to ASTM D 1078-70)
Density d_{25}	1.028 g/ml (DIN 51757 corresponding to ASTM D 941-55)
Flash point	91°C (DIN 51758 corresponding to ASTM D 93-73)

The figures quoted for the assay and the impurities are for our commercial grade of NMP. Our special grade of NMP contains at least 99.5% *N*-methylpyrrolidone, not more than 0.05% water, and not more than 0.01% methylamine.

3 Storage

NMP can be stored in mild steel, e.g., boiler plate, vessels. Air and moisture must be excluded. The product may assume a slight yellow coloration on prolonged storage, but this does not have any effect on its efficiency.
Other materials that can be used for storing NMP are alloy steels and nickel. At room temperature, aluminum may also be used. ®Dimetcote (Amercoate Europe N.V.) is resistant to NMP and may thus be used for lining ships' tanks.

4 Chemistry

4.1 Reactions

N-Methylpyrrolidone is the lactam of 4-methylaminobutyric acid. It is a very weak base and enters into an addition reaction with anhydrous hydrogen chloride to form a solid hydrochloride.

NMP is stable at temperatures of over 315 °C in an inert atmosphere. Above 200 °C, a yellow coloration is assumed, but this is not accompanied by any analytically detectable change in the purity of the product.

If NMP is exposed to the atmosphere, oxygen dissolves in it, with the result that hydroperoxides are formed in amounts of the order of some ppm. Autoxidation of NMP is favored by exposure to light. The reaction is presumably analogous to the formation of ε-caprolactam peroxide [1]. If it is heated to 150–160 °C, NMP hydroperoxide decomposes, one of the products of the reaction being *N*-methylsuccinimide.

Pure NMP diluted with ten times its own volume of water has a neutral to slightly alkaline reaction. The figure for the pH is influenced by traces of methylamine and other impurities.

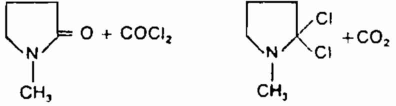
In an aqueous solution with a pH value of 5, about 2×10^{-3} % wt of NMP hydrolyzes to 4-methylaminobutyric acid in one hour at 100 °C; at a pH value of 9, about 2×10^{-2} % wt. Strong aqueous acids [2] or alkalis hydrolyze NMP to 4-methylaminobutyric acid at a rate that depends on the temperature.

The $-CO-CH_2-$group can be converted into an enol by sodium alkylates. An example of where this occurs is the first stage in the Späth nicotine synthesis, in which ethyl nicotinate is condensed with *N*-methylpyrrolidone in the presence of sodium ethylate to yield 3-pyridyl-1'-methylpyrrolidon-2'-yl-3'-ketone [3].

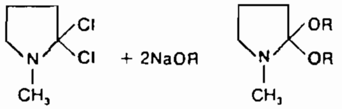
A complex with the composition $NiBr_2 \cdot 3$ (NMP) is obtained by heating nickel dibromide with NMP. By virtue of their solubility in organic compounds, complex salts of this nature can be used as catalysts.

An example of their application is in carbonylation.

2,2-Dichloro-1-methylpyrrolidine is obtained from NMP and phosgene, phosphorus pentachloride, or other chlorinating agents.



The amidochloride reacts with alcoholates to yield the corresponding amidoacetals.



The amidochloride primarily formed in chlorobenzene solution by reaction with phosgene condenses with NMP to form 2,3'-dimethyl-2,3'-diaza-2'-oxo-1,1'-bicyclopentylidene [4].

4.2 Medium for organic syntheses

NMP is an inert, stable, and polar solvent for any difficult reactions. Very often, it acts as an auxiliary catalyst and thus ensures that the reaction proceeds more rapidly and more smoothly than would be the case with another solvent. Other advantages are the ease with which it can be recovered, the absence of handling hazards, and the fact that it is not corrosive if oxygen is excluded. The tremendous scope that it offers is illustrated by the following typical examples.

4.2.1 Alkylation

Substituted acetylenes can be readily alkylated with alkyl halides via their alkali compounds, but alkali acetylides themselves cannot be alkylated by these reagents except in liquefied ammonia. Nevertheless, in NMP or in solvent blends containing NMP, sodium or potassium acetylide and alkyl halides or alkyl sulphates react to form the corresponding acetylene hydrocarbons, e.g., alkylacetylenes, 1,7-octadiyne, etc. [5].

Lower alkyl or benzyl groups may be introduced into esters of malonic acid, cyanoacetates, acetylacetates, or other beta-ketone esters with an active hydrogen atom if an alkyl halide or dialkyl sulphate is used and the catalyst is a polar solvent such as NMP [6].

4.2.2 Ethynylation

NMP and other solvents with a high dielectric constant favor the ethynylation of ketones to alkynols in the presence of sodium or potassium acetylides or alkoxides [7, 8].

An analogous reaction is the addition of 3-dimethylamino-1-propyne to xanthone and thioxanthone in NMP with the aid of lithium amide [9].

4.2.3 Vinylation

Carbazole, maleic hydrazide, 2,5-diketopiperazine and other compounds that are difficult to vinylate by normal means can be readily vinylated in the presence of NMP and suitable catalysts, e.g., alkali metals. The reactions in NMP proceed rapidly at moderate acetylene pressures to yield pure products; the catalyst requirements are low [10]. Glycerol can also be vinylated to 1,2,3-trisvinyloxypropane more easily and with better yield in NMP than by any other method [11].

4.2.4 Manufacture of carboxylic acids and their derivatives

Examples for these processes:

the conversion of alcohols, carbon monoxide and hydrogen to the corresponding carboxylic acids, anhydrides, and esters in the presence of complex 'onium compounds of nickel and cobalt bromide and iodide; in this case the NMP acts as a solvent [12];

the manufacture of acetic anhydride from dimethyl ether, carbon monoxide, and a little hydrogen in the presence of catalysts; in this case NMP acts as a medium for the reaction [13];

the carbonylation of alcohols and their ethers and esters and of amines to yield carboxylic acids and their esters and anhydrides in the

presence of catalysts consisting of nickel or cobalt salts and NMP, which acts here as a complexing agent [14, 15];
the manufacture of acrylic acid and its derivatives by the reaction between acetylene, carbon monoxide, and a compound with an active hydrogen atom in the presence of a complex catalyst such as $NiBr_2 \cdot 3$ NMP [16];
the manufacture of carboxylic anhydrides from carboxylic acids and alkyl chlorides in the presence of catalysts containing carbonamides, e.g., NMP [17];
α-chloroacrylates are obtained in a smooth reaction between lower alkyl acrylates and chlorine in the presence of metal salts, which act as catalysts, and a little NMP [18].

4.2.5 Cleavage and addition of hydrogen halides

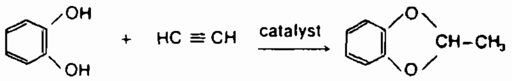
Improved yields of monochloro and monobromo cyclooctatetraenes are obtained when the hydrogen halide is removed from 7,8-dihalobicyclo[0.2.4]octa-2,4-diene in NMP solution [19]. NMP acts as a catalyst in the removal of hydrogen chloride from *α,β*-dichloropropionates to form chloroacrylates [20]. By the cleavage of hydrogen halide from halogenated non-aromatic hydrocarbons at elevated temperatures in a medium of NMP and with alkali halides as catalysts, the corresponding unsaturated hydrocarbons are obtained. For example, cyclohexene is obtained from chlorocyclohexane [21]; and 2-methylpropene, from *tert*-butyl bromide [22]. The manufacture of conjugated diolefins from 1,3-dioxans is more complicated. In the presence of NMP hydrochloride at 150 °C, isoprene is obtained from 4,4-dimethyl-1,3-dioxan [23].
Conversely, a solution of mercuric chloride in NMP is used as a catalyst for addition reactions involving hydrogen chloride. An example is the production of vinyl chloride from acetylene at 130–190 °C [24].

4.2.6 Nitrile syntheses

In the synthesis of acrylonitrile from hydrocyanic acid and acetylene in the presence of copper(I) chloride, NMP prevents the formation of acetaldehyde in troublesome amounts; in this case it acts as a solvent [25].
NMP increases the yields and reduces the time required for the reaction in the Rosenmund and von Braun nitrile synthesis. It dissolves the reactants – aromatic and heterocyclic halides and in particular the copper-(I) cyanide – to give a homogeneous liquid [26, 27].

4.2.7 Miscellaneous reactions

NMP is used as an inert diluent in the manufacture of aromatic ethylidenedioxy compounds [28].



If they are in the form of a solution in NMP, monosaccharides, disaccharides, trisaccharides and their alkali alcoholates can enter into a chemical reaction with, for example, acid anhydrides or alkyl halides [29].

NMP acts as a solvent in the manufacture of ethyleneurea/aldehyde condensation products [30], which are soluble in water and are used in textile finishing. NMP acts both as a solvent and as a catalyst in the formation of acid esters on wadding by reaction with acid chlorides or isocyanates. This technique is adopted for improving shrink resistance and fastness to oxygen, light and alkalis [31–34].
Another use for NMP is in the synthesis of a class of ionic boron compounds that display great chemical stability and are recommended for pyrotechnics: the crystalline adducts $B_{12}H_{10} \cdot 2$ NMP, $B_{10}H_8 \cdot 2$ NMP and $B_{10}Cl_8 \cdot 2$ NMP are formed [35–37].
α-Halocarbonyl compounds react with carbonyl compounds in the presence of a metal catalyst and an aprotic solvent such as NMP according to the following equation:

$$ClCH_2COOCH_3 + C_6H_5CHO \xrightarrow[NMP]{Fe, Na}$$

$$C_6H_5CH = CHCOOCH_3 + C_6H_5CH(OH)CH_2COOCH_3$$

Under different conditions, the reaction does not proceed to completion [38].

5 Applications

5.1 Recovery of pure hydrocarbons from mixtures

5.1.1 Introduction

A well-established application for NMP is the recovery of technical hydrocarbons by extractive distillation.
This technique exploits the high solubility of hydrocarbons in NMP and the fact that differences in volatility are sometimes considerably increased in the presence of NMP. If NMP is used as the solvent in extractive distillation, the azeotropes otherwise formed by hydrocarbons do not occur. An advantage that NMP has over other technical solvents in this application is that it is very stable to heat and chemicals.
The product is miscible with water in all proportions. This property facilitates setting the process to the desired conditions and stripping the dissolved hydrocarbons from the solvent. NMP has a high boiling point and a correspondingly low vapor pressure, with the result that losses can be kept at a minimum in commercial-scale separation processes.
At the temperatures normally encountered in practice, the viscosity is low, and this favors mass transfer.
NMP is not a very toxic solvent.

5.1.2 Acetylene

NMP has successfully been used over a number of years for the removal and purification of acetylene from mixtures of cracked gases obtained in the partial combustion of saturated hydrocarbons by the BASF submerged flame process [39, 40]. The mixture of gases obtained by this pyrolysis reaction contains 8–10 % of acetylene, about 4 % of carbon dioxide, and hydrogen and carbon monoxide. At 1000 mbar and 20 °C, NMP dissolves 38.7 times its own volume of acetylene. Bunsen solubility coefficients are listed in Table 4. A measure of the ease with which given mixtures can be separated can be derived from the ratio of the solubility coefficients, which is referred to as the selectivity. It can be seen that acetylene can be very easily separated from the light key component, carbon dioxide, as well as from higher acetylenes.
A simplified flow chart of the two-stage scrubbing process with NMP as selective solvent for the recovery of acetylene from the gas mixture after the pyrolysis reaction is shown in Figure 1. After the cracked gas has been compressed, most of the higher acetylenes are removed in a separate NMP circuit comprising the absorber K1, the countercurrent stripper K2 and the vacuum stripper K3. On leaving this first scrubbing stage, the gas stream is fed to a second NMP circuit containing the scrubber K4 the rectifier K5 and stripper K7. Acetylene of about 98.5 % purity is extracted by selective absorption in NMP from the gas in the scrubber K4 and the rectifier K5. Traces of NMP in the outlet stream are removed by scrubbing with water and returned to the system. The lower section of the NMP stripper K7 is operated under vacuum. The higher acetylenes that are stripped from the NMP in K7 are withdrawn through K3 and leave the plant.
A special advantage of this process is that there is no likelihood whatever that the acetylene will decompose spontaneously.
By the end of 1980, 18 plants with a total annual capacity of about 550 000 metric tons had been erected, 16 of them under licence.

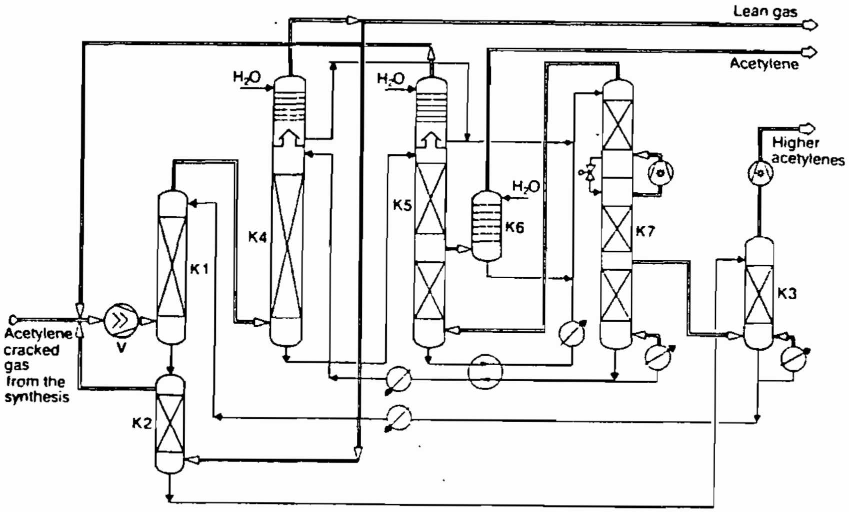


Fig. 1 Recovery of acetylene from the cracked gases obtained in the BASF process by two-stage scrubbing with NMP.

5.1.3 Butadiene

A C_4 fraction is obtained in large amounts as a by-product in the manufacture of ethylene by the steam cracking process and similar commercial-scale pyrolysis reactions. It contains 40–50 % of butadiene. NMP is a good selective solvent for separating butadiene from butene or from C_4 acetylenes. This fact is exploited in the BASF butadiene process [41, 42, 99], in which NMP containing 5–10 % water is used in two-stage countercurrent gas scrubbing.
Butadiene of either SBR or poly-cis quality (99.5–99.9 %, less than 5–10 ppm of NMP) is obtained in high yield (≥ 98 %). A simplified flow chart of the process is shown in Fig. 2.
A first extraction distillation stage comprises column K1 and the upper part of K2. C_4 olefins and C_4 paraffins that are less soluble than

1,3-butadiene in NMP are withdrawn at the top of the scrubber K1. The butadiene itself passes to the second stage, which consists of the column K3 and the lower section of K2. Components that are more soluble than 1,3-butadiene in NMP, i.e. C_4 acetylenes, are withdrawn in a side-stream from the stripper K4 after vapor traces of NMP have been scrubbed from the gas stream with water in a small column.

The crude butadiene obtained at the top of K3 is separated from propyne and traces of 1,2-butadiene in two subsequent distillation stages. The pressure in the extractive distillation stages and in K5 and K6 is set so that all product streams can be liquefied with cooling water. The compressor V, the capacity of which is reduced owing to predegassing in the flash drum B1, allows the stripper to be operated at a pressure only slightly above atmospheric. As a result, energy requirements are reduced, and stripping can be accomplished at a lower temperature.

By the end of 1980, sixteen licences had been granted for the BASF butadiene process. The total annual capacity involved is about 1.3 million metric tons of 1,3-butadiene.

The same procedure may also be adopted for separating C_4 olefins and paraffins.

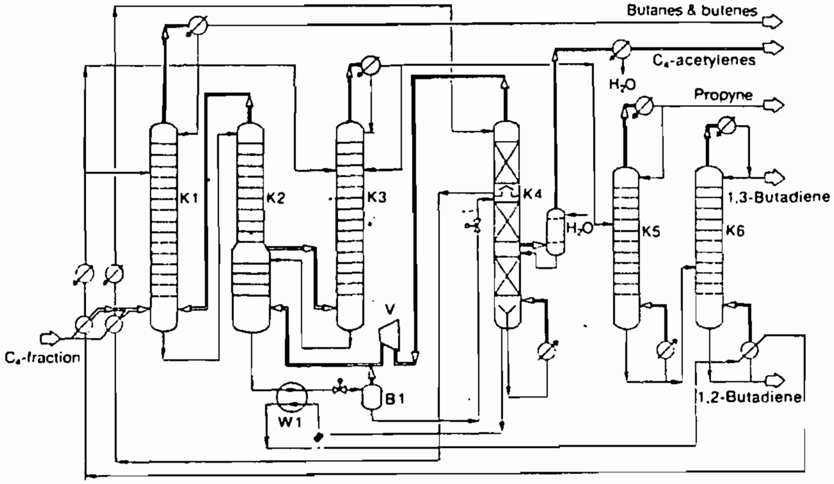


Fig. 2 BASF butadiene process.

5.1.4 Isoprene

The BASF method of recovering isoprene is a further development of the butadiene process. Either extractive distillation or liquid-liquid extraction may be resorted to for the separation. As a rule, C_5 cuts from pyrolysis reactions contain 15–20 % of isoprene. The purity of the end product is 99 % [43].

5.1.5 Aromatics

Aromatics can be extracted by the Lurgi ®Arosolvan process from mixtures of hydrocarbons, e.g., reformed or hydrogenated pyrolysis gasolines [44–48]. A high yield of benzene, toluene, xylene, and other aromatics with boiling points below 180 °C is thus obtained. The additives to the NMP are chosen to ensure a solvent blend of optimum selectivity and high solvent capacity. The latter term is defined as the ratio of the aromatics concentration in the solvent phase to that in the hydrocarbon phase.

An advantage of NMP over the many other solvents investigated is that the difference between its boiling point and those of the extracted aromatics is sufficiently large to ensure that the gas can be removed quite easily. Another is that the phases can be separated quite rapidly owing to the difference in density; and yet another is that NMP is resistant to chemicals and heat at the temperatures adopted in the process.

In the Lurgi ®Distapex process, pure benzene is extracted from the crude product by countercurrent scrubbing and fractionating with NMP as selective absorbent. This process is particularly advantageous if the impurities in the crude benzene or their azeotropes cannot be separated economically by distillation [49, 50].

Mixtures of monocyclic and polycyclic alkyl-substituted or unsubstituted aromatics can also be separated with a mixture of NMP and water [51]. Likewise olefinic and aromatic hydrocarbons can be removed from paraffinic hydrocarbons by selective extraction of naphtha fractions with alkyl pyrrolidones, particularly NMP, mixed with another solvent [52].

5.2 Desulfurization of gases

High concentrations of acidic compounds are often present in natural or synthesis gases. Examples are hydrogen sulfide, carbon oxysulfide, carbon dioxide, and organic sulfur compounds. They are removed by physical scrubbing in several stages with a mixture of NMP and alcohol (Lurgi ®Purisol process) [53], instead of by the chemical process. The difference between the Bunsen solubility coefficient for hydrogen sulfide and that for carbon dioxide is so great that these gases can be easily separated and recovered in a very pure form [54].

5.3 Lubricating oils

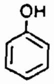
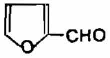
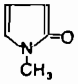
High-grade lubricating oils to meet certain specifications are produced from various petroleum fractions. Components responsible for quality impairment, e.g. aromatics and compounds containing nitrogen, oxygen or sulfur, are removed from the desired paraffins by solvent refining. Afterwards, the n-paraffins are separated from the isoparaffins, which possess the best lubricating properties.

The aromatics and other impurities dissolve to different extents in organic high boilers. These differences are exploited in removing them from the paraffins in industrial solvent refining. Extremely economical solvents for this purpose are *N*-methylpyrrolidone (NMP), furfural and phenol [55, 56].

The refining process consists of admitting the feedstock to the foot of the extraction column and allowing it to flow counter-current to the degassed NMP. Thus the column can be regarded as a multistage extraction zone. As a result of the equilibria established in all stages, a refined product containing the paraffins is withdrawn at the head of the column. The extract containing the more soluble components, i.e. the aromatics and other impurities, is withdrawn at the foot of the column. Both the refined product and the extract must subsequently be distilled at an elevated temperature or reduced pressure in order to remove the NMP. The refined product, largely freed from NMP, and the NMP recovered from the extract may be recycled to the head of the extracter.

It can be seen from Table 1 that NMP is much superior to furfural and phenol for the lube oil extraction process [2]. There are several cases on record in which plants designed to operate on phenol have been successfully modified to cope with NMP [55].

Table 1 Comparison of NMP, furfural, and phenol as extraction solvents for lube oil refining [56].

	Phenol	Furfural	NMP
Structural formula			
Relative cost 1978 in USA	1.0	2.8	4.2
Density 25 °C [g/cm³]	1.07	1.15	1.03
Boiling point [°C]	181.7	161.7	202.5
Melting point [°C]	41	−36.5	−25
Latent heat of evaporation [KJ/kg]	479	451	493
Selectivity	good	excellent	very good
Solvent power for hydrocarbons	very good	good	excellent
Solvent to oil ratio	low	moderate	very low
Product color	good	very good	excellent
Refined oil yield	good	excellent	very good
Stability	very good	good	high
Corrosiveness	moderate	intermediate	low
Toxicity	high	moderate	low
Energy costs	intermediate	moderate	low
Investment costs	moderate	intermediate	low
Operating costs	moderate	intermediate	low

5.4 Plastics

5.4.1 Introduction

NMP is a very popular industrial solvent for natural and synthetic plastics, waxes, resins, and various types of paints. It dissolves polyethylene glycol, nylon, polyesters, polystyrene, polyacrylonitrile, polyvinyl chloride, polyvinyl acetate, cellulose derivatives, polyurethanes, polycarbonates and many copolymers (cf. Table 2). It is also miscible with the corresponding monomers and with conventional organic solvents and water. As a result, the best possible solvent blend for a given application can be found. In many cases, it accelerates a reaction, with the consequence that it gives rise to better yields and purer products, i.e., to more economic processing, than other solvents. The following examples illustrate the advantages of NMP and indicate answers to any similar problems that may arise in the chemical industry.

5.4.2 Synthetic fibers

N-Methylpyrrolidone is a suitable solvent for spinning aromatic polyamides, examples of which are esters of isoterephthalic or terephthalic acid and *p*-phenylenediamine.

Polyacrylonitrile, which is insoluble in most organic solvents, can be dissolved in NMP containing small amounts of lower aliphatic ketones. These solutions can be spun at comparatively low temperatures to uniform fibers [57].

Table 2 Solubility of plastics in *N*-methylpyrrolidone

	20 °C	80 °C	100 °C
®Makrolon (polycarbonate)	+ −	+	
Rigid polyvinylchloride	+		
Polyvinylacetate	+		
®Ultramid S (nylon 6.10)	−		+
Ultramid A (nylon 6.6)	−		+
Ultramid B (nylon 6)	−		+
Urepan (urethane rubber)	s		
®Mylar (polyester film)	−		
®Lupolen (polyethylene)	−		
Polystyrol 168 N (general-purpose polystyrene)	+		
Polystyrol 475 K (high-impact polystyrene)	+		
®Luran 378 P (styrene/acrylonitrile copolymer)	+		
Luran S	+ −		
®Terluran 877 T (acrylonitrile-butadiene-styrene polymer)	+		

+	dissolved
s	swollen and tacky
+−	sparingly soluble
−	undissolved

Mixtures of polyacrylonitrile dissolved in NMP with formylated polyvinyl alcohol [58] and of polyalcohol with α-acylaminoacrylates [59] are stable; they do not separate and can be spun to homogeneous, non-segmenting fibers with a high softening point and good affinity for dyes.

NMP and its blends with tetrahydrofuran or phenol are suitable for producing spinning solutions of vinyl chloride polymers [60], vinylidene chloride polymers [61], and synthetic linearly condensed polyesters derived from polyethylene terephthalates [62]. The solutions obtained are stable, do not gel, and have a low viscosity at a high solids content. They allow the production by wet or dry techniques of fibers, films, etc. with superior physical properties for the manufacture of textiles.

If the solvent phase in the polycondensation reactions involving aminocarboxylic acids and their lactams or salts of polycarboxylic acids and polyamides is NMP instead of phenol, fibers or moldings of superior quality are obtained, and simplifications are achieved in the production process [63].

5.4.3 Synthesis of high polymers

Cases are often quoted in the literature on how NMP allows the synthesis of new products or an improvement in the quality of existing products.

In the manufacture of polyurethane foams [64], NMP catalyzes the foaming reaction to produce highly hydrophilic soft articles In foamed polyether urethanes, NMP acts as a regulator to ensure open cellular structures [65]. Linear synthetic polyamides [66] are readily soluble in NMP at 150–200 °C and sparingly soluble at room temperature; the same applies to polycaprolactam and copolymers of caprolactam with, for example, *N*-vinyl caprolactam [67]. By virtue of this property, troublesome impurities, such as unconverted monomers and colored substances, can be removed by recrystallization.

Urea can be condensed with diamines in NMP at temperatures above 150 °C. The linear, uncrosslinked polyureas thus obtained have a high molecular weight and good mechanical properties and can be processed to fibers. NMP dissolves both the polymers and the monomers at elevated temperatures, but the polymers are precipitated again when the solution cools down to room temperature. Thus NMP is superior to a phenolic solvent in that it simplifies the process and improves the quality [68].

Linear, high-viscosity polyamides can be produced from β-lactams by alkaline catalytic condensation in the presence of the *N*-acyl compound of a dicarboxamide, which acts as activator. NMP is an extremely suitable solvent for these reactions, because it dissolves the monomer and the activator and swells the polymer as it is being precipitated [69].

In the manufacture of polyureas with a high melting point from aromatic diamines and aromatic diisocyanates, a suitable non-corrosive inert solvent for the condensation reaction and subsequent spinning is NMP [70].

If acrylates or methacrylates are polymerized anionically in the presence of dipolar aprotic co-catalysts, such as NMP, the proportion of syndiotactic polymer will be increased, with the consequence that the products obtained will have a more regular structure. The resulting improvements in resistance to deformation by heat, resistance to solvents, and mechanical properties make these products suitable molding compounds and binders for surface coatings [71].

NMP containing lithium chloride is recommendend as a solvent for the manufacture of polymers of aromatic diamines and aromatic acid chlorides, e.g., isophthaloyl chloride, that can form fibers and coatings and that are stable to high temperatures [72].

Very pure linear polyesters that contain nitrogen and have a low color value are obtained if NMP is added in the initial stages of the esterification reaction between terephthalic acid and ethanediol. In this case, NMP forms an 'onium complex *in situ* with the acid. This complex is more readily soluble than the terephthalic acid in the ethanediol, and it is more rapidly esterified [73].

m-Phenylenediamine is a well-known curing agent for epoxyether resins. It is much easier and less dangerous to handle at room temperature when it is in the form of a solution in NMP. This NMP solution lengthens the potlife of the resin and does not exert an adverse effect on the curing characteristic. A melt that has solidified at low temperatures becomes a homogeneous liquid again on thawing [74].

5.4.4 Surface coatings

By virtue of its high boiling point and good solvent power, NMP improves the properties of surface coatings that are baked at high temperatures. The binders can be highly concentrated if the solvent is NMP. Since NMP improves the rheological properties, paints with superior flow-out and covering power are obtained. Hence the coatings are more homogeneous, non-porous and non-cratering and display greater resistance to chemicals and higher mechanical strength. The feature of NMP in the manufacture of thermosetting paints for electrical insulation is its high solvent power for polycarboxylic acids and their anhydrides, e.g., trimellitic and pyromellitic anhydrides, and polymers with amide and carboxyl groups and a high aromatic content. Thus polyisocyanates containing amide and free isocyanate groups are formed in the condensation reaction between NMP solutions of polybasic carboxylic anhydrides and monomeric diisocyanates. The urethane baking finishes thus obtained yield coatings with outstanding mechanical and dielectric properties on copper conductors [75]. If the condensation reaction is carried out at 100–170 °C, the results are polyurethanes that can be used as adhesives or rubberizing compounds on metal surfaces [76]. NMP is a suitable solvent for the resinous copolyesters produced in the reaction between a diimide (e.g., that obtained from trimellitic anhydride and 4,4-methylenedianiline) and polyhydric alcohols (e.g., ethanediol and trihydroxyalkyl isocyanurate). The solutions thus formed can be baked to yield very heat-resistant wire enamels [77]. NMP is also a solvent for polyamide/polyimide baking finishes derived from the condensation of a tricarboxylic acid with aromatic and aliphatic diamines [78].

Table 3 Solvent power of *N*-methylpyrrolidone for coatings raw materials

Cellulose derivatives	
Cellulose nitrate	+
Cellulose acetate	+
Cellulose acetobutyrate	+
Ethyl cellulose	+
Chlorinated rubber	+
Cyclized rubber	+⊖
Vinyl chloride polymers	
Polyvinyl chloride	+
Polyvinylchloride, chlorinated	+
®Laroflex MP	+
®Lutofan 200 L	+
Vinyl chloride/vinyl acetate copolymers	+
Vinyl chloride/maleate copolymers	+
Polyacrylonitrile	+
Polyvinyl acetate	+
Polyvinyl ethers	+
Polyacrylates	
®Acronal 4 F	+
Acronal 700 L	+
®Lumitol resins	+
®Luprenal resins	+
Polymethylmethacrylate	+
Styrene polymers	
®Suprapal	+
®Emu Powder	+
Styrene/acrylic acid copolymers	+
Vinyltoluene/acrylic acid copolymers	+
Polyisobutylene	
®Oppanol B 3	⊖
®Lutonal IC	+⊖
Styrene-maleate resins	+
®Suprapal AP and TP	
Unmodified alkyd (phthalate) resins	
®Phtalopal PP	+
Phtalopal SEB	+
Cyclohexanone resins	
®Laropal K 80 and K 100	+
Urea resins	
®Plastopal resins	+
Melamine resins	
®Luwipal resins	+
Phenolic resins	+
Thermosetting acrylic resins	
®Larodur resins	+
Epoxy resins	+
Modified alkyd resins	+
Natural resins	+
Rosin	+
Ester gum	+
Manila copal	+
Shellac	+
Dammar	+⊖
Drying oils	+
Linseed oil	+
Tung oil	+
Linseed oil stand oil	⊖
Tung oil stand oil	⊖
Plasticizers	+
Castor oil	+
Butyl stearate	+
Tritolyl phosphate	+
®Palatinol grades	+
®Plastomoll grades	+
®Palamoll grades	+
®Plastigen G	+
Chlorinated paraffins	+

\+ soluble
⊖ insoluble
+⊖ sparingly soluble or swellable

NMP is a useful solvent for butadiene/acrylonitrile copolymers (Perbunan N), which are used for coating the insides of tanks. The rubber solutions have better flow and levelling than those obtained with ketones.
Vinyl chloride/vinyl acetate copolymers may be dissolved in a blend of NMP and mononuclear aromatic hydrocarbons. Owing to the synergic effect between the two solvents, the solutions have a low viscosity and can be applied readily.

5.4.5 Moldings

The production of fibers, films, tapes, etc. from linear high polymers frequently presents technological problems. The difficulty is that there are no suitable solvents or plasticizers that are non-corrosive, physiologically harmless and non-flammable at the processing temperature. NMP is very useful in cases of this nature, because it allows highly concentrated solutions or moldable compounds to be produced from polyamides, polyacrylonitrile, polyvinyl chloride, polystyrene, cellulose triacetate [79, 80], etc. The same applies at elevated temperatures to vinyl fluoride homopolymers and copolymers. By virtue of its swelling and solubilizing action, NMP can also be used for bonding plastics together at room temperature.

5.4.6 Paint removers

Since it can dissolve so many plastics, NMP is a useful ingredient in paint removers. It detaches primers, top coats, paints, and varnishes from the substrate, so that they can be washed off with water [81, 82].

5.5 Pesticides

NMP is used as a co-solvent in insecticides, fungicides, and herbicides. The following examples can be quoted. Insecticides: lindane, carbaryl, methoxychlor. Herbicides: atrazine, phenmedipham, propham, chlorpropham, monuron, diuron, buturon, and propanil. Fungicides (particularly for seed treatment): phenylmercuryacetate, 2-chloro-4-(hydroxymercury)phenol, methylmercury dicyandiamide (®Panogen, Casco AB). NMP forms adducts with bacteriostatics, such as substituted ureas, carbanilides, thiocarbamates, guanidines, salicylanilides, etc.; these are more bactericidal and allow better growth control of bacteria cultures [83].

5.6 Pigment dispersions

NMP is an efficient dispersing agent for organic and inorganic pigments in the manufacture of paints and inks [84]. It is a solvent for polymers in the production of pigment dispersions [85]. Very often, pigment dispersions of superior intensity and brilliance can be obtained without a roll or ball mill simply by stirring the pigment in the NMP [86].
Pigment dispersions containing NMP can be thinned with all types of diluents and can be kept for long periods without settling or flocculating.

5.7 Dyeing

NMP is suitable for the production of stable solutions or dispersions of diazotizable primary amines for dyeing and printing with azo dyes [87, 88]. Aromatic polyester, particularly polyethylene terephthalate, articles can be colored with insoluble azo dyes by dissolving the amine and coupling components together in NMP; this procedure improves the uniformity and fastness of the shades [89]. In the vat dyeing of cellulosic [90], polyacrylonitrile, polyester and polyamide fibers or blends of cellulosic fibers with any of the others, NMP improves the affinity to the fiber [91, 92]. NMP is also added to vat dye baths for leather, in order to improve the levelness and fastness of the shades [93].

5.8 Miscellaneous

NMP is used as a cleaner for removing carbon and other residues from the pistons, ports and cylinders of internal combustion engines. It may be blended with benzene, chlorobenzene, or butanone for this purpose [94].
Groups of dyes and synthetic fibres may be distinguished from one another by employing NMP as specific solvent for identification [95].

6 Disposal in effluents

An idea of the acute toxicity of NMP on fish can be derived from the fact that, when the product was fed in concentrations of 100 ppm to guppies *(Lebistes reticulatus)* for a period of four days, the fish displayed no symptoms whatever of toxic effects. NMP can be readily biologically degraded.

7 Physiological data

7.1 Summary

In experiments on animals, *N*-methylpyrrolidone showed only slight toxicity after single and repeated oral administration and after single and repeated inhalation of the vapors. However, it does cause local irritation of the skin and mucosa of animals but no more than any other organic solvent.

7.2 Acute oral and parenteral toxicity

According to experiments on animals, *N*-methylpyrrolidone has only very slight acute toxicity. The figures calculated according to Litchfield and Wilcoxon for the median lethal dose (LD_{50}) after an observation period of 7 days were 1.9 (1.58–2.28) ml/kg body weight for intraperitoneal injection in mice and 3.5 (3.24–3.78) ml/kg for oral administration to rats.

A single dose of 2 ml/kg was tolerated by rabbits and 1 ml/kg by cats. The rabbits did not display any noticeable toxic effects, but some of the cats suffered from nausea, vertigo, and loss of appetite.

7.3 Subacute oral toxicity

In previous experiments, oral administration of 0.4 ml/kg repeated 25 times (5 times a week) was tolerated by rabbits. Examination of the blood count and the hepatic and renal functions as well as necropsy and histological examination of the animals put to death at the end of the studies did not reveal any pathological changes.

Cats proved to be more sensitive to repeated oral administration of 0.4 ml/kg *N*-methylpyrrolidone: twenty administrations (five administrations a week) caused salivation and impaired coordination, loss of appetite, and decrease in body weight. No pathological changes could be detected in the blood count and renal function, but there was a slight delay in the sodium bromosulfophthalein excretion. Necropsy and histological examination of the rabbits and cats that were put to death after termination of the experiments failed to reveal any pathological changes that could be attributed to *N*-methylpyrrolidone.

A more recent experiment has shown a no-adverse-effect level of 250 µl/kg body weight after a 4-week administration to rats by gavage. 500 µl/kg caused reduced body weight gain in males but no other clinical signs or any pathological changes. Higher doses (1000 µl/kg and 2000 µl/kg) resulted in impairment of testicles and decreases of leucocytes.

In a six-month study a no-adverse-effect dose of 0.25 mg/kg was determined [96].

7.4 Acute inhalation toxicity

Cats, rabbits, guinea pigs, rats, and mice were exposed for 6–8 hours to a stream of air saturated at 20 °C with *N*-methylpyrrolidone. All of the animals tolerated this inhalation test without showing any symptoms or injury. Two days after the cats and rabbits had been thus exposed, the blood count, urine, blood urea, and hepatic function (bromosulfophthalein test and glutamic-pyruvic transaminase) were all normal. The same animals were subsequently exposed for six hours to a current of air saturated at 50 °C with the volatile fraction of *N*-methylpyrrolidone. They again tolerated this inhalation test without any recognizable toxic effects.

7.5 Subacute inhalation toxicity

Even when the same animals as those subjected to the acute inhalation study were repeatedly exposed (17 times, 5 times a week) to a stream of air saturated at 50 °C with *N*-methylpyrrolidone, no signs of toxicity could be detected in cats, rabbits, guinea pigs, and rats. Clinicochemical examination of the cats and rabbits revealed normal blood count, normal blood urea values, and normal hepatic function. There were no pathological findings at the necropsy of the animals that were put to death after the experiments had been completed.

No toxic effects could be detected when cats, rabbits, guinea pigs, and rats were exposed 17 times for 6 hours/day to a current of air saturated with *N*-methylpyrrolidone at 50 °C. Clinicochemical examination of the cats and rabbits revealed normal blood count, normal blood urea values, and normal hepatic function. There were no pathological findings at the necropsy of the animals that were put to death after the experiments had been completed.

7.6 Acute skin and eye irritation

A patch soaked in undiluted *N*-methylpyrrolidone was applied to the clipped skin on the backs of white rabbits for 1–15 minutes. It gave rise to pronounced inflammation with subsequent scaling. When the impregnated patches were applied for 20 hours, distinct swelling and erythema occurred. All that could be observed on the skin of a rabbit's ear after 20-hours' exposure was slight erythema. The insertion of a drop of undiluted *N*-methylpyrrolidone in the conjunctival sac of a rabbit's eye caused inflammation of the conjunctiva and cloudiness of the cornea. However, these symptoms subsided almost completely one week later.

7.7 Subacute dermal toxicity

In a 20-day subacute dermal toxicity study, doses of 0.4 and 0.8 ml/kg body weight per day were applied to rabbits.

Both abraded and normal skin sites were included. Mild local skin irritation was observed. Blood studies, body weight gain and final histopathological studies of major organs revealed no systemic effects. At a dose level of 1.6 ml/kg/day, one out of four animals died. One death occurred when the application was made on abraded skin. There was no evidence of systemic effects [97].

7.8 Prenatal toxicity

N-methylpyrrolidone was administered orally in doses of 323 µl/kg to rats from the 6–15th day *post coitum* (FDA regulations).

The oral dose administered to mice was 1026 µl/kg; and the intraperitoneal dose, 610 µl/kg. In each case, administration took place from the 10–14th day *post coitum*.

The prenatal inhalation toxicity on rats was also determined. The dose selected was the saturation concentration of *N*-methylpyrrolidone in air at 25 °C, i.e. about 800 ppm at a vapor pressure of 0.85 mbar.

In order to ensure that the test covered the critical stages in organogenesis, the animals were exposed to the vapors for six hours a day from the fourth to the eighth day *post coitum* in one test and from the 11th to the 15th day post coitum in a second test.

All the tests demonstrated that *N*-methylpyrrolidone is not teratogenic if it is administered in doses that the does can tolerate and that are not toxic for the embryos.

A publication of a limited study describes embryotoxic and teratogenic effects in mice with a threshold dose of 129 mg/kg [98].

7.9 Mutagenicity

NMP was found to be negative in an Ames Test.

A combined teratogenicity and mutagenicity study in rats after 6-week inhalation (chromosome analysis of bone marrow) showed no positive effects.

In a dominant lethal test NMP was not mutagenic either.

The experiments were carried out in BASF unless otherwise indicated. The 1981 MAK-Value for *N*-methylpyrrolidone is 100 ml/m^3 or 400 mg/m^3.

8 Instructions for handling *N*-methylpyrrolidone

N-Methylpyrrolidone is comparatively non-toxic and is not a skin irritant. Nevertheless, the results of experiments on animals demonstrate that skin contact must be avoided in handling and processing *N*-methylpyrrolidone and that the eyes should be protected. Another general rule in handling organic solvents should also be observed, viz., the place of work must be adequately ventilated.
Since *N*-methylpyrrolidone is a powerful solvent for fats, it removes the protective layer of fat when it comes in contact with the skin, with the attendant risk of eczema, etc. Therefore, certain precautions are necessary in handling this solvent.

1. Any product that has come in contact with the skin must be washed off immediately with water.

2. Any articles of clothing that have been wetted by the solvent must be removed immediately. The affected part of the skin should be washed with water and pH 5-Eucerin ointment should be rubbed into it.

3. Safety goggles must be worn in handling the solvent, opening valves or cocks, etc.

4. After the hands have been washed at the end of a shift, they should be greased with pH 5-Eucerin ointment.

5. There is no point in wearing cloth or rubber gloves to protect the hands, because cloth absorbs the solvent and becomes soaked before the operator can notice it and *N*-methylpyrrolidone can permeate rubber.

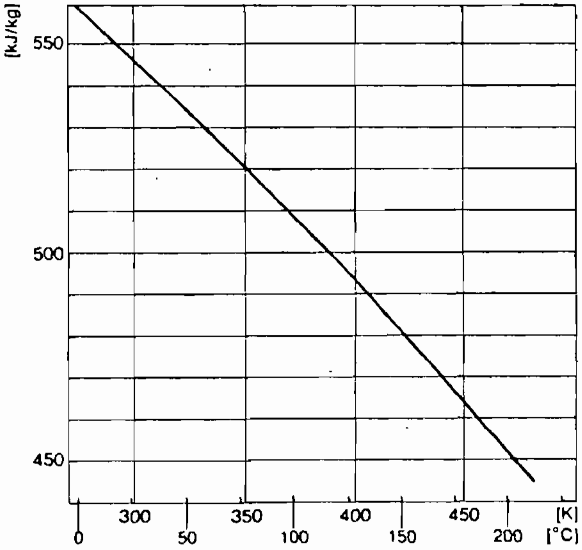
9 Physical properties

The physical data submitted below were obtained from measurements or derived from the literature. The figures are not binding for our commercial grade.

9.1 Pure *N*-methylpyrrolidone

Freezing point		−23.5 °C					
Boiling point		203 °C					
Density d_{25}		1.027–1.028 g/ml					
Evaporation rate (diethyl ether = 1)		360 (DIN 53170, no equivalent ASTM specification)					
Vapor pressure	°C	40	60	80	100	150	200
	mbar	1.33	4.65	12.7	30.6	200	877
Specific heat capacity c_p	°C	0		50		100	
	kJ/(kg·K)	1.68		1.89		2.10	
Heat of combustion		3.02×10^3 kJ/mol					

Latent heat of evaporation



Total heat of solution for acetylene in NMP at 23 °C	$1.12 \times 10^3 \pm 12.6$ kJ/m^3_n
Density of saturated solution of acetylene in NMP 20 °C	1.020 g/ml

Thermal conductivity	°C	20	50	80
	W/(m·K)	0.163	0.155	0.145

Table 4

Bunsen solubility coefficients
[$m^3/m^3 \cdot$bar] in anhydrous NMP (p = 1013 mbar)

		20 °C	40 °C	60 °C
Methane	CH_4	0.28	0.155	–
Ethane	C_2H_6	1.24	0.99	–
Ethylene	C_2H_4	1.90	1.17	–
Acetylene	C_2H_2	38.7	24.0	14.75
Propane	C_3H_8	4.74	3.08	2.08
Propylene	C_3H_6	7.6	5.1	3.75
Propadiene	C_3H_4	30.5	17.5	11.0
Propyne *	C_3H_4	82.5	42.0	24.0
1-Butene	C_4H_8	30	15.4	9.4
Isobutene	C_4H_8	32	16	8.5
1,3-Butadiene	C_4H_6	94	43	24
Vinylacetylene	C_4H_4	–	292	95
Diacetylene	C_4H_2	4870 *	–	807 **
Hydrogen	H_2	0.05	–	–
Oxygen	O_2	0.055	–	–
Hydrogen sulfide	H_2S	48.8	–	–
Carbon dioxide	CO_2	3.95	2.6	1.8

* at 0.15 mbar
** at 68 °C and 0.78 mbar

Viscosity

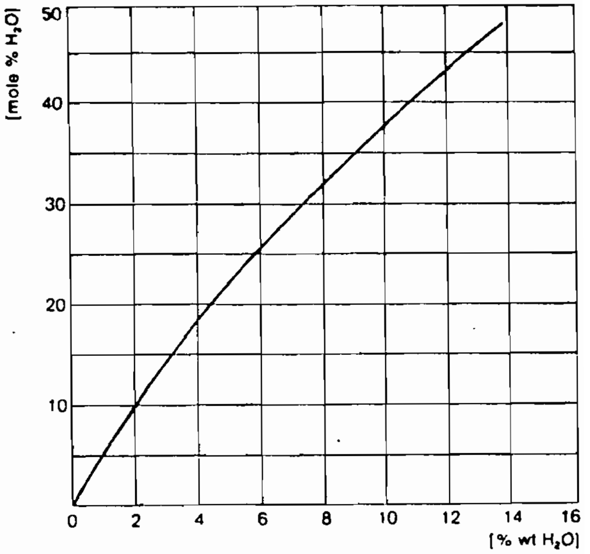
°C	mPa·s	°C	mPa·s
−20	4.366	100	0.752
0	2.637	160	0.409
20	1.796	200	0.303
60	1.018		

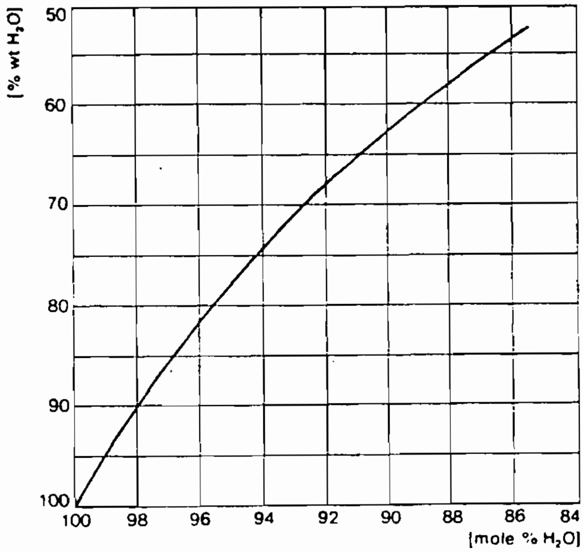
Refractive index n_D^{25}	1.469
Dielectric constant (23 °C, 1 x 10^5 Hz)	32
Dipolar moment (30 °)	4.09 ± 0.04 D
Surface tension (20 °C)	4.1×10^{-4} N/cm
Flash point (Pensky-Martens)	91 °C
Explosive range (1013 mbar, 20 °C)	
lower limit 81 °C	1.3 % vol of NMP ≙ 58 g/m^3
upper limit 129 °C	9.5 % vol of NMP ≙ 420 g/m^3
Ignition temperature	270 °C
Ignition category	G3

See para 9.2.13 for ignition temperatures and flash points for mixtures of NMP and water.

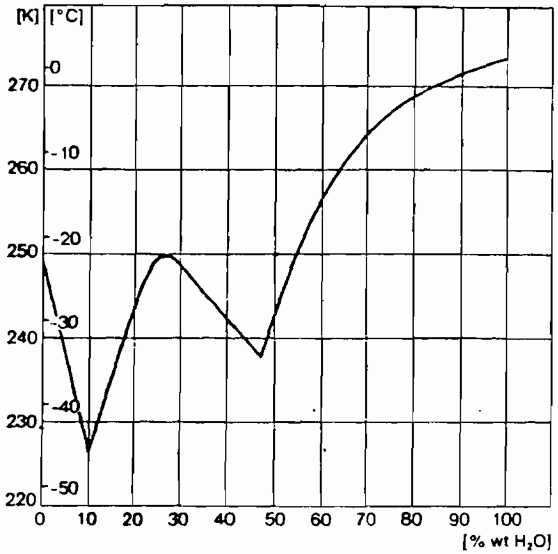
9.2 *N*-Methylpyrrolidone water system

9.2.1 Conversion of mole % to % wt

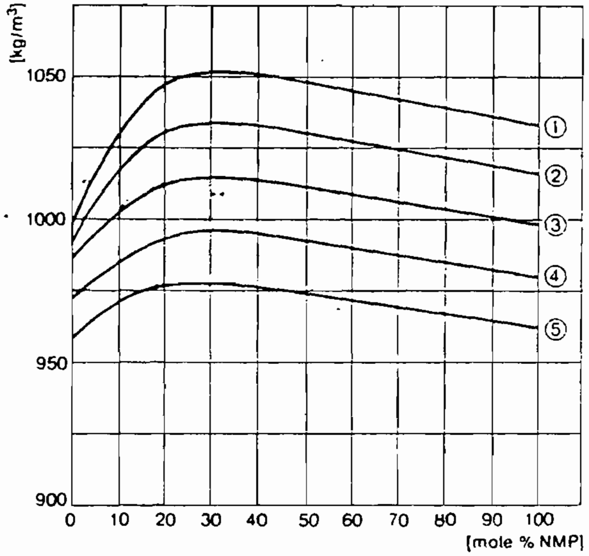




9.2.2 Melting point

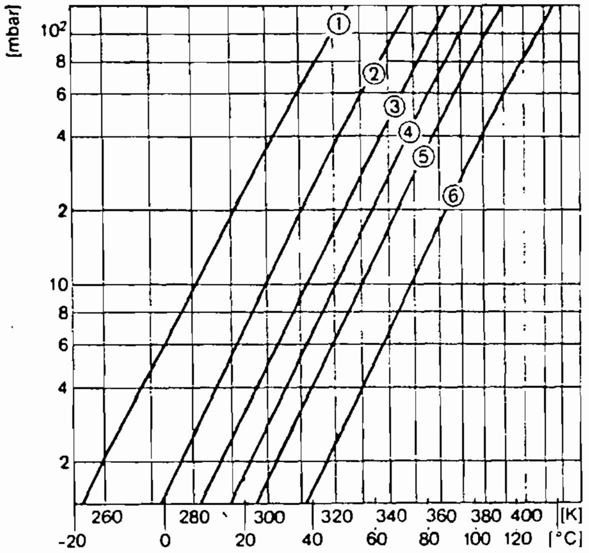


9.2.3 Density of the liquid

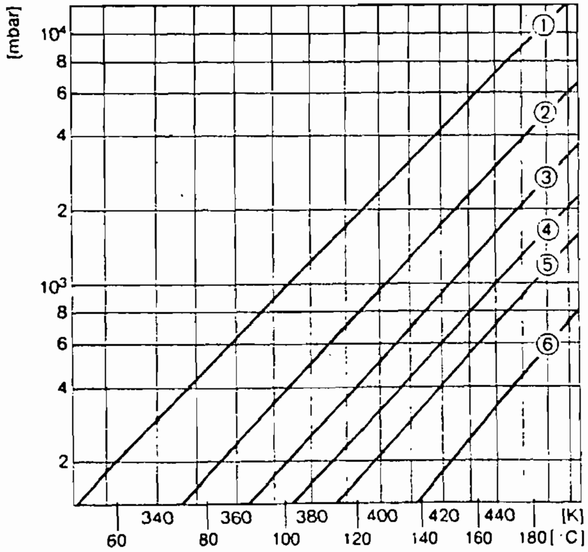


1 20 °C
2 40 °C
3 60 °C
4 80 °C
5 100 °C

9.2.4 Vapor pressure

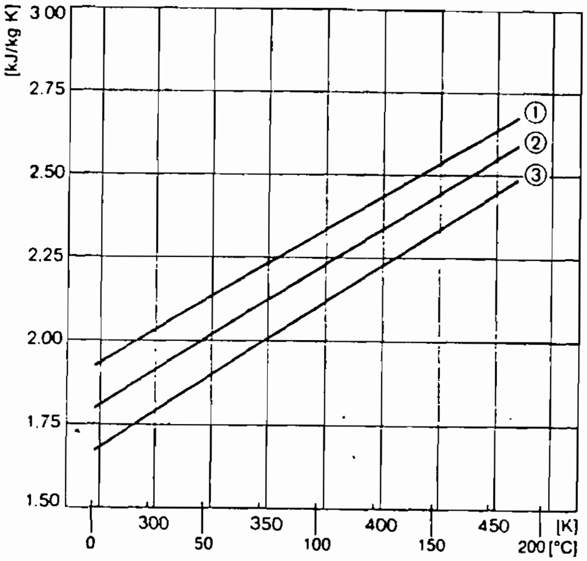


1 100 % wt H_2O
2 10 % wt H_2O
3 4 % wt H_2O
4 2 % wt H_2O
5 1 % wt H_2O
6 0 % wt H_2O



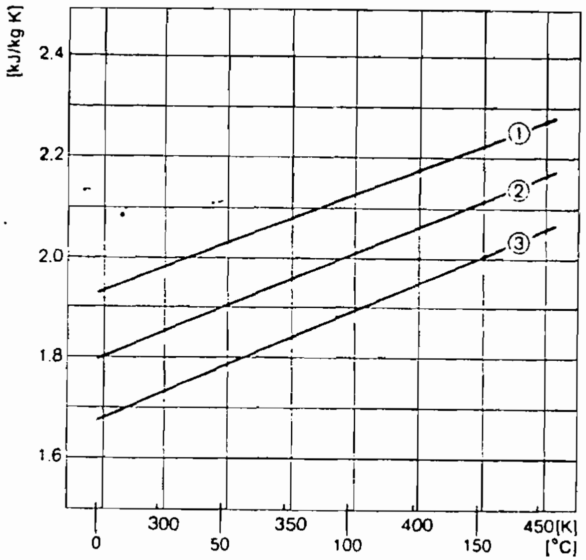
1 100 % wt H_2O
2 10 % wt H_2O
3 4 % wt H_2O
4 2 % wt H_2O
5 1 % wt H_2O
6 0 % wt H_2O

9.2.5 True specific heat capacity of the liquid



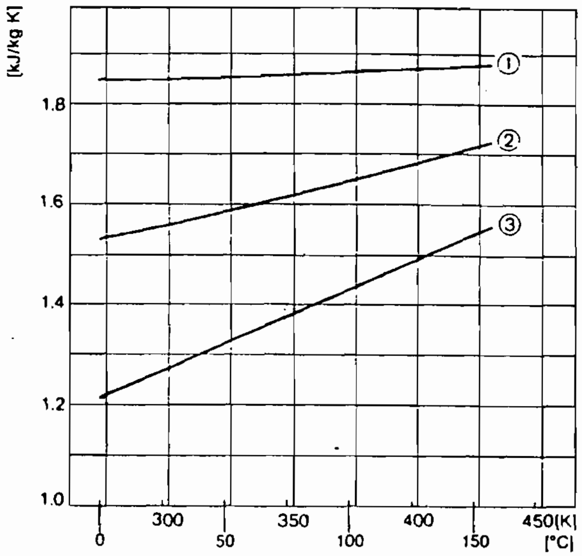
1 10 % wt H_2O
2 5 % wt H_2O
3 0 % wt H_2O

9.2.6.1 Average specific heat capacity of the liquid



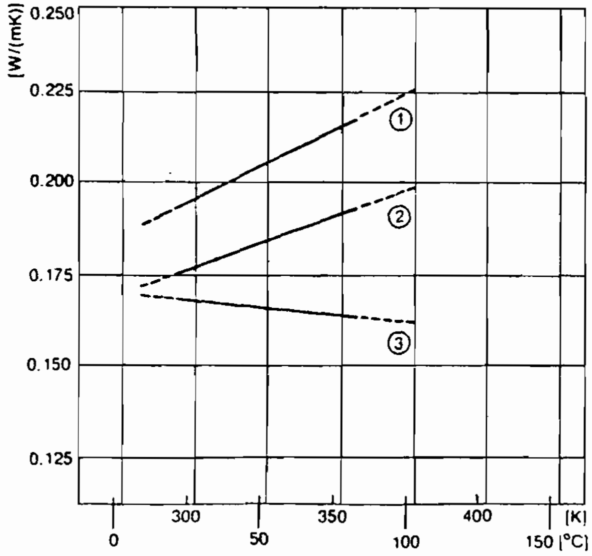
1 10 % wt H_2O
2 5 % wt H_2O
3 0 % wt H_2O

9.2.6.2 Average specific heat capacity of the vapor



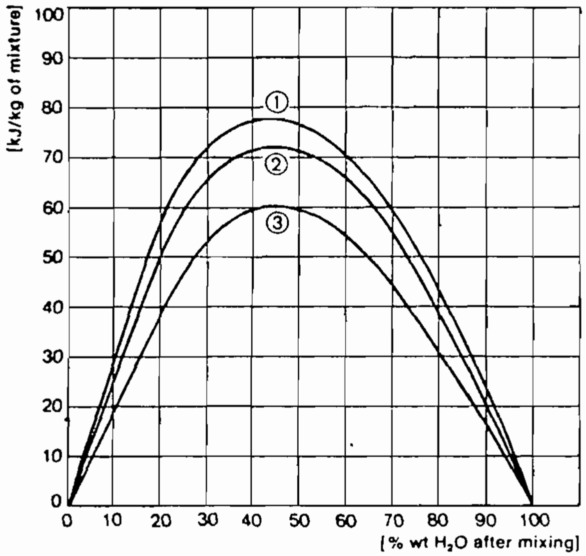
1 100 % wt H_2O
2 50 % wt H_2O
3 0 % wt H_2O

9.2.7 Thermal conductivity of the liquid



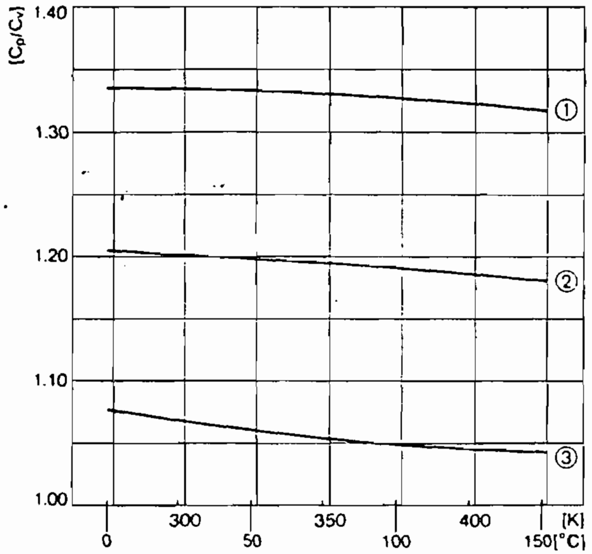
1 10 % wt H_2O
2 5 % wt H_2O
3 0 % wt H_2O

9.2.8 Integral heat of mixing for the liquid



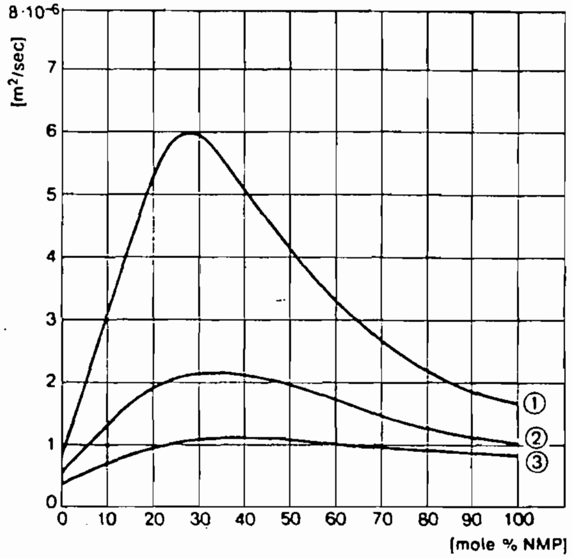
1 20 °C
2 40 °C
3 80 °C

9.2.9 Adiabatic index



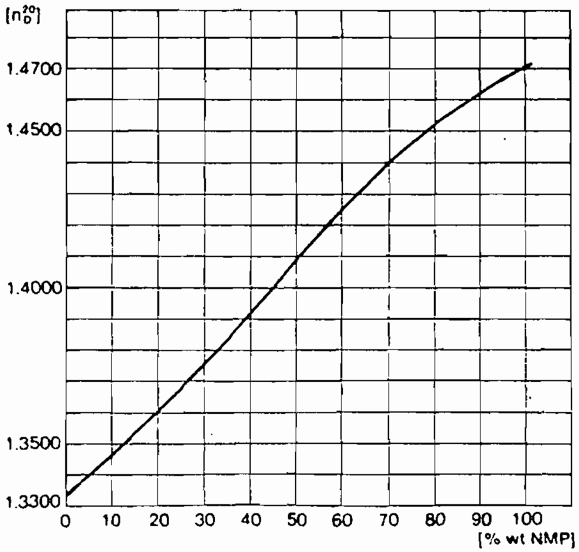
1 100 % wt H_2O
2 50 % wt H_2O
3 0 % wt H_2O

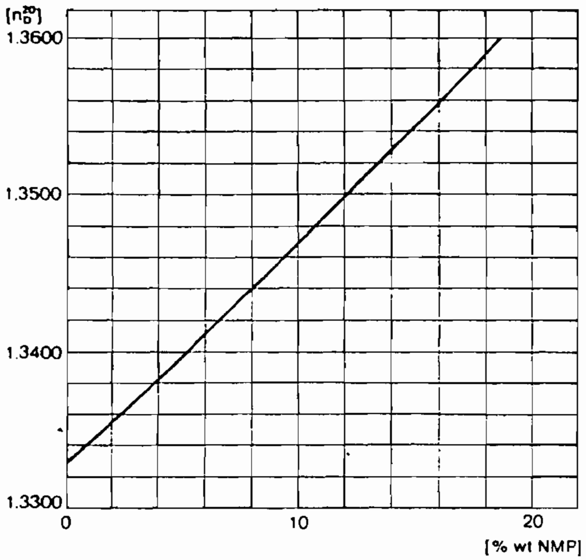
9.2.10 Kinematic viscosity of the liquid

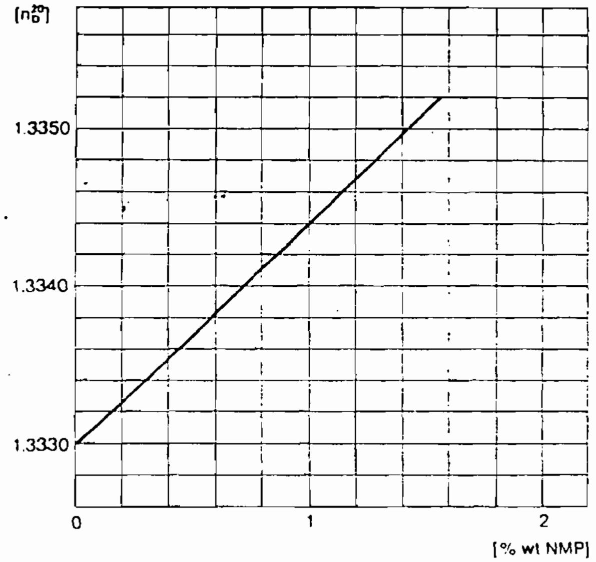


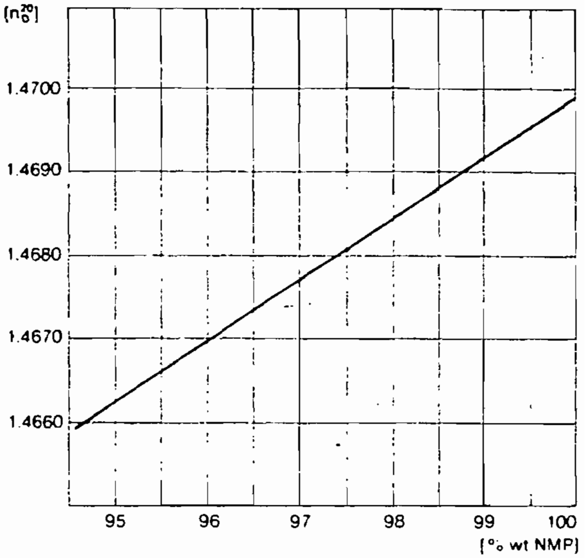
1 20 °C
2 50 °C
3 80 °C

9.2.11 Refractive index of the liquid

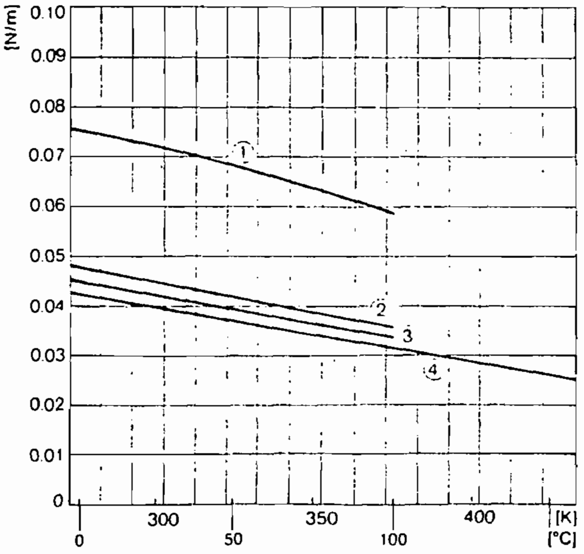








9.2.12 Surface tension



1 100 % wt H_2O
2 10 % wt H_2O
3 5 % wt H_2O
4 0 % wt H_2O

9.2.13 Ignition temperatures and flash points

The following values of ignition temperature were determined for NMP and mixtures of NMP and water by the test method laid down in ASTM-D 286-58 T.

Concentration [% wt] NMP	 H_2O	Ignition temperature ϑ_z [°C]
100	0	270
95	5	270
90	10	270
30	70	400

The following figures were determined for the flash points by the method laid down in ASTM-D 93-72

Concentration [% wt] NMP	 H_2O	Flash point [°C]
100	0	91
98	2	93
95	5	97
90	10	104
80	20	118

Nota bene

The statements in this publication are based on our present technical knowledge and experience. They do not relieve processors of the responsibility of carrying out their own tests and experiments, because many factors that could influence the results may arise during processing and application; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. Any proprietary rights should be respected.

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BOARD OF COUNTY COMMISSIONERS
PINELLAS COUNTY, FLORIDA
315 COURT STREET
CLEARWATER, FLORIDA 33516

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CHARLES E. RAINEY
BRUCE TYNDALL

December 11, 1984

Mr. Sid White
Silor Optical of Florida, Inc.
4900 Park Street
St. Petersburg, FL 33709-2299

RE: Degreaser Emission Factors

Dear Mr. White:

Enclosed is the information on determining emissions from solvent cleaning processes which you requested.

The emission factor section is, unfortunately, vague when trying to compare your proposed system to those discussed. I was unable to obtain or reference any evaporation rate data which could be used to compare with your chemical/solvent properties. The only comparison available, which you inquired about, was for n-butyl acetate which has an E.R. of 8.2 based on diethyl ether equal to 1.0.

I hope the enclosed information is useful. Please call our office if we can be of further assistance.

Sincerely,

Peter A. Hessling, Environmental Engineer
Division of Air Quality

PAH/wn
Enclosures

BOARD OF COUNTY COMMISSIONERS
PINELLAS COUNTY, FLORIDA
315 COURT STREET
CLEARWATER, FLORIDA 33516

October 8, 1984

Silor Optical of Florida, Inc.
4900 Park Street
St. Petersburg, FL 33709-2299

RE: VOC Air Pollution Source Permit Applications
Permit A052-55878

Attention: Mr. Edgar J. Vallar
Mr. Sidney S. White, Jr.

Dear Mr. Vallar and Mr. White, Jr:

Consultation with the State Department of Environmental Regulation has yielded the following recommendations regarding the permit application for your proposed replacement system.

Silor shall submit an application for a permit to construct the proposed system, to the DER - S.W. District Office, 7601 Highway 301 North, Tampa, Florida 33610. The application shall be made in quadruplicate (forms are enclosed). The application fee is based upon the potential emissions level from the source. Consult the fee schedule provided in my letter of July 18, 1984 to your firm.

The application should include all appropriate engineering and emissions calculations data as specified on the forms. The application review process may take up to ninety (90) days for completion. Therefore sufficient time should be allowed for this review prior to the anticipated start of construction.

If you have any questions regarding this matter or if we can provide assistance during the application process please contact me at 530-6522 or James Estler, Air Permitting Engineer, DER, Tampa at 985-7402.

Sincerely,

Peter A. Hessling

Peter A. Hessling, Environmental Engineer
Division of Air Quality

PAH/wn

Enclosures

COMPLIANCE VERIFICATION INSPECTION

SILOR OPTICAL, INC.
PINELLAS COUNTY
NEDS NO.: 052-0098-01
PERMIT NO.: A052-55878
INSPECTION DATE: SEPTEMBER 28, 1983

Silor Optical, Inc. is located at 4900 Park Street, St. Petersburg, Florida. The inspection was conducted by Peter Hessling, Pinellas County Division of Air Quality. Plant contact was Mr. Sid White.

This facility is permitted to operate a conveyorized lens washing system using trichlorethylene solvent (a VOC). The firm manufactures hard resin opthalmic lenses. The materials used in the lense manufacturing are non-volatile resins and chemical compounds.

A portion of the lenses made are racked and passed through a conveyorized "wash machine". Trichlorethlylene and other ingredients are pumped/sprayed over the lenses to remove polyester resin particles and films left on them. The system is enclosed and has two exhaust stacks. There are two identical units at the plant.

The present permit calls for research and development of an emission control system. The firm is studying/developing both total equipment change and also the use of exempt solvents to perform the cleaning task.

The research to date indicates a possibility of using methylene chloride as the solvent, though it is slightly inferior to trichlorethylene in its cleaning performance. The company expects the engineering of new equipment to take another six months to complete.

This facility has been operating in compliance with its permit conditions. However, the firm has not submitted the necessary R & D progress status reports at the six month intervals as required. The plant contact was directed to submit this report as soon as possible in order to meet administrative compliance requirements. This facility is considered to be in Administrative non-compliance until the report is received. This permit expires August 5, 1984.

PF

BOARD OF COUNTY COMMISSIONERS
PINELLAS COUNTY, FLORIDA
315 COURT STREET
CLEARWATER, FLORIDA 33516

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BRUCE TYNDALL

July 18, 1984

Silor Optical of Florida, Inc.
4900 Park Street
St. Petersburg, FL 33709-2299

Re: VOC Air Pollution Source Permit Applications -
Permit A052-55878

Attention: Mr. Edgar J. Vallar
Mr. Sidney S. White, Jr.

Dear Mr. Vallar and Mr. White, Jr.:

The following information is provided relevant to our meeting of July 11, 1984 at your firm.

The requested copies of the States permit application fee schedule and the list of compounds exempt from VOC RACT emission limiting standards are enclosed.

Consultation with the State DER, S.W. District Office staff has yielded the following recommendation for permit application on the existing source, permit A052-55878. In order to avoid non-compliance through expiration of the current permit and to cover operation of the source on a limited basis during construction and "phase-in" of the new system, an application for "renewal" of the existing permit should be filed with the State as soon as possible. Renewal forms are enclosed for your use. Basically, this would "allow the continued operation" of the existing source under the existing permit conditions until the renewed permit is issued. Terms, conditions and emissions limits for continued operation of the existing source would be evaluated during the review process. Proposed limitations would of course be discussed/negotiated with Silor prior to issuance.

Procedural requirements on Silors application submittal and subsequent permitting of the proposed lens cleaning system are still being discussed with State staff. As soon as decisions are made I will provide you with the appropriate guidance.

If you have any questions or if I can be of any further assistance please contact me at 530-6522.

Sincerely,

Peter A Hessling

Peter A. Hessling, Environmental Engineer
Division of Air Quality

PAH/wn
Enclosures

cc: DER - Tampa

COMPLIANCE VERIFICATION INSPECTION

SILOR OPTICAL, INC.
PINELLAS COUNTY
NEDS NO.: 052-0098-01
PERMIT NO.: A052-55878
INSPECTION DATE: JULY 11, 1984

Silor Optical is located at 4900 Park St., St. Petersburg, Florida. The inspection was conducted by Peter Hessling, Pinellas County Division of Air Quality. Plant contacts were: Mr. Sid White and Mr. Edgar Valar.

This facility is permitted to operate a conveyoized lens washing system using trichloroethylene solvent, a VOC. The firm manufactures hard resin, opthalmic lenses. The materials used in the manufacturing are non-volatile resins and chemical compounds.

The present permit calls for research and development of an emission control system. The firm has been studying/developing both total equipment change and the use of exempt (non-photochemically reactive) solvents to perform the cleaning task and reduce overall emissions.

All proposals are not in yet. A test unit using exempt solvents has been utilized over the past year (Mid-83 to Mid-84). Predominantly it used methylene chloride and an ultrasonic station with the last cleaning stage being a vapor degreasor.

The firm is awaiting receipt of a bid proposal from Crest Ultrasonics in New Jersey. Construction could be initiated in the end of this calendar year. The firm would keep the existing system as a back-up for 1 to 2 years during the transition into the new systems.

The current permit expires 8/5/84. The company is submitting for a renewal of the existing permit to cover operation during the construction, then transition into the new systems when they are finalized.

The firm will be required to obtain a permit to construct for the proposed new system. This may be processed through CAPS at BAQM as a major source. The potential emissions are undetermined at this time.

This facility is considered to be in compliance with Chapters 17-2 and 17-4, F.A.C.

BEST AVAILABLE COPY

PINELLAS COUNTY

VOC STATIONARY SOURCE INVENTORY FORM

RECEIVED
APR 1984
AIR & WATER
QUALITY DIVISION

Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, FL 33709

Pinellas County Business Telephone 541-5733

SIC Codes (If Known) ____

A. Does your company or operation use, sell or process Volatile Ogranic Compounds* (VOC's) ? If certain information is considered confidential, then contact this office for details of how confidential data will be handled.

YES X (Complete B) NO ____ (If NO, stop, please sign and return form)
*Examples of VOC's: paint thinners, petroleum products, cleaning solvents, liquid adhesives, alcohols, industrial surface coatings, liquid chemical coatings, fiberglass resins and solvents, liquid acetates, asphaltic compounds, plating solvents, ink thinners; mold release compounds, lacquers, finish coatings, etc.

Industries typically using VOC's: paint, pharmaceutical, plastics, or rubber prod. mfg.; large applicance, magnet wire, paper, fabric, vinyl, furniture or metal product coatings; architectural coating; auto refinishing; electronics mfg.; graphic arts; cutback asphalt; drycleaning; fiberglass products.

NOTE: If you are not sure whether the materials you are using are VOC's, call the Air Quality Division for assistance, 530-6522.

B. If YES to question "A", please list the trade or chemical name and quantities used in 1983. (Attach additional sheets if necessary). (Subtract amounts of solvents recovered for reprocessing or for disposal).

177 T by AQR

	Name	Gallons/Yr.		Name	Gallons/Yr.
1.	Trichloroethylene @12.14	21,120 (= 128 T)	5.	Isopropyl alcohol @ 6.6	596 = 1.96
2.	Methylene chloride	3,190 EX	6.	Methanol @ 6.6	55 = .18
3.	Acetone @ 6.6	4,175 = 13.72	7.		
4.	Trichlorotrifluroethane	1160.5 EX	8.		144 T/yr

192 T/yr by AQR

Please verify this information to be true and correct to the best of your knowledge by signing below.

Edgar J. Vallar, Manager-Engineering & Development	Edgar J. Vallar	4/10/84
Print name and title of company officer	Signature	Date

TO RETURN
PLEASE SEE REVERSE SIDE OF THIS FORM

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

February 22, 1984

George W. Richardson, Air Engineer
Department of Environmental Regulation
Southwest District
State of Florida
7601 Highway 301 North
Tampa, Florida 33610

Dear George:

This letter is written in response to the request from your organization for an Annual Operation Report for Air Emissions Sources. The original form and three xeroxed copies have been completed and attached to this letter.

Sincerely,

Sidney S. White, Jr.
Lead Engineer

SSW/bd

Enc.

D. E. R.
FEB 2[illegible]
SOUTHWEST DISTRICT
TAMPA

D. E. R.
FEB 2[illegible]
SOUTHWEST DISTRICT
TAMPA

STATE OF FLORIDA

DEPART[illegible] OF ENVIRONMENTAL[illegible]ULATION

UTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

ANNUAL OPERATION REPORT FORM FOR AIR EMISSIONS SOURCES

For each permitted emission point, please submit a separate report for calendar year 19 ~~83~~ prior to March 1st of the following year.

I GENERAL INFORMATION

1. Source Name: Silor Optical of Fla., Inc.
2. Permit Number: AO52-55878
3. Source Address: ~~4900 Park St. No.~~
4. Description of Source: Conveyorized Lens Washing System (UBC Source)

II ACTUAL OPERATING HOURS: ______ hrs/day ______ days/wk ______ wks/yr

III RAW MATERIAL INPUT PROCESS WEIGHT: (List separately all materials put into process and specify applicable units if other than tons/yr)

Raw Material	Input Process Weight	
TRICHLOROETHYLENE	312.18	tons/yr
SAWDUST	3.26	tons/yr
WATER	4.26	tons/yr
AMINE	0.0561	tons/yr
		tons/yr

IV PRODUCT OUTPUT (Specify applicable units)

N/A

V TOTAL FUEL USAGE including standby fuels. If fuel is oil, specify type and sulfur content (e.g., No. 6 oil with 1% S).

________	10^6 cubic feet Natural Gas	________	10^3 Kerosene
________	10^3 gallons ________ Oil, ________ %S	________	tons Coal
________	10^3 gallons Propane	________	tons Carbonaceous
________	10^6 Black Liquor Solids	________	tons Refuse

Other (Specify type and units) ____________________

VI EMISSION RATE(S) (tons/yr)

________	Particulates	________	Sulfur Dioxide	________	Total Reduced Sulfur
________	Nitrogen Oxide	________	Carbon Monoxide	________	Fluoride
________	Hydrocarbon		Other (Specify type and units) TRICHLOROETHYLENE 177.54 to		

yea

/II METHOD OF CALCULATING EMISSION RATES (e.g., use of fuel and materials balance, emission factors drawn from AP 42, etc.)

See attached addendum

III CERTIFICATION:

hereby certify that the information given in this report is correct to the best of my nowledge.

SIGNATURE OF OWNER OR AUTHORIZED REPRESENTATIVE

Hubert Dreckmann
Vice President & General Manager

TYPED NAME AND TITLE

2-27-84

DATE

R Form 17-1.202(6)
fective November 30, 1982

ADDENDUM

TO

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

ANNUAL OPERATIONS REPORT - 1983

AIR POLLUTION SOURCES

SILOR OPTICAL OF FLORIDA, INC.

FEBRUARY 22, 1984

CONVEYORIZED LENS WASHER

This equipment provides clean lenses for inspection for flaws. Soiled lenses are conveyorized through various closed chambers. The first chamber scrubs with sawdust and the second and third chambers rinse with Trichloroethylene resulting in spot free lenses.

FORMULA

Trichloroethylene	52 gallons
Sawdust	1.5 cubic feet (32 pounds)
Water	5 gallons
Amine	250 ml.

Remarks:

Sawdust absorbs almost an equal volume of trichlorethylene with 20% increase in volume of sawdust due to absorption (swelling).

Water and amine are lost from the above formulation during operation. The maximum water/amine content in spent trichloroethylene would be 5 gallons/drum.

SPENT TRICHLOROETHYLENE

Only four drums a week of spent trichloroethylene contain significant quantities of sawdust, water, and amine because the sawdust is changed only once or twice a week (as necessary).

COMPOSITION OF SPENT DRUM OF TRICHLOROETHYLENE CONTAINING SAWDUST/ WATER/AMINE: 87.27% trichloroethylene in each drum.

MATERIAL BALANCE FOR TIME PERIOD

1/3/83 through 12/31/83

TRICHLOROETHYLENE USED

946 drums (data taken from trichloroethylene material usage sheet)

SPENT TRICHLOROETHYLENE GENERATED

434 drums (data taken from EPA Hazardous Waste Records)

Total spent trichloroethylene = spent trichloroethylene containing sawdust/water/amine (204 drums) + spent trichloroethylene containing very small amounts of sawdust/

water/amine (230 drums).

Spent trichloroethylene containing sawdust/water/amine = 204 x 0.8727 = 178.03 or 178 drums net.

Total spent trichloroethylene = 178 drums + 230 drums = 408.

OVERALL MATERIAL BALANCE

Total usage trichloroethylene	946 drums
Total spent trichloroethylene	-408 drums
	538 drums

TOTAL WEIGHT TRICHLOROETHYLENE LOST IN 1983

538 drums @660 pounds/drum = 355080 pounds or 177.54 tons/year.

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

December 21, 1983

RECEIVED
DEC 22 1983
AIR AND WATER
QUALITY DIVISION

Mr. James Estler
Department of Environmental Regulation
Southwest District
State of Florida
7601 Highway 301 North
Tampa, Florida 33610

Dear Mr. Estler:

Regarding our permit to operate our conveyorized lens washing machine and discharge volatile organic compounds to atmosphere:

Permit: AO52-55878
Dated: August 13, 1983

We submit the following summary of our developmental project status.

Our goal is to abandon the lens cleaning method we now use and develop an upgraded process that will essentially eliminate the discharge of volatile organic compounds to atmosphere.

The process requirements are such that we must accomodate our lens washing volume, and satisfactorily clean the lenses to meet our final and customer specifications.

We have committed two engineers from a limited engineering resource to meet these requirements and a formal engineering development program has produced what we believe may be a suitable cleaning process.

The proposed process, however, has some areas requiring further study. We are presently preparing to install a scaled-up, low volume production cleaning line for additional tests. We expect this line to be functioning in February 1984. If this low volume production testing produces acceptable results we estimate placing orders for full scale production equipment some time in April 1984. Our best estimate at this time is that we would be ready for production to transition to the new process equipment by December 1984.

Our permit expiration date is August 5, 1984 and our present schedule forcasts the likely request for a six month extension.

We would, however, delay formally requesting any extension until April 1984 when low volume production tests are complete.

We are devoting considerable resources to completion of this program and we are optomistic that we will be successful. We trust you will continue to support us in meeting our goals.

If there is additional information you need at this time please advise me.

Very truly yours,

Edgar J Vallar

Edgar J. Vallar
Manager-Engineering & Development

EJV/bd

cc: Peter Hessling
Pinellas County Division of Air Quality

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT

7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHA
GOVERNO

VICTORIA J. TSCHINKE
SECRETAR

WILLIAM K. HENNESSE
DISTRICT MANAGE

BEST AVAILABLE COPY

D.E.R.

MAR 1 1983

SOUTHWEST DISTRICT
TAMPA

ANNUAL OPERATION REPORT FORM FOR AIR EMISSIONS SOURCES

For each permitted emission point, please submit a separate report for calendar year 19 82 prior to March 1st of the following year.

I GENERAL INFORMATION

1. Source Name: Silor Optical of Fla., Inc.
2. Permit Number: A052-55878
3. Source Address: 4900 Park St. No.
4. Description of Source: Conveyorized Lens Washing System (UBC Source)

II ACTUAL OPERATING HOURS: ________ hrs/day ________ days/wk ________ wks/yr

III RAW MATERIAL INPUT PROCESS WEIGHT: (List separately all materials put into process and specify applicable units if other than tons/yr)

Raw Material	Input Process Weight	
TRICHLOROETHYLENE	241.23	tons/yr
SAWDUST	1.66	tons/yr
WATER	2.17	tons/yr
AMINE	0.0286	tons/yr
		tons/yr

IV PRODUCT OUTPUT (Specify applicable units)

N/A

AL FUEL USAGE including standby fuels. If fuel is oil, specify type and sulfur ontent (e.g., No. 6 oil with 1% S).

______ 10^6 cubic feet Natural Gas ______ 10^3 Kerosene

______ 10^3 gallons ______ Oil, ______ %S ______ tons Coal

______ 10^3 gallons Propane ______ tons Carbonaceous

______ 10^6 Black Liquor Solids ______ tons Refuse

Other (Specify type and units) ______

/I EMISSION RATE(S) (tons/yr)

______ Particulates ______ Sulfur Dioxide ______ Total Reduced Sulfur

______ Nitrogen Oxide ______ Carbon Monoxide ______ Fluoride

______ Hydrocarbon Other (Specify type and units) Trichloroethylene 126.7 tons/year

/II METHOD OF CALCULATING EMISSION RATES (e.g., use of fuel and materials balance, emission factors drawn from AP 42, etc.)

See attached addendum

/III CERTIFICATION:

hereby certify that the information given in this report is correct to the best of my nowledge.

SIGNATURE OF OWNER OR AUTHORIZED REPRESENTATIVE

Hubert Dreckmann
Vice President & General Manager

TYPED NAME AND TITLE

2-28-83

DATE

ADDENDUM

TO

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

ANNUAL OPERATIONS REPORT - 1982

AIR POLLUTION SOURCES

SILOR OPTICAL OF FLORIDA, INC.

FEBRUARY 25, 1983

NOTE: Section III Parts A and C

CONVEYORIZED LENS WASHER

This equipment provides clean lenses for inspection for flaws. Soiled lenses are conveyorized through various closed chambers. The first chamber scrubs with sawdust and the second and third chambers rinse with Trichloroethylene resulting in spot free lenses.

FORMULA

Trichloroethylene	52 Gallons
Sawdust	1.5 ft.^{3} (32 lbs.)
Water	5 Gallons
Amine	250 ml.

Remarks:

Sawdust absorbs almost an equal volume of trichloroethylene with 20% increase in volume of sawdust due to absorption (swelling).

Water and amine are lost from the above formulation during operation. The maximum water/amine content in spent trichloroethylene would be 5 gallons/drum.

Spent Trichloroethylene

Only 2 drums a week of spent trichloroethylene contain significant quantities of sawdust, water, and amine because the sawdust is changed only once or twice a week (as necessary).

COMPOSITION OF SPENT DRUM OF TRICHLOROETHYLENE CONTAINING SAWDUST/WATER/AMINE: 87.27% trichloroethylene in each drum.

Material Balance for Time Period

1/4/82 through 12/31/82

Trichloroethylene Used

731 drums (data taken from trichloroethylene material usage sheet)

Spent Trichloroethylene Generated

360 drums (data taken from EPA Hazardous Waste Records)

Total spent trichloroethylene = spent trichloroethylene containing sawdust/water/amine (104 drums) + spent trichloroethylene containing very small amounts of sawdust/water/amine (256 drums).

Spent trichloroethylene containing sawdust/water/amine = 104 x 0.8727 = 90.76 or 91 drums net

Total spent trichloroethylene = 91 drums + 256 drums = 347

Overall Material Balance

Total usage trichloroethylene	731 drums
Total spent trichloroethylene	- 347 drums
	384 drums

Total Weight Trichloroethylene Lost in 1982

384 drums @660 lbs./drum =253440 lbs. or 126.7 tons/year

BEST AVAILABLE COPY

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

Esther,
Sound reasons
include compl.
schedule in perm
DW

June 21, 1982

D.E.R.
JUN 23 1982
SOUTHWEST DISTRICT
TAMPA

Mr. Dan Williams
District Engineer, Air Programs
Department of Environmental Regulation
7601 Highway 301 North
Tampa, Florida 33610

Dear Mr. Williams:

We have received your letter concerning processing our application for a permit to operate our conveyorized lens washer.

We understand we will be permitted to operate at current levels but that you are requesting that we install polution control equipment to reduce our emissions and are proposing a one year and six month schedule to meet this request.

We wish to comply with all regulatory requirements in this matter but we are concerned with your recommended timing schedule.

At Silor Optical of Florida, we have a small engineering staff and a limited budget for capital equipment expenditures. We have an engineering project presently planned to start in the last quarter of this year to study improvements to our entire lens washing process and substantially reduce VOC emissions.

We feel twelve months of study will allow us to suitably evaluate and test practical alternatives to the lens washing method we now use.

Should these engineering studies prove unsuccessful we would then commit our efforts to reducing emissions from our present process or installing suitable emission control equipment to meet recommended RACT standards.

We wish therefore to request an additional twelve months to your one year and six month proposal and we hope you see fit to give us your approval.

Thank you for your consideration and please let me know if additional information is needed.

Very truly yours,

Edgar J. Vallar
Manager-Engineering &
Development

EJV/bd

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

June 16, 1982

RECEIVED
JUN 18 1982
AIR AND WATER
QUALITY DIVISION

Mr. Peter Hessling
Environmental Engineer
Division of Air Quality
St. Petersburg-Clearwater Airport
Clearwater, Florida 33520

Dear Mr. Hessling:

This letter is written in response to the request from your organization for additional information for our application to operate a stationary source of VOC (Reference: Joyce M. Gibb's letter of June 1, 1982).

For your review:

1) Provide data giving the air/vapor interface area within the unit [Re: 17-2.650 (1)(f) 12.a(ii)(B)]:

Two screened areas	1.82 square feet
Large tank area	11.18 square feet
Total air/vapor interface area	13.00 square feet

2) Provide 8-1/2" x 11" plot plans per application Section V, numbers 7 and 8 [Per 17-4.07(2)]:

Attached are four copies of appropriate plot plans.

If you have any further questions please call.

Cordially,

Hubert Dreckmann
Vice President & General Manager

HD/bd
Enclosure

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610-9544

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

June 2, 1982

Mr. Hubert Dreckmann, V.P.
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Fla. 33709

RE: Pinellas County AP
Silor Optical of Florida, Inc.

Dear Mr. Dreckmann:

The Department is currently processing an application for an operating permit for the conveyorized lens washer at Silor Optical of Florida, Inc. This facility is located in an ozone nonattainment area and is a major emitter of Volatile Organic Compounds (VOC). Most existing sources of VOC are regulated under Section 17-2.650(1), Florida Administrative Code (FAC) through the use of Reasonably Available Control Technology (RACT). However, the only RACT emission standard for solvent cleaning is for those processes catagorized as Solvent Metal Cleaning (Subsection 17-2.650(1)(b)f.12., F.A.C.). Since this facility is not subject to a particular RACT emission standard, the applicable emission standard for this source is Subsection 17-2.620 (1)(a), F.A.C. This provision states:

> "No person shall store, pump, handle, process, load, unload or use in any process or installation volatile organic compounds or organic solvents without applying known and existing vapor emission control devices or systems deemed necessary and ordered by the Department".

The Department feels that some type of pollution control technology should be installed to reduce the emissions from this major facility and suggest that the RACT standards for Solvent Metal Cleaning may be amenable to this facility (see attached).

It is the Department's recommendation that the following schedule be incorporated into an operating permit issued to this facility. The operating permit would allow the facility to discharge the amount of V.O.C. specified in the application until Number 2 below is complied with.

1. A construction permit application be submitted to the Department within one year from the date of issuance of the operating permit. This application would specify the type of control equipment and/or operating procedures selected to comply with Section 17-2.620(1)(a), F.A.C.

Protecting Florida and Your Quality of Life

2. Construction of the selected equipment be completed and initiation of appropriate operation procedures be implemented within six months from the date of issuance of the construction permit.

Should the company agree to the proposal as outlined above, please provide the Department with a letter confirming this. If there is some problem with this proposal, I suggest we meet to discuss the alternatives at the earliest possible time.

If you have any questions or need to set up a meeting, please give me a call at (813) 985-7402.

Sincerely,

Dan A. Williams

Dan A. Williams
District Engineer
Air Programs

DAW/rkt

cc Peter Hessling, PCDEM ✓
Edgar J. Vallar, P.E.

File

BOARD OF COUNTY COMMISSIONERS
PINELLAS COUNTY, FLORIDA
315 COURT STREET
CLEARWATER, FLORIDA 33516

COMMISSIONERS

CHARLES E. RAINEY, CHAIRMAN
BARBARA SHEEN TODD, VICE-CHAIRMAN
GABRIEL CAZARES
JOHN CHESNUT, JR.
BRUCE TYNDALL

April 13, 1982

Mr. William Oalmann
Silor Optical of Florida, Inc.
4900 Park Street
St. Petersburg, Florida 33709

RE: Requirement to obtain a permit to operate a source of VOC air pollutants.

Dear Mr. Oalmann:

This letter is conveyed to you to provide formal notice of the requirement to obtain a permit to operate a stationary source of air pollutants. The operation of any source of air pollution without valid permits is in violation of Chapter 403, Florida Statutes, and the rules and regulations promulgated thereunder, specifically:

1. Chapter 17-2.210, which states "The owner or operator of any source which emits or can reasonably be expected to emit any air pollutant shall obtain a permit from the Department prior to beginning construction or operation of the source unless exempted pursuant to Department rule or statute".

These rules are applied to the operation of the conveyorized lens wash systems which utilize VOC's. The general pollutant emission limiting standard for volatile organic compounds emissions or organic solvents emissions contained in Chapter 17-2.620(1) is the applicable standard.

You are hereby given 45 days from the date of receipt of this letter to submit the application for a permit to operate the referenced source. The application should be submitted in quadruplicate, and accompanied by a check for $20.00 made payable to "Florida Department of Environmental Regulation". The application package should be mailed to this office at:

Division of Air Quality
St. Petersburg/Clearwater International Airport
Clearwater, Florida 33520

Should you have any questions regarding this letter or the application procedures, please contact our office at 448-2521 (after 4/19/82 phone 530-6523).

Sincerely,

Joyce M Gibbs

Joyce M. Gibbs, Chief
Division of Air Quality

PAH/jh
cc: DER-S.W. District Office

Certified P14 8844371

V.O.C. SOURCE INSPECTION

SILOR OPTICAL OF FLORIDA, INC.
4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709

This company was inspected on October 29, 1981 by P. Hessling and R. Solis of Pinellas County Division of Air Quality. The inspection was conducted to determine compliance and applicability of this sources operations with regards to State and County V.O.C. RACT regulations. Plant contact person was Mr. William Oalmann, Superintendent of Facilities.

This firm has been in operation for approximately 10 years and currently employs 475 people. This company manufactures hard resin opthalmic lenses. The lenses are made of a polycarbonate resin (CR 39 by PPG, Inc.) combined with a catalyst IPP (isopropyl percarbonate - an organic peroxide). The polycarbonate resin is an allyl diglycol carbonate (-a glycol ester) containing 1% volatiles. Plant consumption of this resin was 645,272 gal. in CY 1980. The catalyst has a negligible volatile content. However, it has a disagreeable odor and is listed on the producers MSD sheet as being a fire and explosion hazard. It self ignites near its melting point if exposed to air. It is kept frozen at -40°C and handled in enclosed containers when being combined with the liquid resin. The resulting combined formula is a viscous liquid which is injected between two glass lens molds held together by a thermoformed plastic gasket.

Curing of the lenses is accomplished by placing racks of lenses in either electric hot air drying ovens or by racking the lenses on a conveyor through warm water baths. The lenses are passed through a series of cleaning operations and quality assurance checks. The bulk of the acetone solvent use by this plant is at bench work areas where small (6oz) squeeze bottles are used to dampen cleaning cloths used by the Q.A. personnel. There is no practicable control for this solvent vapor loss, (4,884 gal. or 16 ton for CY 1980).

Racked lenses are also passed through a conveyorized "wash machine". Trichloroethylene solvent is mixed with soap, water, and sawdust and the mixture is pumped over the lenses to clean off small particles. The lenses then are immersed in two subsequent baths of only the solvent. This system is enclosed and has vent ducts to an induced draft fan (700 CFM) through a common stack. The unit is operated 16 hrs/day and 5 days/wk. The evaporative loss was estimated at 32 gal/day (or 388 lbs/day; 48 ton/yr; 24.28 lbs/hr operating time). The system operates with the solvent at ambient temperature. There are two identical washing systems, however only one is operational at a time. They are cleaned weekly and the contaminated solvent is put in drums and shipped to a reclaimer for redistillation and is re-purchased by Silor. Management stated that they are investigating using a solvent which would not be photochemically reactive (Chlorothene-VG or Methylene Chloride). This system does not fall under any of the presnet RACT controlled categories in Chapter 17-2 FAC; however it could be permitted under the general VOC rule 17-2.620(1) and a RACT guideline could be developed.

The aspects of this facilities operation will be reviewed with the DER District Air Engineer for determination of permit requirements.

P 408 530 290

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED—
NOT FOR INTERNATIONAL MAIL

(See Reverse)

Sent to Mr. Edgar J. Vallar	
Street and No.	
P.O., State and ZIP Code	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to whom and Date Delivered	
Return Receipt Showing to whom, Date, and Address of Delivery	
TOTAL Postage and Fees	$
Postmark or Date 7/29/85	

PS Form 3800, Feb. 1982

PS Form 3811, July 1983

● **SENDER: Complete items 1, 2, 3 and 4.**

Put your address in the "RETURN TO" space on the reverse side. Failure to do this will prevent this card from being returned to you. The return receipt fee will provide you the name of the person delivered to and the date of delivery. For additional fees the following services are available. Consult postmaster for fees and check box(es) for service(s) requested.

1. ☐ Show to whom, date and address of delivery.
2. ☐ Restricted Delivery.

3. Article Addressed to:
Mr. Edgar J. Vallar
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, FL 33709

4. Type of Service: ☐ Registered ☐ Insured ☒ Certified ☐ COD ☐ Express Mail	Article Number P 408 530 290

Always obtain signature of addressee or agent and DATE DELIVERED.

5. Signature – Addressee
X Denise J. Random

6. Signature – Agent
X

7. Date of Delivery
7/31/85

8. Addressee's Address *(ONLY if requested and fee paid)*

DOMESTIC RETURN RECEIPT

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
NOTICE OF PERMIT

Mr. Edgar J. Vallar
Manager, Engineering & Development
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

July 26, 1985

Enclosed is Permit Number AC 52-097471 to Silor Optical of Florida, Inc. to construct a conveyorized lens washer, issued pursuant to Section 403, Florida Statutes.

Any Party to this permit has the right to seek judicial review of the permit pursuant to Section 120.68, Florida Statutes, by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the clerk of the Department in the Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32301; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this permit is filed with the clerk of the Department.

Sincerely,

C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality
Management

Enclosure

cc: Peter Hessling
Bill Thomas

CERTIFICATION

This is to certify that the foregoing Notice of Permit and all copies requested were mailed before the close of business on July 29, 1985.

C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality
Management
2600 Blair Stone Road
Tallahassee, Florida 32301

FILING AND ACKNOWLEDGEMENT
FILED, on this date, pursuant to §120.52(9), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Patricia G. Adams
Clerk

July 29, 1985
Date

Final Determination

Silor Optical of Florida, Inc.
St. Petersburg, Pinellas County, Florida

Conveyorized Lens Washer Facility
Permit Number AC 52-097471

Florida Department of Environmental Regulation
Bureau of Air Quality Management
Central Air Permitting

July 25, 1985

Final Determination

Silor Optical's application for a permit to construct a cold temperature conveyorized lens washing system at the Silor Optical facility in St. Petersburg, Pinellas County, Florida, has been reviewed by the Bureau of Air Quality Management.

Public Notice of the Department's Intent to Issue the construction permit was published in the Pinellas County Review on June 14, 1985.

Copies of the preliminary determination have been available for public inspection at the Department's Southwest District office in Tampa, the Pinellas County Department of Environmental Management office in Clearwater, and the Bureau of Air Quality Management office in Tallahassee.

No comments were received as a result of the public notice period.

The final action of the Department will be to issue the permit as notice during the public notice period.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

PERMITTEE:
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

Permit Number: AC 52-097471
Expiration Date: February 28, 1986
County: Pinellas
Latitude/Longitude: 27° 48' 54" N/
82° 45' 06" W
Project: Conveyorized Lens Washer

This permit is issued under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code Rule(s) 17-2 and 17-4. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents attached hereto or on file with the department and made a part hereof and specifically described as follows:

For the installation of a cold temperature conveyorized lens washer to replace major VOC source involving trichloroethylene. The total solvent use is estimated to be 2 drums/day. The proposed new system will phase-out the existing operation, and effectively reduce the facility emissions approximately 75 percent.

The facility location is 4900 Park Street North, near the intersection of Park Street and 49th Avenue, St. Petersburg, Pinellas County, Florida. The UTM coordinates of the site are 17-327.5 East and 3077.8 North

The construction and operation of the conveyorized lens washer shall be in accordance with the application for permit to construct, submitted by Mr. Edgar G. Vallar on February 20, 1985, and the additional information provided by Mr. Peter Hessling, and Mr. Sidney S. White's letters of February 14, 1985, received February 25, 1985, and April 2, 1985, received April 4, 1985.

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations, and restrictions set forth herein are "Permit Conditions" and as such are binding upon the permittee and enforceable pursuant to the authority of Sections 403.161, 403.727, or 403.859 through 403.861, Florida Statutes. The permittee is hereby placed on notice that the department will review this permit periodically and may initiate enforcement action for any violation of the "Permit Conditions" by the permittee, its agents, employees, servants or representatives.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the department.

3. As provided in Subsections 403.087(6) and 403.722(5), Florida Statutes, the issuance of this permit does not convey any vested rights or any exclusive privileges. Nor does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations. This permit does not constitute a waiver of or approval of any other department permit that may be required for other aspects of the total project which are not addressed in the permit.

4. This permit conveys no title to land or water, does not constitute state recognition or acknowledgement of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the state. Only the Trustees of the Internal Improvement Trust Fund may express state opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, plant or aquatic life or property and penalties therefore caused by the construction or operation of this permitted source, nor does it allow the permittee to cause pollution in contravention of Florida Statutes and department rules, unless specifically authorized by an order from the department.

GENERAL CONDITIONS:

6. The permittee shall at all times properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit, as required by department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized department personnel, upon presentation of credentials or other documents as may be required by law, access to the premises, at reasonable times, where the permitted activity is located or conducted for the purpose of:

a. Having access to and copying any records that must be kept under the conditions of the permit;

b. Inspecting the facility, equipment, practices, or operations regulated or required under this permit; and

c. Sampling or monitoring any substances or parameters at any location reasonably necessary to assure compliance with this permit or department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately notify and provide the department with the following information:

a. a description of and cause of non-compliance; and

b. the period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

GENERAL CONDITIONS:

The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the department for penalties or revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source, which are submitted to the department, may be used by the department as evidence in any enforcement case arising under the Florida Statutes or department rules, except where such use is proscribed by Sections 403.73 and 403.111, Florida Statutes.

10. The permittee agrees to comply with changes in department rules and Florida Statutes after a reasonable time for compliance, provided however, the permittee does not waive any other rights granted by Florida Statutes or department rules.

11. This permit is transferable only upon department approval in accordance with Florida Administrative Code Rules 17-4.12 and 17-30.30, as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the department.

12. This permit is required to be kept at the work site of the permitted activity during the entire period of construction or operation.

13. This permit also constitutes:

- ( ) Determination of Best Available Control Technology (BACT)
- ( ) Determination of Prevention of Significant Deterioration (PSD).
- ( ) Compliance with New Source Performance Standards.

14. The permittee shall comply with the following monitoring and record keeping requirements:

a. Upon request, the permittee shall furnish all records and plans required under department rules. The retention period for all records will be extended automatically, unless otherwise stipulated by the department, during the course of any unresolved enforcement action.

GENERAL CONDITIONS:

b. The permittee shall retain at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation), copies of all reports required by this permit, and records of all data used to complete the application for this permit. The time period of retention shall be at least three years from the date of the sample, measurement, report or application unless otherwise specified by department rule.

c. Records of monitoring information shall include:

- the date, exact place, and time of sampling or measurements;
- the person responsible for performing the sampling or measurements;
- the date(s) analyses were performed;
- the person responsible for performing the analyses;
- the analytical techniques or methods used; and
- the results of such analyses.

15. When requested by the department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the department, such facts or information shall be submitted or corrected promptly.

SPECIFIC CONDITIONS:

1. This permit replaces operation permit No. AO 52-90650, as it applies to the conveyorized lens washer.

2. The facility shall meet all applicable requirements of 40 CFR 60, III appendix D- Required Emission Inventory Information.

3. The operating hours shall not exceed 4,000 hours per year.

4. The maximum VOC emission rate shall not exceed 232 tons/year thru 10/25/85; 116 tons/year 10/25/85 to 10/25/86; and 58 tons/year 10/25/86 to 10/25/87.

SPECIFIC CONDITIONS:

5. The emission for the cleaning chemical shall not exceed 1.75 lbs/hr or 3.5 tons/yr.

6. The applicant will demonstrate compliance with the conditions of this construction permit and submit a complete application for an operating permit to the Southwest District prior to 90 days before the expiration date of this permit. The applicant may continue to operate in compliance with all terms of the construction permit until its expiration or until issuance of an operating permit.

7. Upon obtaining an operating permit, the applicant will be required to submit annual reports on the actual operation of the facility. These reports will include, as a minimum: The amount of solvents used by inventory control, total hours of operation, and other requirements of 40 CFR 60, III Appendix D.

Issued this 25 day of July,
19 85.

**STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION**

VICTORIA J. TSCHINKEL, Secretary

____ pages attached.

Appendix D—Required Emission Inventory Information

(a) Completed NEDS point source form(s) for the entire plant containing the designated facility, including information on the applicable criteria pollutants. If data concerning the plant are already in NEDS, only that information must be submitted which is necessary to update the existing NEDS record for that plant. Plant and point identification codes for NEDS records shall correspond to those previously assigned in NEDS; for plants not in NEDS, these codes shall be obtained from the appropriate Regional Office.

(b) Accompanying the basic NEDS information shall be the following information on each designated facility:

(1) The state and county identification codes, as well as the complete plant and point identification codes of the designated facility in NEDS. (The codes are needed to match these data with the NEDS data.)

(2) A description of the designated facility including, where appropriate:

(i) Process name.

(ii) Description and quantity of each product (maximum per hour and average per year).

(iii) Description and quantity of raw materials handled for each product (maximum per hour and average per year).

(iv) Types of fuels burned, quantities and characteristics (maximum and average quantities per hour, average per year).

(v) Description and quantity of solid wastes generated (per year) and method of disposal.

(3) A description of the air pollution control equipment in use or proposed to control the designated pollutant, including:

(i) Verbal description of equipment.

(ii) Optimum control efficiency, in percent. This shall be a combined efficiency when more than one device operate in series. The method of control efficiency determination shall be indicated (e.g., design efficiency, measured efficiency, estimated efficiency).

(iii) Annual average control efficiency, in percent, taking into account control equipment down time. This shall be a combined efficiency when more than one device operate in series.

(4) An estimate of the designated pollutant emissions from the designated facility (maximum per hour and average per year). The method of emission determination shall also be specified (e.g., stack test, material balance, emission factor).

(Sec. 114. Clean Air Act is amended (42 U.S.C. 7414)). 08.83

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

INTEROFFICE MEMORANDUM

For Routing To District Offices And/Or To Other Than The Addressee		
To:	Loctn.:	
To:	Loctn.:	
To:	Loctn.:	
From:	Date:	
Reply Optional [ ]	Reply Required [ ]	Info. Only [ ]
Date Due:	Date Due:	

TO: Victoria J. Tschinkel

FROM: Clair Fancy

DATE: July 25, 1985

SUBJ: Approval of Attached Air Construction Permit

Attached for your approval and signature is one Air Construction Permit for which the applicant is Silor Optical of Florida, Inc. The construction proposed is a conveyorized lens washing system at the applicant's facility in St. Petersburg, Florida.

Day 90, after which the permit would be issued by default, is August 6, 1985.

The Bureau recommends your approval and signature.

CF/pa

Attachment

RECEIVED
JUL 25 1985
Office of the Secretary

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

DER
JUN 20 1985
BAQM

June 17, 1985

C.H. Fancy, P.E.
Deputy Bureau Chief
Bureau of Air Quality Management
State of Florida
Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Subject: Silor Optical of Florida, Inc. Conveyorized Lens Washer, Application to Construct, AC 52-097471

Dear Mr. Fancy:

Attached is proof of publication of the required Notice of Proposed Agency Action for our new conveyorized lens washer as per Florida Administrative Code 17-103.150.

Your continued timely processing of this permit would be greatly appreciated.

If there are any questions, please feel free to contact me.

Sincerely,

Sidney S. White, Jr.
Lead Engineer/Chemist

SSW/bd

Enc.

State of Florida
Department of
Environmental Regulation
Notice of Proposed
Agency Action on
Permit Application

The Department of Environmental Regulation gives notice of its intent to authorize Silor Optical of Florida, Inc. to construct a cold temperature conveyorized lens washing system. The alternative system will phase-out the existing lens washer operation. The total solvent use is estimated to be 2 drums/day. The new system will reduce facility emissions by approximately 75 percent to 58 TPY by October 25, 1986. A determination of best available control technology (BACT) was not required.

Persons whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must conform to the requirements of Chapters 17-103 and 28-5, Florida Administrative Code, and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida 32301, within fourteen (14) days of publication of this notice. Failure to file a request for hearing within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this preliminary statement. Therefore, persons who may not object to the proposed agency action may wish to intervene in the proceeding. A petition for intervention must be filed pursuant to Model Rule 28-5.207 at least five (5) days before the final hearing and be filed with the hearing officer if one has been assigned at the Division of Administrative Hearings, Department of Administration, 2009, Apalachee Parkway, Tallahassee, Florida, 32301. If no hearing officer has been assigned, the petition is to be filed with the Department's Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32301. Failure to petition to intervene within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, Florida Statutes.

The application, technical evaluation, and Department's Intent for the proposed project is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at the following locations:

DEPT. OF ENVIRONMENTAL
REGULATION
Southwest District
7601 Highway 301 N
Tampa, Florida 33610

DEPT. OF ENVIRONMENTAL
REGULATION
Bureau of Air Quality
Management
2600 Blair Stone Road
Tallahassee, Florida 32301

PINELLAS COUNTY DEPT. OF
ENVIRONMENTAL MANAGEMENT
Air and Water Quality Division
16100 Fairchild Drive
Bldg. V-102
Clearwater, Florida 33520

Any person may send written comments on the proposed action to Mr. Bill Thomas at the Department's Tallahassee address. All comments mailed within 30 days of the publication of this notice will be considered in the Department's final determination.

SILOR OPTICAL OF FLORIDA
Sid White, Lead Engineer
4900 Park Street N.
St. Petersburg, FL 33709
PR - June 14, 1985

Pinellas County REVIEW

Published Weekly
St. Petersburg, Pinellas County, Florida

COUNTY OF PINELLAS)
) S.S.
STATE OF FLORIDA)

Before the undersigned authority personally appeared B. Paulus who on oath says that he is Foreman of the Pinellas County Review, a weekly newspaper published at St. Petersburg, in Pinellas County, Florida; that the attached copy of advertising,

being a Notice

in the matter Silor Optical of Florida, Inc. Permit Application

in the ________ Court was published

in said newspaper in the issues of June 14, 1985

Affiant further says that the Pinellas County Review is a newspaper published at St. Petersburg, in said Pinellas County, Florida, and that the said newspaper has heretofore been continuously published in said Pinellas County, Florida, each week and has been entered as second class matter at the Post Office in St. Petersburg, in said Pinellas County, Florida, for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant further says that he has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in said newspaper.

Sworn to and subscribed before me this
14th day of June A.D., 19 85

B Paulus

(SEAL) Notary Public
Notary Public, State of Florida at Large
My commission expires My Commission Expires NOV. 1, 1987 19

No. 0155567

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED— NOT FOR INTERNATIONAL MAIL

(See Reverse)

SENT TO
Mr. Edgar Vallar

STREET AND NO.

P.O., STATE AND ZIP CODE

CONSULT POSTMASTER FOR FEES	POSTAGE	$
	CERTIFIED FEE	¢
OPTIONAL SERVICES	SPECIAL DELIVERY	¢
	RESTRICTED DELIVERY	¢
RETURN RECEIPT SERVICE	SHOW TO WHOM AND DATE DELIVERED	¢
	SHOW TO WHOM, DATE, AND ADDRESS OF DELIVERY	¢
	SHOW TO WHOM AND DATE DELIVERED WITH RESTRICTED DELIVERY	¢
	SHOW TO WHOM, DATE AND ADDRESS OF DELIVERY WITH RESTRICTED DELIVERY	¢
	TOTAL POSTAGE AND FEES	$

POSTMARK OR DATE

5/31/85

PS Form 3800, Apr. 1976

PS Form 3811, July 1983

● **SENDER: Complete items 1, 2, 3 and 4.**

Put your address in the "RETURN TO" space on the reverse side. Failure to do this will prevent this card from being returned to you. The return receipt fee will provide you the name of the person delivered to and the date of delivery. For additional fees the following services are available. Consult postmaster for fees and check box(es) for service(s) requested.

1. ☐ Show to whom, date and address of delivery.
2. ☐ Restricted Delivery.

3. Article Addressed to:
Mr. Edgar J. Vallar
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, FL 33709

4. Type of Service:
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail

Article Number
0155567

Always obtain signature of addressee or agent and DATE DELIVERED.

5. Signature – Addressee
X Denise Rondon

6. Signature – Agent
X

7. Date of Delivery

8. Addressee's Address (ONLY if requested and fee paid)

CROSSROADS STA. ST. PETERSBURG
JUN 3 1985

DOMESTIC RETURN RECEIPT

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

May 30, 1985

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. Edgar J. Vallar
Manager, Engineering & Development
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

Dear Mr. Vallar:

Attached is one copy of the Technical Evaluation and Preliminary Determination, and proposed permit to construct the cold temperature conveyorized lens washer located at your St. Petersburg, Pinellas County, facility.

Before final action can be taken on your draft permit, you are required by Florida Administrative Code Rule 17-103.150 to publish the attached Notice of Proposed Agency Action in the legal advertising section of a newspaper of general circulation in Pinellas County no later than fourteen days after receipt of this letter. The department must be provided with proof of publication within seven days of the date the notice is published. Failure to publish the notice may be grounds for denial of the permit.

Please submit, in writing, any comments which you wish to have considered concerning the department's proposed action to Mr. Bill Thomas of the Bureau of Air Quality Management.

Sincerely,

C. H. Fancy, P.E.
Deputy Bureau Chief
Bureau of Air Quality
Management

CHF/LJ/rw

Attachments

cc: Peter Hessling, Pinellas County
Bill Thomas, DER Southwest District

State of Florida
Department of Environmental Regulation
Notice of Proposed Agency Action
on Permit Application

The Department of Environmental Regulation gives notice of its intent to authorize Silor Optical of Florida, Inc. to construct a cold temperature conveyorized lens washing system. The alternative system will phase-out the existing lens washer operation. The total solvent use is estimated to be 2 drums/day. The new system will reduce facility emissions by approximately 75 percent to 58 TPY by October 25, 1986. A determination of best available control technology (BACT) was not required.

Persons whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must conform to the requirements of Chapters 17-103 and 28-5, Florida Administrative Code, and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida 32301, within fourteen (14) days of publication of this notice. Failure to file a request for hearing within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this preliminary statement. Therefore, persons who may not object to the proposed agency action may wish to intervene in the proceeding. A petition for intervention must be filed pursuant to Model Rule 28-5.207 at least five (5) days before the final hearing and be filed with the hearing officer if one has been assigned at the Division of Administrative Hearings, Department of Administration, 2009, Apalachee Parkway, Tallahassee, Florida 32301. If no hearing officer has been assigned, the petition is to be filed with the Department's Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32301. Failure to petition to intervene within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, Florida Statutes.

The application, technical evaluation, and Department's Intent for the proposed project is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at the following locations:

Dept. of Environmental Regulation
Southwest District
7601 Highway 301 N
Tampa, Florida 33610

Dept. of Environmental Regulation
Bureau of Air Quality Management
2600 Blair Stone Road
Tallahassee, Florida 32301

Pinellas County Dept. of Environmental Management
Air and Water Quality Division
16100 Fairchild Drive, Bldg. V-102
Clearwater, Florida 33520

Any person may send written comments on the proposed action to Mr. Bill Thomas at the Department's Tallahassee address. All comments mailed within 30 days of the publication of this notice will be considered in the Department's final determination.

RULES OF THE ADMINISTRATIVE COMMISSION
MODEL RULES OF PROCEDURE
CHAPTER 28-5
DECISIONS DETERMINING SUBSTANTIAL INTERESTS

28-5.15 Requests for Formal and Informal Proceedings

(1) Requests for proceedings shall be made by petition to the agency involved. Each petition shall be printed, typewritten or otherwise duplicated in legible form on white paper of standard legal size. Unless printed, the impression shall be on one side of the paper only and lines shall be double spaced and indented.

(2) All petitions filed under these rules should contain:

- (a) The name and address of each agency affected and each agency's file or identification number, if known;
- (b) The name and address of the petitioner or petitioners;
- (c) All disputed issues of material fact. If there are none, the petition must so indicate;
- (d) A concise statement of the ultimate facts alleged, and the rules, regulations and constitutional provisions which entitle the petitioner to relief;
- (e) A statement summarizing any informal action taken to resolve the issues, and the results of that action;
- (f) A demand for the relief to which the petitioner deems himself entitled; and
- (g) Such other information which the petitioner contends is material.

BEFORE THE STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

In the Matter of an)
Application for Permit by)
)
Silor Optical of Florida, Inc.) DER File No. AC 52-097471
4900 Park Street North)
St. Petersburg, Florida 33709)
)

INTENT TO ISSUE

The Department of Environmental Regulation hereby gives notice of its Intent to Issue, and proposed order of issuance for, a permit pursuant to Chapter 403, Florida Statutes, for the proposed project as detailed in the application specified above. The Department is issuing this Intent to Issue for the reasons stated in the attached Technical Evaluation and Preliminary Determination.

The applicant, Silor Optical of Florida, Inc., applied on February 20, 1985, to the Department of Environmental Regulation for a permit to construct the conveyorized lens washer as an alternative system to the existing lens washer. The information supplied by Mr. Sidney S. White, Jr. in his letter of April 2, 1985, received April 4, 1985, completed the application so that it could be processed by the Department. Information submitted by the company shows the operation of the new cold temperature conveyorized lens washing system will reduce emissions by 75 percent and will comply with all federal and state air pollution control regulations.

The Department has permitting jurisdiction under Chapter 403, Florida Statutes and Florida Administrative Code Rules 17-2 and 17-4. The project is not exempt from permitting procedures. The applicant was officially notified by the Department that an air construction permit was required for the proposed work.

This intent to issue shall be placed before the Secretary for final action unless an appropriate petition for a hearing pursuant to the provisions of Section 120.57, Florida Statutes, is filed within fourteen (14) days from receipt of this letter or publication of the public notice (copy attached) required pursuant to Rule 17-103.150, Florida Administrative Code, whichever occurs first. The petition must comply with the requirements of Section 17-103.155 and Rule 28-5.201, Florida Administrative Code (copy attached) and be filed pursuant to Rule 17-103.155(1) in the Office of General Counsel of the Department of Environmental Regulation at 2600 Blair Stone Road, Tallahassee, Florida 32301.

Petitions which are not filed in accordance with the above provisions are subject to dismissal by the Department. In the event a formal hearing is conducted pursuant to Section 120.57(1), all parties shall have opportunity to respond, to present evidence and argument on all issues involved, to conduct cross-examination of witness and submit rebuttal evidence, to submit proposed findings of facts and orders, to file exceptions to any order or hearing officer's recommended order, and to be represented by counsel. If an informal hearing is requested, the agency, in accordance with its rules of procedure, will provide affected persons or parties or their counsel an opportunity, at a convenient time and place, to present to the agency or hearing officer, written or oral evidence in opposition to the agency's action or refusal to act, or a written statement challenging the grounds upon which the agency has chosen to justify its action or inaction, pursuant to Section 120.57(2), Florida Statutes.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the proposed agency action. Therefore, persons who may not wish to file a petition, may wish to intervene in the proceeding. A petition for intervention must be filed pursuant to Model Rule 28-5.207 at least five (5) days before the final hearing and be filed with the hearing officer if one has been assigned at the Division of Administrative Hearings, 2009 Apalachee Parkway, Tallahassee, Florida 32301. If no hearing officer has been assigned, the petition is to be filed with the Department's Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32301. Failure to petition to intervene within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, Florida Statutes.

Executed the 31 day of May, 1985, in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION

C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality
Management

Copies furnished to:

Edgar J. Vallar, Silor Optical of Florida, Inc.
Peter Hessling, Pinellas County
Bill Thomas, DER Southwest District

CERTIFICATION

This is to certify that the foregoing Intent to Issue and all copies were mailed before the close of business on 31 May, 1985.

C H Fancy

C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality
Management
2600 Blair Stone Road
Tallahassee, Florida 32301

FILING AND ACKNOWLEDGEMENT
FILED, on this date, pursuant to §120.52(9), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Patricia G. Adams   May 31, 1985
Clerk   Date

Technical Evaluation
and
Preliminary Determination

Silor Optical of Florida, Inc.
Conveyorized Lens Washer

St. Petersburg, Pinellas County, Florida

Permit Number:
AC 52-097471

Florida Department of Environmental Regulation

Bureau of Air Quality Management

Central Air Permitting

May 30, 1985

I. Project Description

A. Applicant

Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

B. Project and Location

Silor Optical is a production facility of hard resin, ophthalmic lenses. The facility is located in St. Petersburg, Pinellas County, Florida, near the intersection of Park Street and 49th Avenue.

The company has applied for a construction permit to install a cold temperature conveyorized lens washer. The proposed new system will phase-out the existing operation and reduce the facility VOC emissions approximately 75 percent.

C. Process and Controls

The lens cleaning operation consists of an automatic six-tank conveyorized ultrasonic cleaning line. The loading is done manually. The cleaning chemical and other solvents are pumped into tanks from drums. The applicant has requested that the specific solvent being used for the alternative system be kept confidential. The department has evaluated this specific solvent and agrees to keep the solvent name confidential. Tanks Nos. 1 and 2 contain the cleaning chemical and it is continuously recycled through a pump and filtration system. The dirty lenses are positioned in stainless lens racks and are automatically raised and lowered through the six-tank cleaning line. Tank No. 3 contains water plus soap. Tanks Nos. 4 and 5 contain water only. Tank No. 6 is the last tank. It functions as a dryer to remove water from the clean lenses.

Ventilation over the solvent tanks leading to an exhaust stack will remove the small amount of vapor. The system is enclosed except for entry and exit sections. Vapor emissions are due to ventilation and the system dynamics. The spent solvent or liquid waste generated in tanks Nos. 1 and 2 is pumped directly into drums for disposal or recycling. The cleaning chemical, which is carried over into water rinse tanks Nos. 3, 4, and 5, is drained into the sewer.

The ultrasonic dip tanks with relatively non-volatile solvent will replace the current high ventilated solvent spray system.

II. Rule Applicability

State Regulations

The proposed project to construct a conveyorized lens washing system as an alternative system is subject to preconstruction review under the provisions of Chapter 403, FS, and Chapter 17-2, FAC.

The plant site is in an area designated as non-attainment for the air pollutant ozone (17-2.410[1][g]), and attainment for the air pollutants particulate matter (PM), sulfur dioxide, carbon monoxide, and nitrogen dioxide (17-2.420).

Presently, the facility is a major source for volatile organic compounds (VOC's). Current emissions exceed 100 tons per year. The proposed project is an alternative system to lens washing and will reduce VOC emissions for the facility by approximately 75 percent.

Silor Optical was operating under DER Permit No. AO 52-55878. Renewal Permit is AO 52-90650. Specific Conditions of both permits require compliance with Section 17-2.620(1)(a) and 17-2.650(1)(f).

III. Summary of Emissions

Silor Optical of Florida, Inc. is designated as a major source for volatile organic compounds. The following proposed emissions, after change to the alternative system, will result in the facility becoming a minor source for volatile organic compounds.

Year	Trichloroethylene Permitted Yearly Emissions
10/02/84-10/25/85	232 tons/year
10/25/85-10/25/86	116 tons/year
10/25/86-10/25/87	58 tons/year

The following is the 1984 inventory of all VOC's at this facility obtained by material balance of chemicals used and hazardous waste generated.

Chemical	Estimated Emissions Tons/yr	Emission Points
Trichloroethylene	220.77	Ventilation duct
Acetone	17.28	Fugitive
Methyl Alcohol	0.525	Fugitive
Isopropyl Alcohol	2.45	Fugitive

The estimated emission values for the alternative system after complete phase out of the existing lens washing system is as follows:

	Emission	
	Max lb/hr	Actual Ton/year
Cleaning Chemical	1.74	3.49*

*Based on 16 hrs/day and 50 weeks/year operation.

IV. Conclusion

Based on a review of the data submitted by Silor Optical of Florida, Inc. and information from the Pinellas County Division of Air Quality, the Department has concluded that the reduction in VOC emissions in the area will comply with the air pollution contol regulations. The reduction will be a great benefit for the safety and health of those in the area.

Therefore, the Department proposes to issue Silor Optical of Florida, Inc. a permit for construction of the Conveyorized Lens Washer Alternative System. The general and specific conditions listed in the proposed permit will assure compliance with all applicable air pollution regulations.

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

PERMITTEE:
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

Permit Number: AC 52-097471
Expiration Date: February 28, 1986
County: Pinellas
Latitude/Longitude: 27° 48' 54" N/
82° 45' 06" W
Project: Conveyorized Lens Washer

This permit is issued under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code Rule(s) 17-2 and 17-4. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents attached hereto or on file with the department and made a part hereof and specifically described as follows:

For the installation of a cold temperature conveyorized lens washer to replace major VOC source involving trichloroethylene. The total solvent use is estimated to be 2 drums/day. The proposed new system will phase-out the existing operation, and effectively reduce the facility emissions approximately 75 percent.

The facility location is 4900 Park Street North, near the intersection of Park Street and 49th Avenue, St. Petersburg, Pinellas County, Florida. The UTM coordinates of the site are 17-327.5 East and 3077.8 North

The construction and operation of the conveyorized lens washer shall be in accordance with the application for permit to construct, submitted by Mr. Edgar G. Vallar on February 20, 1985, and the additional information provided by Mr. Peter Hessling, and Mr. Sidney S. White's letters of February 14, 1985, received February 25, 1985, and April 2, 1985, received April 4, 1985.

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations, and restrictions set forth herein are "Permit Conditions" and as such are binding upon the permittee and enforceable pursuant to the authority of Sections 403.161, 403.727, or 403.859 through 403.861, Florida Statutes. The permittee is hereby placed on notice that the department will review this permit periodically and may initiate enforcement action for any violation of the "Permit Conditions" by the permittee, its agents, employees, servants or representatives.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the department.

3. As provided in Subsections 403.087(6) and 403.722(5), Florida Statutes, the issuance of this permit does not convey any vested rights or any exclusive privileges. Nor does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations. This permit does not constitute a waiver of or approval of any other department permit that may be required for other aspects of the total project which are not addressed in the permit.

4. This permit conveys no title to land or water, does not constitute state recognition or acknowledgement of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the state. Only the Trustees of the Internal Improvement Trust Fund may express state opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, plant or aquatic life or property and penalties therefore caused by the construction or operation of this permitted source, nor does it allow the permittee to cause pollution in contravention of Florida Statutes and department rules, unless specifically authorized by an order from the department.

GENERAL CONDITIONS:

6. The permittee shall at all times properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit, as required by department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized department personnel, upon presentation of credentials or other documents as may be required by law, access to the premises, at reasonable times, where the permitted activity is located or conducted for the purpose of:

a. Having access to and copying any records that must be kept under the conditions of the permit;

b. Inspecting the facility, equipment, practices, or operations regulated or required under this permit; and

c. Sampling or monitoring any substances or parameters at any location reasonably necessary to assure compliance with this permit or department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately notify and provide the department with the following information:

a. a description of and cause of non-compliance; and

b. the period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance.

GENERAL CONDITIONS:

The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the department for penalties or revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source, which are submitted to the department, may be used by the department as evidence in any enforcement case arising under the Florida Statutes or department rules, except where such use is proscribed by Sections 403.73 and 403.111, Florida Statutes.

10. The permittee agrees to comply with changes in department rules and Florida Statutes after a reasonable time for compliance, provided however, the permittee does not waive any other rights granted by Florida Statutes or department rules.

11. This permit is transferable only upon department approval in accordance with Florida Administrative Code Rules 17-4.12 and 17-30.30, as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the department.

12. This permit is required to be kept at the work site of the permitted activity during the entire period of construction or operation.

13. This permit also constitutes:

( ) Determination of Best Available Control Technology (BACT)
( ) Determination of Prevention of Significant Deterioration (PSD).
( ) Compliance with New Source Performance Standards.

14. The permittee shall comply with the following monitoring and record keeping requirements:

a. Upon request, the permittee shall furnish all records and plans required under department rules. The retention period for all records will be extended automatically, unless otherwise stipulated by the department, during the course of any unresolved enforcement action.

GENERAL CONDITIONS:

b. The permittee shall retain at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation), copies of all reports required by this permit, and records of all data used to complete the application for this permit. The time period of retention shall be at least three years from the date of the sample, measurement, report or application unless otherwise specified by department rule.

c. Records of monitoring information shall include:

- the date, exact place, and time of sampling or measurements;
- the person responsible for performing the sampling or measurements;
- the date(s) analyses were performed;
- the person responsible for performing the analyses;
- the analytical techniques or methods used; and
- the results of such analyses.

15. When requested by the department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the department, such facts or information shall be submitted or corrected promptly.

SPECIFIC CONDITIONS:

1. This permit replaces operation permit No. AO 52-90650, as it applies to the conveyorized lens washer.

2. The facility shall meet all applicable requirements of 40 CFR 60, III appendix D- Required Emission Inventory Information.

3. The operating hours shall not exceed 4,000 hours per year.

4. The maximum VOC emission rate shall not exceed 232 tons/year thru 10/25/85; 116 tons/year 10/25/85 to 10/25/86; and 58 tons/year 10/25/86 to 10/25/87.

PERMITTEE:
Silor Optical of Florida, Inc.

Permit Number: AC 52-097471
Expiration Date: February 28, 1986

SPECIFIC CONDITIONS:

5. The emission for the cleaning chemical shall not exceed 1.75 lbs/hr or 3.5 tons/yr.

6. The applicant will demonstrate compliance with the conditions of this construction permit and submit a complete application for an operating permit to the Southwest District prior to 90 days before the expiration date of this permit. The applicant may continue to operate in compliance with all terms of the construction permit until its expiration or until issuance of an operating permit.

7. Upon obtaining an operating permit, the applicant will be required to submit annual reports on the actual operation of the facility. These reports will include, as a minimum: The amount of solvents used by inventory control, total hours of operation, and other requirements of 40 CFR 60, III Appendix D.

Issued this_____day of_______________,
19___.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION

____
VICTORIA J. TSCHINKEL, Secretary

____ pages attached.

APPENDIX D—REQUIRED EMISSION INVENTORY INFORMATION

(a) Completed NEDS point source form(s) for the entire plant containing the designated facility, including information on the applicable criteria pollutants. If data concerning the plant are already in NEDS, only that information must be submitted which is necessary to update the existing NEDS record for that plant. Plant and point identification codes for NEDS records shall correspond to those previously assigned in NEDS; for plants not in NEDS, these codes shall be obtained from the appropriate Regional Office.

(b) Accompanying the basic NEDS information shall be the following information on each designated facility:

(1) The state and county identification codes, as well as the complete plant and point identification codes of the designated facility in NEDS. (The codes are needed to match these data with the NEDS data.)

(2) A description of the designated facility including, where appropriate:

(i) Process name.

(ii) Description and quantity of each product (maximum per hour and average per year).

(iii) Description and quantity of raw materials handled for each product (maximum per hour and average per year).

(iv) Types of fuels burned, quantities and characteristics (maximum and average quantities per hour, average per year).

(v) Description and quantity of solid wastes generated (per year) and method of disposal.

(3) A description of the air pollution control equipment in use or proposed to control the designated pollutant, including:

(i) Verbal description of equipment.

(ii) Optimum control efficiency, in percent. This shall be a combined efficiency when more than one device operate in series. The method of control efficiency determination shall be indicated (e.g., design efficiency, measured efficiency, estimated efficiency).

(iii) Annual average control efficiency, in percent, taking into account control equipment down time. This shall be a combined efficiency when more than one device operate in series.

(4) An estimate of the designated pollutant emissions from the designated facility (maximum per hour and average per year). The method of emission determination shall also be specified (e.g., stack test, material balance, emission factor).

(Sec. 114, Clean Air Act as amended (42 U.S.C. 7414)).[68.83]

AMMENDED APPLICATION OF DECEMBER 20, 1984

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Conveyorized Lens Washer ☒ New[1] ☐ Existing[1]

APPLICATION TYPE: ☒ Construction ☐ Operation ☐ Modification

COMPANY NAME: Silor Optical of Florida, Inc. COUNTY: Pinellas

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) ______

SOURCE LOCATION: Street 4900 Park Street North City St. Petersburg

UTM: East 17-327.5 KME North 3077.8 KMN

Latitude 27 ° 48 ' 54 "N Longitude 82 ° 45 ' 06 "W

APPLICANT NAME AND TITLE: Edgar J. Vallar, Manager-Engineering & Development

APPLICANT ADDRESS: 4900 Park Street No., St. Petersburg, Florida 33709

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Silor Optical of Fla. Inc.

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: ______

Hubert Dreckmann, VP & General Manager
Name and Title (Please Type)

Date: 2-20-85 Telephone No. (813) 541-5733

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

---

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed

Edgar J. Vallar
Name (Please Type)

Silor Optical of Florida, Inc.
Company Name (Please Type)

4900 Park St. No., St. Petersburg, FL 33709
Mailing Address (Please Type)

Florida Registration No. 16156 Date: 15 FEB 85 Telephone No. (813) 541-5733

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Obtaining construction permit for cold temperature conveyorized lens washer to replace major VOC source involving trichloroethylene. Ultrasonic dip tanks with relatively non-volatile solvent replaces high ventilated solvent spray system.

(See Attachment A)

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction December 1984 Completion of Construction October 1985

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

No pollution control devices involved; however, present VOC source is being replaced with an expensive alternative system.

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

This conveyorized lens washer system will eventually replace VOC source with Permit Number AO52-55878 and renewal permit A052-90650 dated October 25, 1984

E. Requested permitted equipment operating time: hrs/day 16 ; days/wk 5 ; wks/yr 50 ;

if power plant, hrs/yr _____; if seasonal, describe: _____

Note: New syster will be phased in and present VOS source equipment will be phased out according to permit renewal A052-90650, dated October 25, 1984.

F. If this is a new source or major modification, answer the following questions. ([✓ Yes] or No)

1. Is this source in a non-attainment area for a particular pollutant? Yes
    - a. If yes, has "offset" been applied? No
    - b. If yes, has "Lowest Achievable Emission Rate" been applied? No
    - c. If yes, list non-attainment pollutants. Ozone precusors (VOC's)
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. No
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. No
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? No
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? (non-RACT plastics being cleaned) No

- a. If yes, for what pollutants? _____
- b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Cleaning Chemical [1]	VOC	100	See note below	See attached flow diagram

Note: Material is recycled through process with minimal loss of material

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): NA - see addendum

2. Product Weight (lbs/hr): NA - see addendum

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
Cleaning Chemical	1.74 [1]	3.49 [1]	NA RACT	NA	10440 [1]	5.22 [1]	See flow diagram

---

[1] See Section V, Item 2. [1] Estimated values based on assumptions and calculations given in addendum

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

[1] The actual cleaning chemical for this application is considered confidential.

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
NA - RACT Control Technology				

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
NA			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis:

Percent Sulfur: ______ Percent Ash: ______

Density: ______ lbs/gal Typical Percent Nitrogen: ______

Heat Capacity: ______ BTU/lb ______ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average NA Maximum ______

G. Indicate liquid or solid wastes generated and method of disposal.

This cleaning chemical is biodegradeable; however, disposal will involve recycle or proper disposal.

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 22 feet above ground ft. Stack Diameter: 1 ft.

Gas Flow Rate: 600 ACFM ~~DSCFM~~ Gas Exit Temperature: ambient °F.

Water Vapor Content: ambient condition % Velocity: FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type 0 (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated	NA						
Uncontrolled (lbs/hr)							

Description of Waste

Total Weight Incinerated (lbs/hr) Design Capacity (lbs/hr)

Approximate Number of Hours of Operation per day day/wk wks/yr.

Manufacturer

Date Constructed Model No.

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ft. Stack Diamter: Stack Temp.

Gas Flow Rate: ACFM DSCFM* Velocity: FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: ☐ Cyclone ☐ Wet Scrubber ☐ Afterburner

☐ Other (specify)

Brief description of operating characteristics of control devices: ________________

____

____

____

____

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

____

____

____

____

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).

6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

☐ Yes ☐ No

Contaminant	Rate or Concentration
NA	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

☐ Yes ☐ No

Contaminant	Rate or Concentration

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration

D. Describe the existing control and treatment technology (if any).

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life:

6. Operating Costs:

7. Energy:

8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.

b. Diameter: ft.

c. Flow Rate: ACFM

d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Costs:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

1. Control Device:

2. Efficiency:[1]

3. Capital Cost:

4. Useful Life:

5. Operating Cost:

6. Energy:[2]

7. Maintenance Cost:

8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City:

(4) State:

---

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

---

[1] Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. NA no. sites ________ TSP ________ ( ) SO^{2}* ________ Wind spd/dir

Period of Monitoring ____ / ____ / ____ to ____ / ____ / ____
month day year month day year

Other data recorded ________________________________

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? ☐ Yes ☐ No

b. Was instrumentation calibrated in accordance with Department procedures?

☐ Yes ☐ No ☐ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. ______ Year(s) of data from ____/____/____ to ____/____/____
month day year month day year

2. Surface data obtained from (location)______________________________

3. Upper air (mixing height) data obtained from (location)______________________________

4. Stability wind rose (STAR) data obtained from (location)______________________________

C. Computer Models Used

1. ______________________________ Modified? If yes, attach description.

2. ______________________________ Modified? If yes, attach description.

3. ______________________________ Modified? If yes, attach description.

4. ______________________________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate	
TSP	______________________________	grams/sec
SO^2	______________________________	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

ATTACHMENT A

DESCRIPTION OF CLEANING CHEMICAL LENS WASHER

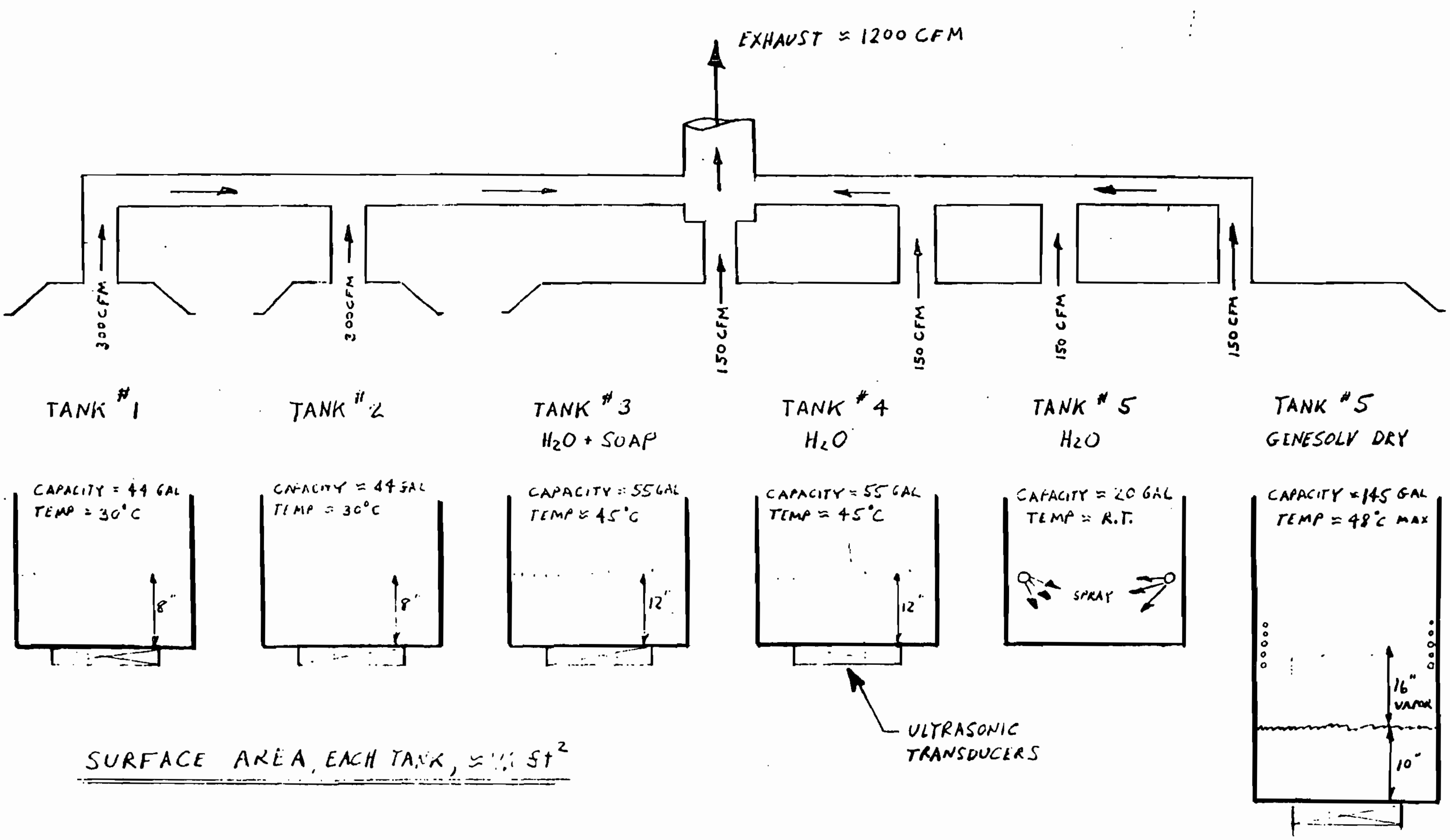
Dirty lenses are moved automatically through a six tank conveyorized ultrasonic cleaning line with the following tanks.

Tank	Contents	Ultrasonics
1	Cleaning chemical	Yes
2	Cleaning chemical	Yes
3	Water and soap	Yes
4	Water	Yes
5	Water	No
6	Gensolve dryer *	No

Cleaning compound in Tanks 1 and 2 is continuously recycled through a pump and filtration system. Ventilation is necessary only to remove a small amount of odor.

Liquid wastes are generated from Tanks 1 and 2 whenever they become sufficiently contaiminated to prevent proper cleaning of lens. Although this cleaning chemical is biodegradable, the wastes from these tanks will be recycled or properly disposed of.

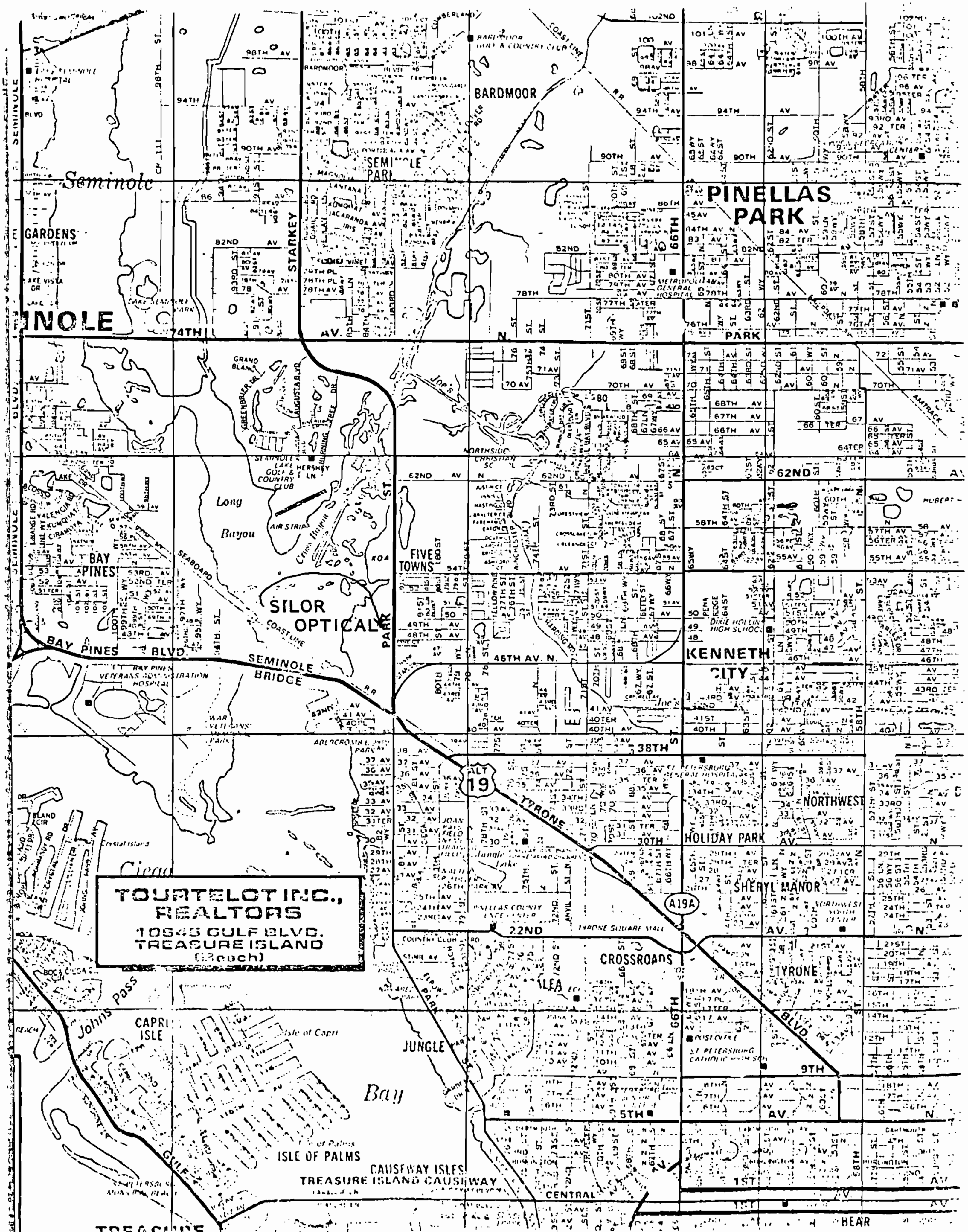
* Trichlorotrifluoroethane dryer

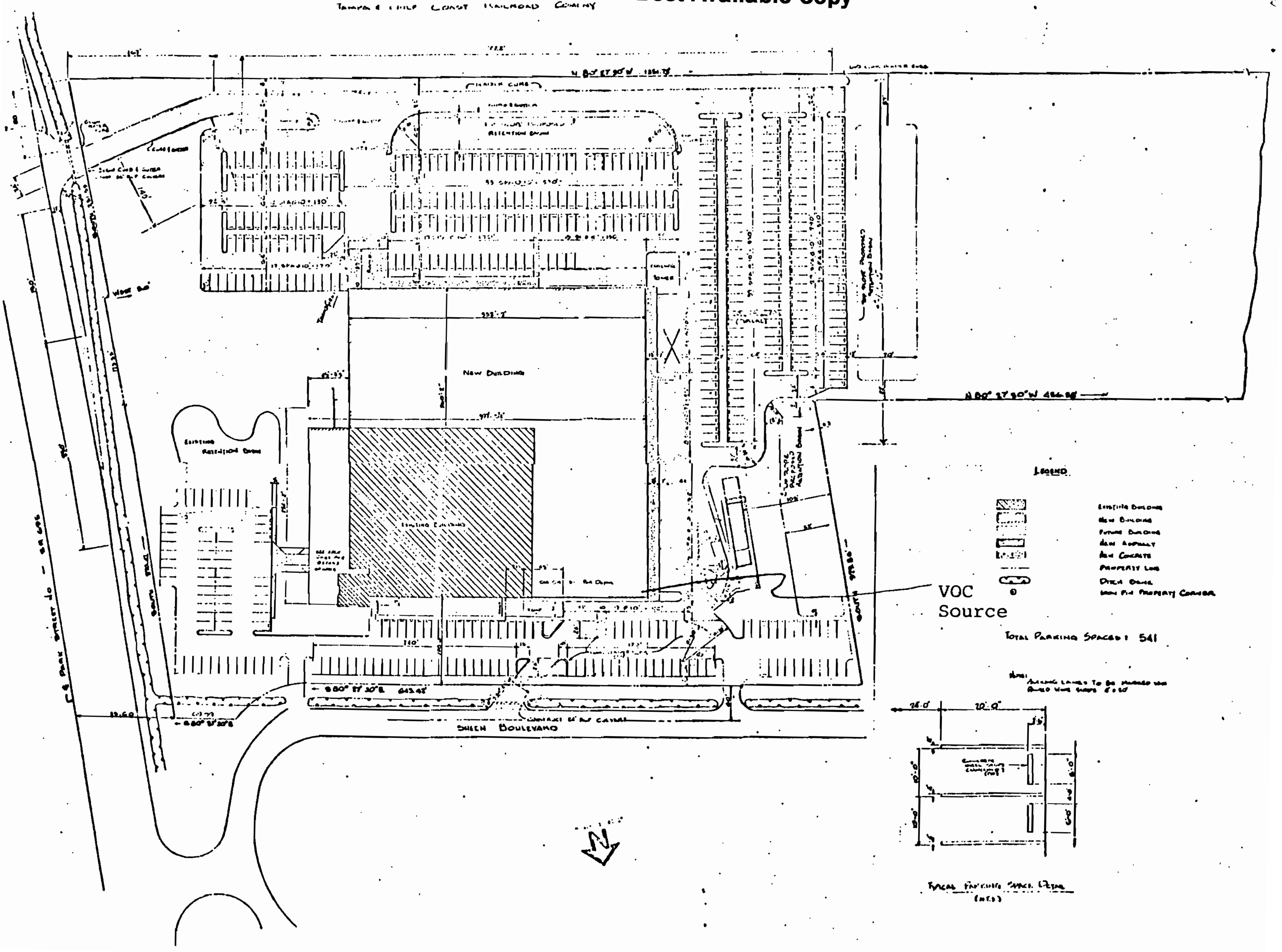


SURFACE AREA, EACH TANK, ≈ [illegible] ft^2

SCALE —	DATE 12-10-84	TITLE	REV / DESCRIPTION / DATE
TOLERANCES UNLESS OTHERWISE SPECIFIED	DRAWN BY P.J.S.	LENS CLEANING PROCESS (TENTATIVE)	silor optical of florida, inc. St. Petersburg, Florida 33709
METRIC — DECIMAL — ANGULAR —	APPROVED		DRAWING NO. SKETCH REV

Best Available Copy




Tampa & Gulf Coast Railroad Company
N 89° 27' 30" W
New Building
Existing Building
Existing Retention Basin
Sheen Boulevard
S 80° 27' 30" E 643.43
N 80° 27' 30" W 484.98
Park Street
VOC
Source
Legend
Existing Building
New Building
Future Building
New Asphalt
New Concrete
Property Line
Ditch Drain
Iron Pin Property Corner
Total Parking Spaces: 541
Typical Parking Space Detail
(N.T.S.)
24.0'
20.0'
10.0'

ADDENDUM

TO

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO CONSTRUCT AIR POLLUTION SOURCES

SILOR OPTICAL OF FLORIDA, INC.

DECEMBER 12, 1984

ESTIMATED EMISSION CALCULATIONS FOR

CLEANING CHEMICAL LENS WASHER

Two obvious sources of emission from this system are emissions from open tanks and emissions from dragout or carryover (the material left on lenses after removal from liquid cleaning chemical).

EMISSIONS OF CLEANING CHEMICAL FROM TANKS 1 AND 2

An estimate of the emissions of cleaning chemical tanks can be obtained with a knowledge of the evaporation rate of a known compound (for example, trichlorotrifluoroethane) under relevant conditions and relative evaporation rates of this known compound and cleaning chemical.

In a study of trichlorotrifluoroethane evaporation from a stagnate container with 6½" freeboard, Allied Chemical Corporation found an observed evaporation rate of 0.135 pounds per hour per square foot.

If one assumes a factor of 4 for air and liquid turbulence, an estimated emission of 0.54 pounds per hour per square foot is obtained for trichlorotrifluoroethane.

Calculate a relative evaporation rate of cleaning compound and trichlorotrifluoroethane using data in ASTM D1901-67 tables. A relative evaporation rate of 29 is obtained when trichlorotrifluoroethane is compared to

Calculate the quantity of cleaning chemical emitted from a tank by dividing the relative evaporation factor of 29 into the estimated emission rate of trichlorotrifluoroethane (0.54 pounds per hour per square foot).

Estimated emission rate for cleaning chemical from a tank =

$$\frac{0.54 \text{ pounds/hour/square foot}}{29} \quad (5)^*$$

= 0.0931 pounds/hour/square foot or 0.093 pounds/hour/square foot

Calculate the estimated emission rate for cleaning chemical for both tanks with 7.2 square foot surface area each.

Estimated hourly emission rate for two tanks cleaning chemical =

(0.093 pounds/hour/square foot) (2) (7.2 square feet)

= 1.34 pounds/hour

Calculate the total quantity of cleaning chemical emitted per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of cleaning chemical emitted per year =

(1.34 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 5360 pounds/year.

EMISSIONS OF CLEANING CHEMICAL FROM DRAGOUT

Although total dragout has experimentally determined by Crest Ultrasonics Corporation to be about 1.05g per lens, only a very small amount of this dragout actually evaporates. Crest has determined that only about 0.012g or less is lost to evaporation even after 35 minutes in air. Since the transfer time is only about 1-2 minutes instead of 35 minutes, the value of 0.012g per lens should represent the maximum emission rate for dragout.

Calculate the total quantity per hour of cleaning chemical emitted from dragout by multiplying the estimated evaporation quantity per lens times the total number of lenses cleaned per hour.

Total quantity per hour of cleaning chemical emitted from dragout =

(0.012g/lens) (3060 lenses/hour) (5)* = 183.6 per hour or 0.404 pounds/hour

Calculate the quantity of cleaning chemical emitted from dragout per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of cleaning chemical emitted from dragout per year =

(0.404 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 1616 pounds/year

ESTIMATED TOTAL EMISSIONS FOR CLEANING CHEMICAL LENS WASHER

The total emissions for the cleaning chemical lens washer is obtained by adding the yearly emission from both tanks and from dragout.

Total yearly emissions for cleaning chemical =

5360 pounds/year + 1616 pounds/year = 6976 pounds/year or 3.49 tons/year

SECTION III

AIR POLLUTION SOURCES & CONTROL DEVICES

C. Airborne Contaminants Emitted:

Emission
maximum (16 hours)

The maximum emission is obtained by dividing the total yearly emission for cleaning chemical by the number of hours in working year.

$$\text{Maximum pounds/hour} = \frac{6976 \text{ pounds/year}}{(16 \text{ hours/day})\ (5 \text{ days/week})\ (50 \text{ weeks/year})}$$

= 1,74 pounds/hour

$$\text{Actual tons/year} = \frac{6976 \text{ pounds/year}}{2000 \text{ pounds/ton}} = 3.49 \text{ tons/year}$$

POTENTIAL EMISSION
(For 24 hours/day operation)

The total potential yearly emissions for a 24 hour operation is obtained by multiplying the hourly emission rates of both tanks and from dragout times the number of working hours in a year.

Total potential yearly emission for 24 hours/day operation =

(1.34 pounds/hour + 0.404 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = (1.74 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = 10440 pounds/year or 5.22 tons/year.

* This factor is required to cover uncertainties in actual system and emission measurements.

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

April 2, 1985

DER
APR 4 1985
BAQM

Mr. C.H. Fancy, Deputy Chief
Bureau of Air Quality Management
State of Florida Department of
Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301-8241

Dear Mr. Fancy:

Re: Silor Optical of Florida, Inc., Conveyorized Lens Washer, Application to Construct; AC 52-097471

In reference to your question regarding proposed emissions of trichloroethylene after change to the alternative system, we would propose the following yearly emissions:

Year	Trichloroethylene Permitted Yearly Emissions*
10/2/84 - 10/25/85	232 tons/year
10/25/85 - 10/25/86	116 tons/year
10/25/86 - 10/25/87	58 tons/year
10/25/87 -	NA

* Conveyorized Lens Washer (Trichloroethylene) Renewal Permit AO 52-90650 dated October 25, 1984.

If the new lens washer is immediately successful, then the trichloroethylene emissions could be much lower than proposed emission levels.

If there are any additional questions, please feel free to contact me.

Sincerely,

Sidney S. White, Jr.
Lead Engineer/Chemist

SSW/bd

No. 0155819

RECEIPT FOR CERTIFIED MAIL

**NO INSURANCE COVERAGE PROVIDED—
NOT FOR INTERNATIONAL MAIL**

(See Reverse)

SENT TO
Mr. Edgar J. Vallar

STREET AND NO.

P.O., STATE AND ZIP CODE

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CONSULT POSTMASTER FOR FEES	CERTIFIED FEE	¢
OPTIONAL SERVICES	SPECIAL DELIVERY	¢
	RESTRICTED DELIVERY	¢
RETURN RECEIPT SERVICE	SHOW TO WHOM AND DATE DELIVERED	¢
	SHOW TO WHOM, DATE, AND ADDRESS OF DELIVERY	¢
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PS Form 3800, Apr. 1976

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1. ☐ Show to whom, date and address of delivery.
2. ☐ Restricted Delivery.

3. Article Addressed to:

Mr. Edgar J. Vallar
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, FL 33709

4. Type of Service:

☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail

Article Number
0155819

Always obtain signature of addressee or agent and DATE DELIVERED.

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X K. Mason

6. Signature – Agent
X

7. Date of Delivery
3-29-85

8. Addressee's Address *(ONLY if requested and fee paid)*

DOMESTIC RETURN RECEIPT

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

March 27, 1985

Mr. Edgar J. Vallar
Manager - Engineering & Development
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

Dear Mr. Vallar:

Re: Silor Optical of Florida, Inc., Conveyorized Lens Washer,
Application to Construct; AC 52-097471

In review of Mr. Sidney S. White's letter dated February 14, 1985, please note Question 8 estimated emissions for trichloroethylene of 220.77 tons/yr. What will be the proposed emissions for the facility after the change to the alternative system? In citing these reductions, be advised that they will be included as a federally enforceable permit condition, in lieu of application for RACT determination.

If there are any questions, please call Bill Thomas, Chief Engineer, at (904)488-1344 or write to me at the above address.

Sincerely,

C. H. Fancy, P.E.
Deputy Chief
Bureau of Air Quality
Management

CHF/ks

cc: Bill Thomas, Tampa
Peter Hessling, Pinellas County

AMMENDED APPLICATION OF DECEMBER 20, 1984

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT

7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Conveyorized Lens Washer [X] New[1] [ ] Existing[1]

APPLICATION TYPE: [X] Construction [ ] Operation [ ] Modification

COMPANY NAME: Silor Optical of Florida, Inc. COUNTY: Pinellas

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) ____________

SOURCE LOCATION: Street 4900 Park Street North City St. Petersburg

UTM: East 17-327.5 KME North 3077.8 KMN

Latitude 27 ° 48 ' 54 "N Longitude 82 ° 45 ' 06 "W

APPLICANT NAME AND TITLE: Edgar J. Vallar, Manager-Engineering & Development

APPLICANT ADDRESS: 4900 Park Street No., St. Petersburg, Florida 33709

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Silor Optical of Fla. Inc.

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: ____________

Hubert Dreckmann, VP & General Manager
Name and Title (Please Type)

Date: 2-20-85 Telephone No. (813) 541-5733

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

---

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed

Edgar J. Vallar
Name (Please Type)

Silor Optical of Florida, Inc.
Company Name (Please Type)

4900 Park St. No., St. Petersburg, FL 33709
Mailing Address (Please Type)

Florida Registration No. 16156 Date: 15 Feb 85 Telephone No. (813) 541-5733

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Obtaining construction permit for cold temperature conveyorized lens washer to replace major VOC source involving trichloroethylene. Ultrasonic dip tanks with relatively non-volatile solvent replaces high ventilated solvent spray system.

(See Attachment A)

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction December 1984 Completion of Construction October 1985

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

No pollution control devices involved; however, present VOC source is being replaced with an expensive alternative system.

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

This conveyorized lens washer system will eventually replace VOC source with Permit Number AO52-55878 and renewal permit A052-90650 dated October 25, 1984

E. Requested permitted equipment operating time: hrs/day 16 ; days/wk 5 ; wks/yr 50 ;

if power plant, hrs/yr _____ ; if seasonal, describe:

Note: New system will be phased in and present VOS source equipment will be phased out according to permit renewal A052-90650, dated October 25, 1984.

F. If this is a new source or major modification, answer the following questions. ([✓ Yes] or No)

1. Is this source in a non-attainment area for a particular pollutant? Yes

   a. If yes, has "offset" been applied? No

   b. If yes, has "Lowest Achievable Emission Rate" been applied? No

   c. If yes, list non-attainment pollutants. Ozone precusors (VOC's)

2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. No

3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. No

4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? No

5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? (non-RACT plastics being cleaned) No

   a. If yes, for what pollutants? _____

   b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Cleaning Chemical [1]	VOC	100	See note below	See attached flow diagram

Note: Material is recycled through process with minimal loss of material

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): NA - see addendum

2. Product Weight (lbs/hr): NA - see addendum

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
Cleaning Chemical	1.74 [1]	3.49 [1]	NA RACT	NA	10440 [1]	5.22 [1]	See flow diagram

[1] See Section V, Item 2. [1] Estimated values based on assumptions and calculations given in addendum

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

[1] The actual cleaning chemical for this application is considered confidential.

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
NA - RACT Control Technology				

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
NA			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis:

Percent Sulfur: ______ Percent Ash: ______

Density: ______ lbs/gal Typical Percent Nitrogen: ______

Heat Capacity: ______ BTU/lb ______ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average NA Maximum ______

G. Indicate liquid or solid wastes generated and method of disposal.

This cleaning chemical is biodegradeable; however, disposal will involve recycle or proper disposal.

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 22 feet above ground ft. Stack Diameter: 1 ft.

Gas Flow Rate: 600 ACFM ______ ~~DSCFM~~ Gas Exit Temperature: ambient °F.

Water Vapor Content: ambient condition % Velocity: ______ FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type 0 (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Patholog-ical)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Inciner-ated	NA						
Uncon-trolled (lbs/hr)							

Description of Waste ______

Total Weight Incinerated (lbs/hr) ______ Design Capacity (lbs/hr) ______

Approximate Number of Hours of Operation per day ______ day/wk ______ wks/yr. ______

Manufacturer ______

Date Constructed ______ Model No. ______

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ______ ft. Stack Diamter: ______ Stack Temp. ______

Gas Flow Rate: ______ ACFM ______ DSCFM* Velocity: ______ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify) ______

Brief description of operating characteristics of control devices: ______________________

____

____

____

____

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

____

____

____

____

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).

6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

☐ Yes ☐ No

Contaminant	Rate or Concentration
NA	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

☐ Yes ☐ No

Contaminant	Rate or Concentration

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration

D. Describe the existing control and treatment technology (if any).

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life:

6. Operating Costs:

7. Energy:

8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.

b. Diameter: ft.

c. Flow Rate: ACFM

d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency:[1]

d. Capital Cost:

e. Useful Life:

f. Operating Cost:

g. Energy:[2]

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device:
b. Operating Principles:

c. Efficiency:[1]
d. Capital Cost:

e. Useful Life:
f. Operating Cost:

g. Energy:[2]
h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device:
b. Operating Principles:

c. Efficiency:[1]
d. Capital Costs:

e. Useful Life:
f. Operating Cost:

g. Energy:[2]
h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

1. Control Device:
2. Efficiency:[1]

3. Capital Cost:
4. Useful Life:

5. Operating Cost:
6. Energy:[2]

7. Maintenance Cost:
8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City:
(4) State:

---

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

[1] Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. NA no. sites ______ TSP ______ ( ) SO^2* ______ Wind spd/dir

Period of Monitoring ___/___/___ to ___/___/___
month day year month day year

Other data recorded ____________________

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? [ ] Yes [ ] No

b. Was instrumentation calibrated in accordance with Department procedures?

[ ] Yes [ ] No [ ] Unknown

B. Meteorological Data Used for Air Quality Modeling

1. _____ Year(s) of data from _____/_____/_____ to _____/_____/_____
month day year month day year

2. Surface data obtained from (location)______________________________

3. Upper air (mixing height) data obtained from (location)______________________________

4. Stability wind rose (STAR) data obtained from (location)______________________________

C. Computer Models Used

1. ______________________________ Modified? If yes, attach description.

2. ______________________________ Modified? If yes, attach description.

3. ______________________________ Modified? If yes, attach description.

4. ______________________________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate	
TSP	______________________________	grams/sec
SO^2	______________________________	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

ATTACHMENT A

DESCRIPTION OF CLEANING CHEMICAL LENS WASHER

Dirty lenses are moved automatically through a six tank conveyorized ultrasonic cleaning line with the following tanks.

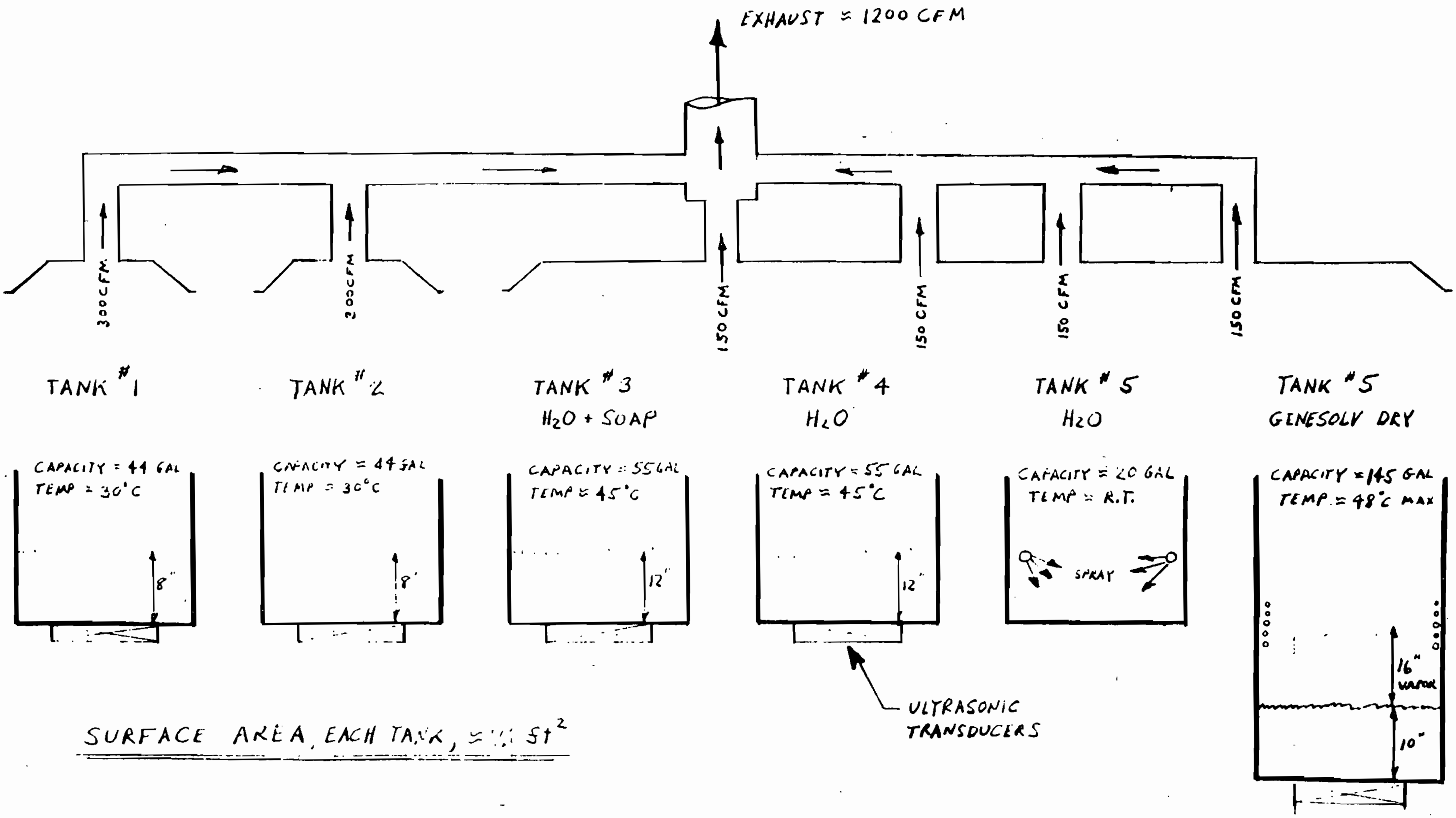
Tank	Contents	Ultrasonics
1	Cleaning chemical	Yes
2	Cleaning chemical	Yes
3	Water and soap	Yes
4	Water	Yes
5	Water	No
6	Gensolve dryer *	No

Cleaning compound in Tanks 1 and 2 is continuously recycled through a pump and filtration system. Ventilation is necessary only to remove a small amount of odor.

Liquid wastes are generated from Tanks 1 and 2 whenever they become sufficiently contaiminated to prevent proper cleaning of lens. Although this cleaning chemical is biodegradable, the wastes from these tanks will be recycled or properly disposed of.

---

* Trichlorotrifluoroethane dryer

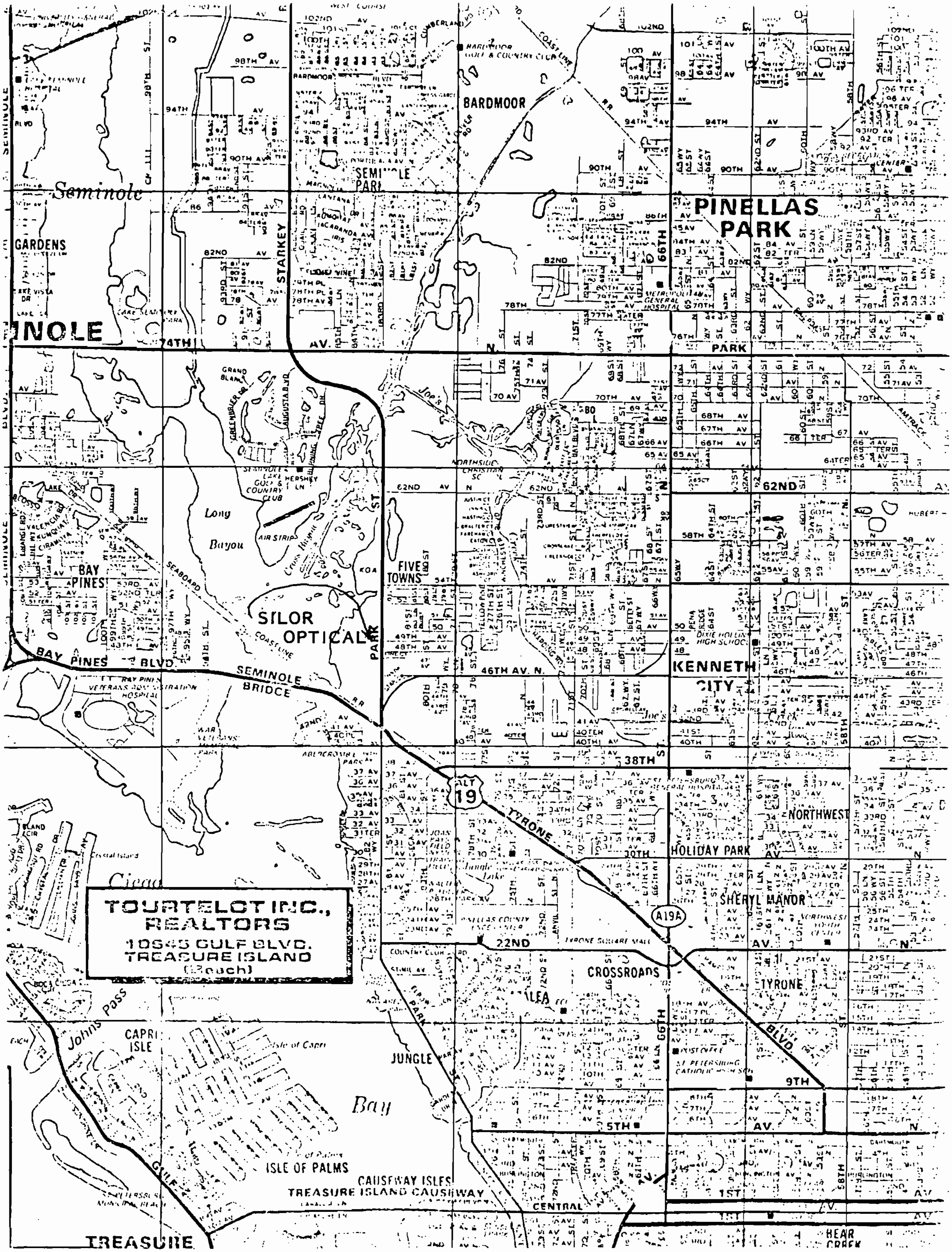


SURFACE AREA, EACH TANK, ≈ [illegible] ft^2

SCALE ∔	**DATE** 12-10-84	**TITLE**	**silor optical** of florida, inc. St. Petersburg, Florida 33709
TOLERANCES UNLESS OTHERWISE SPECIFIED **METRIC** ∔ **DECIMAL** ∔ **ANGULAR** ∔	**DRAWN BY** P. J. S.	LENS CLEANING PROCESS (TENTATIVE)	**DRAWING NO.** SKETCH
	APPROVED		**REV**

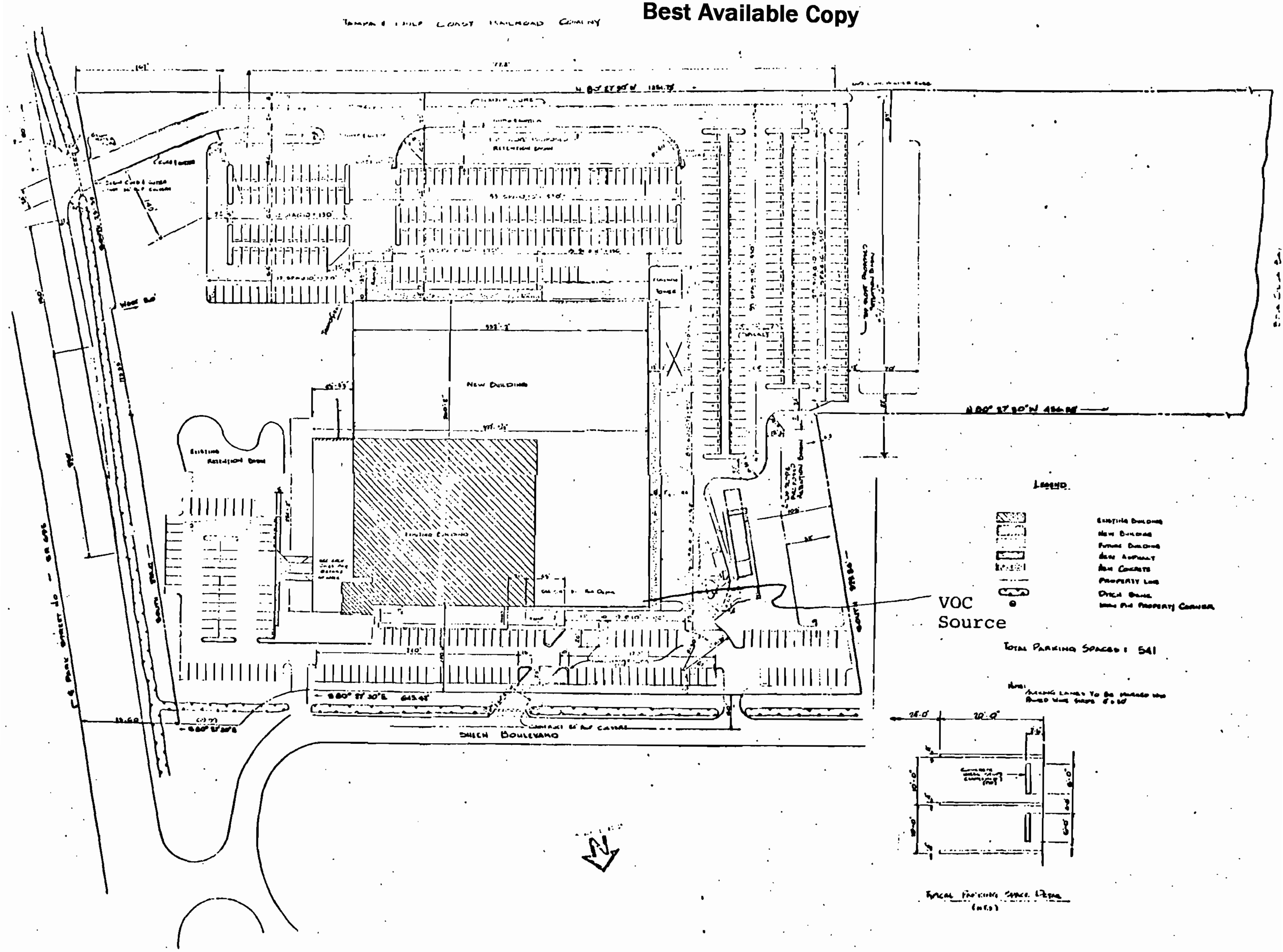
REV	DESCRIPTION	DATE

Best Available Copy



TOURTELOT INC.,
REALTORS
10845 GULF BLVD.
TREASURE ISLAND
(Beach)

Best Available Copy



VOC Source

ADDENDUM
TO
STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO CONSTRUCT AIR POLLUTION SOURCES
SILOR OPTICAL OF FLORIDA, INC.
DECEMBER 12, 1984

ESTIMATED EMISSION CALCULATIONS FOR

CLEANING CHEMICAL LENS WASHER

Two obvious sources of emission from this system are emissions from open tanks and emissions from draqout or carryover (the material left on lenses after removal from liquid cleaning chemical).

EMISSIONS OF CLEANING CHEMICAL FROM TANKS 1 AND 2

An estimate of the emissions of cleaning chemical tanks can be obtained with a knowledge of the evaporation rate of a known compound (for example, trichlorotrifluoroethane) under relevant conditions and relative evaporation rates of this known compound and cleaning chemical.

In a study of trichlorotrifluoroethane evaporation from a stagnate container with 6½" freeboard, Allied Chemical Corporation found an observed evaporation rate of 0.135 pounds per hour per square foot.

If one assumes a factor of 4 for air and liquid turbulence, an estimated emission of 0.54 pounds per hour per square foot is obtained for trichlorotrifluoroethane.

Calculate a relative evaporation rate of cleaning compound and trichlorotrifluoroethane using data in ASTM D1901-67 tables. A relative evaporation rate of 29 is obtained when trichlorotrifluoroethane is compared to

Calculate the quantity of cleaning chemical emitted from a tank by dividing the relative evaporation factor of 29 into the estimated emission rate of trichlorotrifluoroethane (0.54 pounds per hour per square foot).

Estimated emission rate for cleaning chemical from a tank =

$$\frac{0.54 \text{ pounds/hour/square foot}}{29} \quad (5)^*$$

= 0.0931 pounds/hour/square foot or 0.093 pounds/hour/square foot

Calculate the estimated emission rate for cleaning chemical for both tanks with 7.2 square foot surface area each.

Estimated hourly emission rate for two tanks cleaning chemical =

(0.093 pounds/hour/square foot) (2) (7.2 square feet)

= 1.34 pounds/hour

Calculate the total quantity of cleaning chemical emitted per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of cleaning chemical emitted per year =

(1.34 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 5360 pounds/year.

EMISSIONS OF CLEANING CHEMICAL FROM DRAGOUT

Although total dragout has experimentally determined by Crest Ultrasonics Corporation to be about 1.05g per lens, only a very small amount of this dragout actually evaporates. Crest has determined that only about 0.012g or less is lost to evaporation even after 35 minutes in air. Since the transfer time is only about 1-2 minutes instead of 35 minutes, the value of 0.012g per lens should represent the maximum emission rate for dragout.

Calculate the total quantity per hour of cleaning chemical emitted from dragout by multiplying the estimated evaporation quantity per lens times the total number of lenses cleaned per hour.

Total quantity per hour of cleaning chemical emitted from dragout =

(0.012g/lens) (3060 lenses/hour) (5)* = 183.6 per hour or 0.404 pounds/hour

Calculate the quantity of cleaning chemical emitted from dragout per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of cleaning chemical emitted from dragout per year =

(0.404 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 1616 pounds/year

ESTIMATED TOTAL EMISSIONS FOR CLEANING CHEMICAL LENS WASHER

The total emissions for the cleaning chemical lens washer is obtained by adding the yearly emission from both tanks and from dragout.

Total yearly emissions for cleaning chemical =

5360 pounds/year + 1616 pounds/year = 6976 pounds/year or 3.49 tons/year

SECTION III

AIR POLLUTION SOURCES & CONTROL DEVICES

C. Airborne Contaminants Emitted:

Emission
maximum (16 hours)

The maximum emission is obtained by dividing the total yearly emission for cleaning chemical by the number of hours in working year.

$$\text{Maximum pounds/hour} = \frac{\text{6976 pounds/year}}{\text{(16 hours/day) (5 days/week) (50 weeks/year)}}$$

= 1.74 pounds/hour

Actual tons/year = $\frac{\text{6976 pounds/year}}{\text{2000 pounds/ton}}$ = 3.49 tons/year

POTENTIAL EMISSION
(For 24 hours/day operation)

The total potential yearly emissions for a 24 hour operation is obtained by multiplying the hourly emission rates of both tanks and from dragout times the number of working hours in a year.

Total potential yearly emission for 24 hours/day operation =

(1.34 pounds/hour + 0.404 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = (1.74 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = 10440 pounds/year or 5.22 tons/year.

* This factor is required to cover uncertainties in actual system and emission measurements.

From AP-42

Audrey McBath

4.6 SOLVENT DEGREASING

4.6.1 Process Description[1,2]

Solvent degreasing (or solvent cleaning) is the physical process of using organic solvents to remove grease, fats, oils, wax or soil from various metal, glass or plastic items. The types of equipment used in this method are categorized as cold cleaners, open top vapor degreasers or conveyorized degreasers. Nonaqueous solvents such as petroleum distillates, chlorinated hydrocarbons, ketones and alcohols are used. Solvent selection is based on the solubility of the substance to be removed and on the toxicity, flammability, flash point, evaporation rate, boiling point, cost and several other properties of the solvent.

The metalworking industries are the major users of solvent degreasing, i.e., automotive, electronics, plumbing, aircraft, refrigeration and business machine industries. Solvent cleaning is also used in industries such as printing, chemicals, plastics, rubber, textiles, glass, paper and electric power. Most repair stations for transportation vehicles and electric tools utilize solvent cleaning at least part of the time. Many industries use water based alkaline wash systems for degreasing, and since these systems emit no solvent vapors to the atmosphere, they are not included in this discussion.

4.6.1.1 Cold Cleaners – The two basic types of cold cleaners are maintenance and manufacturing. Cold cleaners are batch loaded, nonboiling solvent degreasers, usually providing the simplest and least expensive method of metal cleaning. Maintenance cold cleaners are more numerous and smaller, generally using petroleum solvents such as mineral spirits (petroleum distillates and Stoddard solvents). Manufacturing cold cleaners use a wide variety of solvents, which perform higher quality cleaning, are more specialized, and have about twice the average emission rate of maintenance cold cleaners. Some cold cleaners can serve both purposes.

Cold cleaner operations include spraying, brushing, flushing and immersion. In a typical maintenance cleaner (Figure 4.6-1), dirty parts are cleaned manually by spraying and then soaking in the tank. After cleaning, the parts are either suspended over the tank to drain or are placed on an external rack that routes the drained solvent back into the cleaner. The cover is intended to be closed whenever parts are not being handled in the cleaner. Manufacturing cold cleaners vary widely in design, but there are two basic tank designs: the simple spray sink and the dip tank. Of these, the dip tank provides more thorough cleaning through immersion, and often is made to improve cleaning efficiency by agitation.

4.6.1.2 Open Top Vapor Systems – Open top vapor degreasers are batch loaded boiling degreasers that clean using condensation of hot solvent vapor on colder metal parts. Vapor degreasing uses halogenated solvents (usually perchloroethylene, trichloroethylene, or 1, 1, 1-trichloroethane), because they are not flammable, and their vapors are much heavier than air.

A typical vapor degreaser (Figure 4.6-1) is a sump containing a heater that boils the solvent to generate vapors. The upper level of these pure vapors is controlled by condenser coils and/or a water jacket encircling the device. Solvent and moisture condensed on the coils are directed to a water separator, where the heavier solvent is drawn off the bottom and is returned to the vapor degreaser. A "freeboard" extends above the top of the vapor zone to minimize vapor escape. Parts to be cleaned are immersed in the vapor zone, and condensation continues until they are heated to the vapor temperature. Residual liquid solvent on the parts rapidly evaporates as they are slowly removed from the vapor zone. Lip mounted exhaust systems capture solvent vapors and carry them away from operating personnel. Cleaning action is often increased by spraying the parts with solvent below the vapor level or by immersing them in the liquid solvent bath. Nearly all vapor degreasers are equipped with a water separator which allows the solvent to flow back into the degreaser.

Emission rates are usually estimated from solvent consumption data for the particular degreasing operation under consideration. Solvents are often purchased specifically for use in degreasing and are not used in

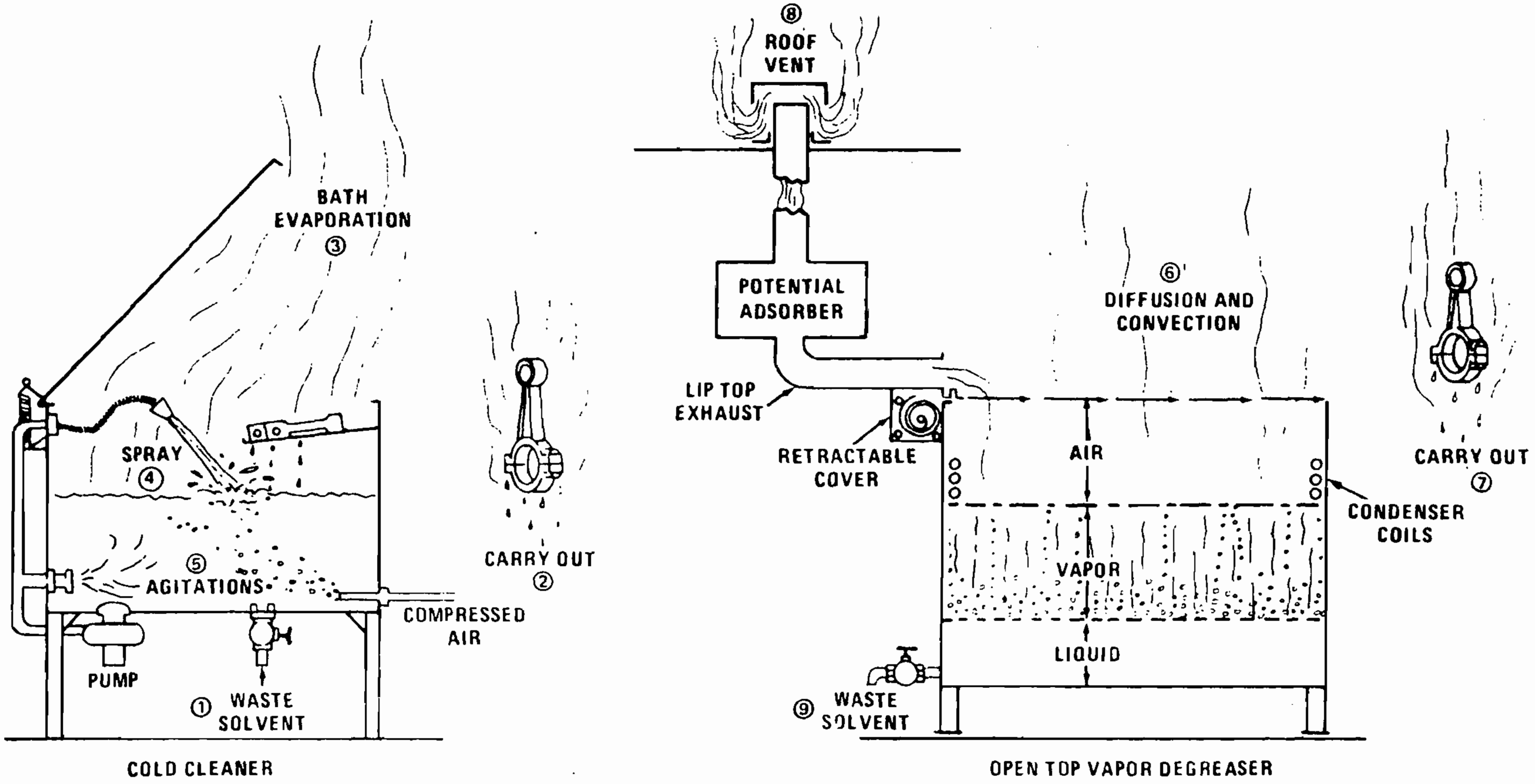


Figure 4.6-1. Degreaser emission points.

any other plant operations. In these cases, purchase records provide the necessary information, and an emission factor of 1,000 kg of volatile organic emissions per metric ton of solvent purchased can be applied (Table 4.6-1). This factor is based on the assumption that all solvent purchased is eventually emitted. When information on solvent consumption is not available, emission rates can be estimated if the number and type of degreasing units are known. The factors in Table 4.6-1 are based on the number of degreasers and emissions produced nationwide and may be considerably in error when applied to one particular unit.

The expected effectiveness of various control devices and procedures is listed in Table 4.6-2. As a first approximation, this efficiency can be applied without regard for the specific solvent being used. However, efficiencies are generally higher for more volatile solvents. These solvents also result in higher emission rates than those computed from the "average" factors listed in Table 4.6-1.

Table 4.6-1. SOLVENT LOSS EMISSION FACTORS FOR DEGREASING OPERATIONS
EMISSION FACTOR RATING: C

Type of degreasing	Activity measure	Uncontrolled organic emission factor[a]	
All[b]	Solvent consumed	2,000 lb/ton	1,000 kg/MT
Cold cleaner			
Entire unit[c]	Units in operation	0.33 tons/yr·unit	0.30 MT/yr·unit
Waste solvent loss		0.18 tons/yr·unit	0.165 MT/yr·unit
Solvent carryout		0.08 tons/yr·unit	0.075 MT/yr·unit
Bath and spray evaporation		0.07 tons/yr·unit	0.060 MT/yr·unit
Entire unit	Surface area and duty cycle[d]	0.08 lb/hr·ft²	0.4 kg/hr·m²
Open top vapor			
Entire unit	Units in operation	10.5 tons/yr·unit	9.5 MT/yr·unit
Entire unit	Surface area and duty cycle[e]	0.15 lb/hr·ft²	0.7 kg/hr·m²
Conveyorized, vapor			
Entire unit	Units in operation	26 tons/yr·unit	24 MT/yr·unit
Conveyorized, nonboiling			
Entire unit	Units in operation	52 tons/yr·unit	47 MT/yr·unit

[a] 100% nonmethane hydrocarbons or volatile organic compounds.

[b] Solvent consumption data will provide much more accurate emission estimates than any of the other factors presented.

[c] Emissions would generally be higher for manufacturing units and lower for maintenance units.

[d] For trichloroethane degreaser. From Reference 3, Appendix C-6.

[e] For trichloroethane degreaser. Does not include waste solvent losses.

Table 4.6-2. PROJECTED EMISSION REDUCTION FACTORS FOR SOLVENT DEGREASING[a]

System	Cold cleaner		Vapor degreaser		Conveyorized degreaser	
	A	B	C	D	E	F
Control devices						
Cover or enclosed design	X	X	X	X	X	X
Drainage facility	X	X	X			X
Water cover, refrigerated chiller, carbon adsorption or high freeboard[b]		X		X		X
Solid, fluid spray stream[c]						
Safety switches and thermostats				X		X
Emission reduction from control devices (%)	13-38	NA[e]	20-40	30-60		40-60
Operating procedures						
Proper use of equipment	X	X	X	X	X	X
Use of high volatility solvent		X				
Waste solvent reclamation	X	X	X	X	X	X
Reduced exhaust ventilation			X	X	X	X
Reduced conveyor or entry speed			X	X	X	X
Emission reduction from operating procedures (%)	15-45	NA[e]	15-35	20-40	20-30	20-30
Total emission reduction (percentage)	28-83[d]	55-69[f]	30-60	45-75	20-30	50-70

[a] Reference 2. Ranges of emission reduction present poor to excellent compliance. X indicates devices or procedures which will effect the given reductions.

[b] Only one of these major control devices would be used in any degreasing system. System B could employ any of them; system D could employ any except water cover; system F could employ any except water cover and high freeboard.

[c] If agitation by spraying is used, the spray should not be a shower type.

[d] A manual or mechanically assisted cover would contribute 6-18% reduction; draining parts 15 seconds within the degreaser, 7-20%; and storing waste solvent in containers, an additional 15-45%.

[e] Breakout between control equipment and operating procedures is not available.

[f] Percentages represent average compliance.

4.6.1.3 Conveyorized Degreasers – Conveyorized degreasers may operate with either cold or vaporized solvent, but they merit separate consideration because they are continuously loaded and are almost always hooded or enclosed. About 85 percent are vapor types, and 15 percent are nonboiling.

4.6.2 Emissions and Controls[1,2,3]

Emissions from cold cleaners occur through (1) waste solvent evaporation, (2) solvent carry-out (evaporation from wet parts), (3) solvent bath evaporation, (4) spray evaporation, and (5) agitation (Figure 4.6-1). Waste solvent loss, cold cleaning's greatest emission source, can be minimized through distillation and sending waste solvent to special incineration plants. Draining cleaned parts for at least 15 seconds reduces carry-out emissions. Bath evaporation can be controlled by regularly using a cover, allowing an adequate freeboard height and avoiding excessive drafts in the workshop. If the solvent used is insoluble in, and heavier than, water, a layer of water about two to four inches thick covering the halogenated solvent can also reduce bath evaporation. This is known as a "water cover". Spraying at low pressure helps to reduce solvent loss from this part of the process. Agitation emissions can be controlled by using a cover, agitating no longer than necessary, and avoiding the use of agitation with low volatility solvents. Emissions of low volatility solvents increase significantly with agitation. However, contrary to what one might expect, agitation causes only a small increase in emissions of high volatility solvents. Solvent type, particularly its volatility at the operating temperature, is the variable which most affects cold cleaner emission rates.

As with cold cleaning, open top vapor degreasing emissions relate heavily to proper operating methods. Most emissions are due to (6) diffusion and convection, which can be minimized by using an automated cover, regularly using a manual cover, spraying below the vapor level, optimizing work loads, or using a refrigerated freeboard chiller (for which a carbon adsorption unit would be substituted on larger units). Safety switches and thermostats that prevent emissions during malfunctions and abnormal operation also reduce diffusion and convection from the vaporized solvent. Additional sources are (7) solvent carry-out, (8) exhaust systems and (9) waste solvent evaporation (Figure 4.6-1). Carry-out is directly affected by the size and shape of the workload, racking of parts, and cleaning and drying time. Exhaust emissions can be nearly eliminated by a carbon adsorber that collects the solvent vapors for reuse. Waste solvent evaporation is not so much a problem with vapor degreasers as it is with cold cleaners, because the halogenated solvents used are often distilled and recycled by solvent recovery systems.

Because of their large workload capacity and the fact that they are usually enclosed, conveyorized degreasers emit less solvent per part cleaned than either of the other two types of degreaser. Compared to operating practices, design and adjustment are major factors affecting emissions, the main source of which is carry-out of vapor and liquid solvents.

References for Section 4.6

1. P.J. Marn, *et al.*, *Source Assessment: Solvent Evaporation - Degreasing*, EPA Contract No. 68-02-1874, Monsanto Research Corporation, Dayton, OH, January 1977.

2. Jeffrey Shumaker, *Control of Volatile Organic Emissions from Solvent Metal Cleaning*, EPA-450/2-77-022, U.S. Environmental Protection Agency, Research Triangle Park, NC, November 1977.

3. K.S. Suprenant and D.W. Richards, *Study To Support New Source Performance Standards for Solvent Metal Cleaning Operations*, EPA Contract No. 68-02-1329, Dow Chemical Company, Midland, MI, June 1976.

silor optical
of Florida inc.

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February 14, 1985

DER
FEB 25 1985
BAQM

Ms. Lillian Jack
Review Engineer
Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32301-8241

Dear Ms. Jack:

Re: Silor Optical of Florida, Inc. Conveyorized Lens Washer, application to construct, additional information, AC 52-097471

This letter is written in response to your request for additional information on our request for a permit to construct a new Conveyorized Lens Washer. An attempt to answer each question will be made in the following paragraphs.

Question 1. The most important reason for changing to an alternative system is to comply with the permit conditions requiring the phase out of the present Trichloroethylene Lens Washer (as per renewal permit AO 52-90650 dated October 25, 1985.) Other factors include health, performance, and financial.

The solvent currently being used is trichloroethylene. Trichlorotrifluoroethane mentioned in Attachment A is used to dry plastic lenses in the last step of the new cleaning line.

The following references show the relative non-volatility of N-methyl-2-pyrollidone (NMP).

(1) Journal of Coatings Technology, Rocklin, A.L., Vol. 48, No. 622, November 1976, P. 51, Table 4, Relative Evaporation Rates of Glycol Ethers and Miscellaneous Solvents at 25^{o}C - N-methyl-2-pyrollidone 0.0361 when compared to n-butyl acetate. A copy of this reference is attached to this memo.

(2) N-methyl-2-pyrollidone, BASF Intermediates, BASF Aktiengesellschaft, D-6700 Ludwigshafen, West Germany, B 377 eE97 (7127) 283 (JWF). pg. 27, Evaporation rate (diethyl ether=1) = 360 (DIN 53170, no equivalent ASTM specification). A copy of this reference has already been sent as per a telephone conversation with Peter Hessling, Environmental Engineer, Division of Air Quality, Pinellas County.

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO

ACTION DUE DATE

1. TO: (NAME, OFFICE, LOCATION)	
Otter 2/26	Initial Date
2. ~~Bill~~	Initial Date
3.	Initial Date
4.	Initial Date

REMARKS:

Incompleteness response
Dist. & Local offices
have copies (& Lillian)
Please return for
file

INFORMATION

☐ Review & Return
☐ Review & File
☐ Initial & Forward
☐

DISPOSITION

☐ Review & Respond
☐ Prepare Response
☐ For My Signature
☐ For Your Signature
☐ Let's Discuss
☐ Set Up Meeting
☐ Investigate & Report
☐ Initial & Forward
☐ Distribute
☐ Concurrence
☐ For Processing
☐ Initial & Return

FROM:
Patty

DATE

PHONE

Question 2. This conveyorized lens washer system will eventually replace the present trichloroethylene VOC source. The following table reveals the timing of the phase out of the present system. (Table 1)

There are no significant fugitive emissions from our present trichloroethylene washer. Solvent losses are automatically replaced with an automatic dispensing system using drums. Spent trichloroethylene is pumped into waste drum and treated as hazardous waste.

No data is available to calculate percentage of TLV concentrations. Modeling could be used to determine the actual percentage of TLV; however, the elimination of the trichloroethylene lens washer via replacement is the preferred step.

Question 3. There is no real process rate in this cleaning operation. The data necessary to calculate the estimated solvent loss is given in Addendum of original application. For example, the total solvent dragout is estimated to be about 1.05g/lens or 7.1 lbs/hr and the estimated hourly emission rate is 1.34 lbs/hr. Therefore, the total solvent loss is estimated to be 8.44 lbs/hr. When N-methyl-pyrollidone tanks become contaminated, solvent in tanks 1 and/or 2 will be changed. Total solvent use should be around 2 drums/day.

Question 4. Details of the test procedure and method used by Allied Chemical Corporation for obtaining the evaporation rate of trichlorotrifluoroethane from an ultrasonic cleaner are not available. This estimate was given to Crest Ultrasonic for estimating solvent evaporation rates in ultrasonic cleaners. The Allied Chemical value of 0.135 lb/ft^2/hr for trichlorotrifluoroethane is slightly less than the value calculated from AP-42. (Solvent Degreasing, 7-79, pg. 4.6-3, Table 4.6-1. Cold cleaner, entire unit surface area and duty cycle-data from: K.S. Suprenant and D.W. Richards, study to support New Source Metal Cleaning Operations, EPA Contract No. 68-02-1329, Dow Chemical Company, Midland, MI, June 1976.) For example, if one uses the relative evaporation rates from the "Solvent Properties Comparison Chart" (Dupont Bulletin No. FS-6, E.J. Dupont D. Nemours and Company, Wilmington, Delaware/1978), one obtains an evaporation rate of 0.16 lbs/ft^2/hr for trichlorotrifluoroethane (Freon TF).

$$\text{Evaporation rate for trichlorotrifluoroethane} = \frac{\text{Evaporation rate of Freon } (0.08\ \text{lbs/ft}^2/\text{hr})}{\text{Evaporation rate of trichloroethane}}$$

$$= \frac{(280^*)}{(139^*)}\ (0.08\ \text{lbs./ft}^2/\text{hr})$$

*Carbon tetrachloride = 100, value for trichlorotrifluoroethane from ASTM D 1901-67.

$$= 0.16\ \text{lbs/ft}^2/\text{hr}$$

TABLE 1

Lens Washer Operation Projections

Present Trichloroethylane Washer					Alternate NMP Washer	
	Number Washers	Usage	Permitted hourly emissions	Permitted yearly emissions	Number Washers	Usage
10/25/85- 10/25/86	2	16hr/day 5 day/wk 50 wk/yr	58 lb/hr each or 116 lb/hr total	232 ton/yr	1	16 hr/day 5 day/wk 50 wk/yr
10/25/86- 10/25/87	1	16 hr/day 5 day/wk 50 wk/yr	58 lb/hr each or 58 lb/hr total	116 ton/yr	1 or 2	16 hr/day 5 day/wk 50 wk/yr
10/25/87- 10/25/88	1	8 hr/day 5 day/wk 50 wk/yr	58 lb/hr each or 58 lb/hr total	58 ton/yr	2	16 hr/day 5 day/wk 50 wk/yr
10/25/88-	1	Back up only	58 lb/hr each or 58 lb/hr total	NA		

If one compares the following evaporation rates, the relative evaporation rate of trichlorotrifluoroethane (Freon TF) to N-methyl pyrollidone could be as high as 228. From the Dupont bulletin:

evaporation rate of Freon TF = 280
evaporation rate of N-butyl acetate = 34
evaporation rate of carbontetrachloride = 100

relative evaporation rate of N-methyl pyrollidone to N-butyl acetate = 0.0361 (from previous reference in Question 1.)

$$\frac{\text{evaporation rate Freon TF}}{\text{evaporation rate N-methyl-Pyrollidone}} =$$

$$\frac{\text{evaporation rate Freon TF}}{(\text{evaporation rate N-butyl acetate})\dfrac{(\text{evaporation rate N-methyl pyrollidone})}{(\text{evaporation rate N-butyl acetate})}}$$

$$= \frac{280}{(34)\ (0.036)} = 228$$

Since calculations in Addendum to original application used a factor of 29 based on the assumption that the evaporation rates of trichlorotrifluoroethane and N-butyl acetate are comparable, factors used in emission calculations are necessary to estimate maximum emission under manufacturing conditions.

An additional factor of four is necessary to take into consideration unusual air and liquid turbulence, possible error in Allied Chemical estimates, and higher operating temperature (86°F compared with 70°F).

Another factor of five is necessary to cover uncertainties in actual system and problems with emission measurements because of the expected small emission losses. This factor may not be necessary except for compliance purposes.

Question 5. This permit application is intended to cover a manually loaded but otherwise completely automatic six-tank conveyorized ultrasonic cleaning line (see N-methyl pyrollidone lens cleaning process sketch). N-methyl pyrollidone and other solvents will be pumped into tanks from drums. N-methyl pyrollidone in tanks 1 and 2 is continuously recycled through a pump and filtration system. Dirty lenses in stainless lens racks will be raised and lowered automatically into all six tanks. The last tank is a dryer to remove water from the clean lenses. Ventilation over solvent tanks will be only that necessary for health and odor control, if required.

Otherwise the cleaning line will be sealed except for entry and exit sections. Vapor emissions are due to ventilation and system dynamics. Liquid wastes are generated in tanks 1 and 2 whenever they become sufficiently contaminated to prevent proper cleaning of lenses. They will be pumped directly into drums. Although N-methyl-2-pyrollidone is biodegradable, the wastes from these tanks will be recycled or properly disposed of. N-Methyl pyrollidone which is carried over into water rinse tanks 3, 4 and 5 will be drained into the sewer. This system has no finished product.

<u>Question 6.</u> This alternate lens cleaning system will have no effect on auxiliary operations. This facility manufactures optical plastic lenses from allyl diglycol carbonate catalyzed with a small amount of diisopropyl peroxydicarbonate. Catalyzed monomer is placed into small assemblies and thermally cured overnight (without the evolution of gases). Assemblies are removed, opened, and solid plastic lenses are removed for inspection and shipment. Volatile organic compounds, including acetone, methyl alcohol, isopropanol are used in plant-wide cleaning operations occuring at individual work stations or cleaning areas.

<u>Question 7.</u> Standard good design practices to reduce emission will be employed on new system. The permitted VOC emission of trichloroethylene (as per permit number AO52-55878 and renewal permit AO52-90650 dated October 25, 1984) is 464,000 lbs or 232 tons (116 lbs/hour-16 hours/day-5 days/week-50weeks/year). The actual emission of trichloroethylene for 1984 was 441,540 lbs or 220.77 tons (from annual report on VOC sources for 1984). Trichloroethylene is the major air pollutant at this facility. Other VOC compounds at our facility include acetone (vapor pressure at 20°C=186mm Hg), methyl alcohol (vapor pressure at 21°C=100mm Hg), isopropyl alcohol (vapor pressure at 20°C=33mm Hg).

<u>Question 8.</u> The following is the 1984 inventory of all VOC's at this facility obtained by material balance of chemicals used and hazardous waste generated.

<u>Estimated Emissions</u>

	Tons/yr	Emission Points
Trichloroethylene	220.77	ventilation duct
Acetone	17.28	fugitive
Methyl alcohol	0.525	fugitive
Isopropyl alcohol	2.45	fugitive

The location of the emission point for trichloroethylene is shown in the figure in the original application. The emission points for the other solvents are air conditioning ventilation ducts in all manufacturing areas.

Question 9. The stack height stated in previous renewal permit A052-090650 was relative to the roof which is 20 feet high.

Question 10. We still consider the use of N-methyl pyrollidone for cleaning plastic parts, especially plastic lenses, to be confidential information. The application has been modified by removing references to N-methyl-2-pyrollidone. In this regard, the attached applications have been changed by substituting the phrase "cleaning chemical" for the word N-methyl-2-pyrollidone.

If you have any additional questions, please feel free to contact me.

Very truly yours,

SIDNEY S. WHITE
Lead Engineer

From AP-42

4.6 SOLVENT DEGREASING

Audrey McBath

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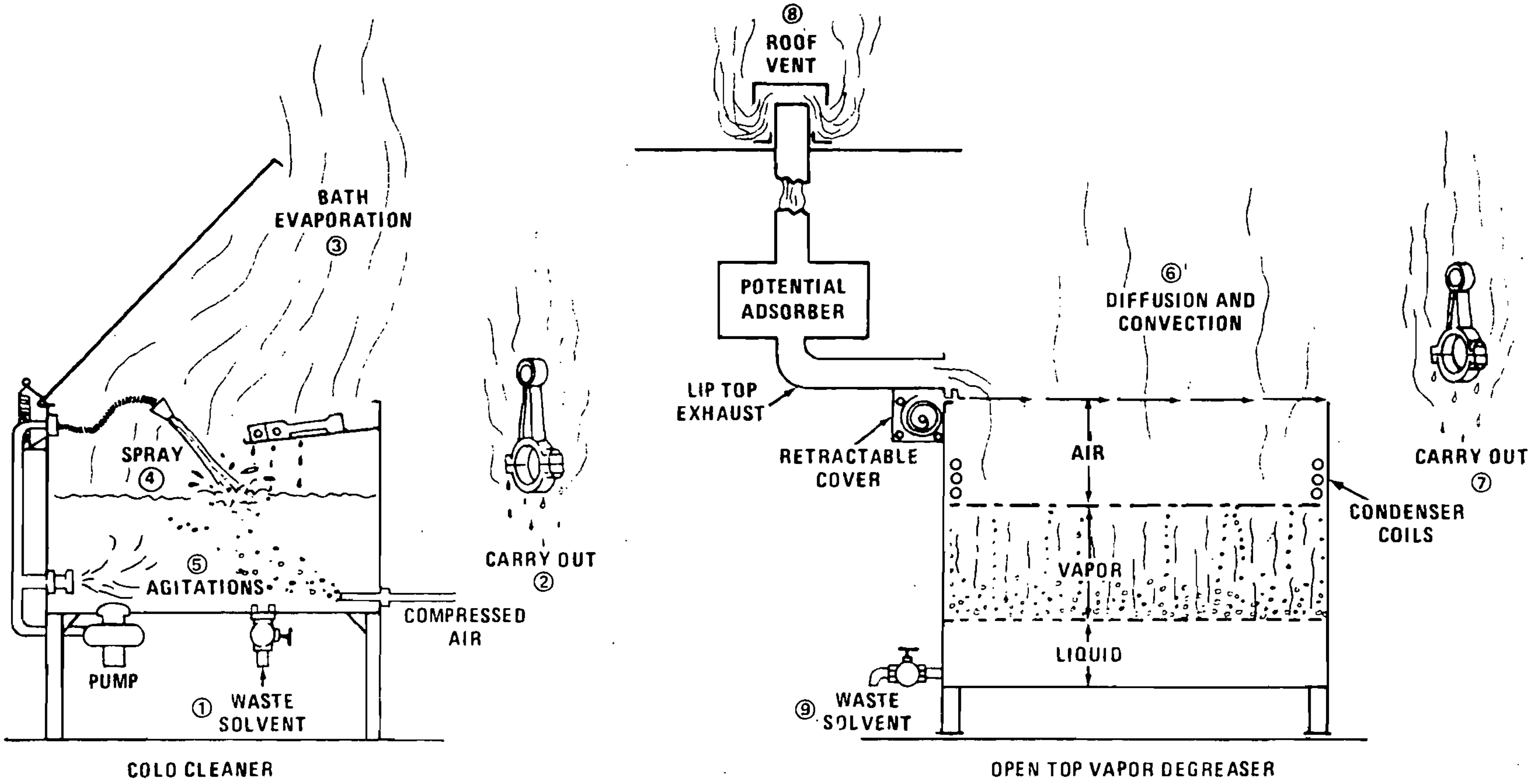

Figure 4.6-1. Degreaser emission points.

any other plant operations. In these cases, purchase records provide the necessary information, and an emission factor of 1,000 kg of volatile organic emissions per metric ton of solvent purchased can be applied (Table 4.6-1). This factor is based on the assumption that all solvent purchased is eventually emitted. When information on solvent consumption is not available, emission rates can be estimated if the number and type of degreasing units are known. The factors in Table 4.6-1 are based on the number of degreasers and emissions produced nationwide and may be considerably in error when applied to one particular unit.

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Solvent carryout		0.08 tons/yr·unit	0.075 MT/yr·unit
Bath and spray evaporation		0.07 tons/yr·unit	0.060 MT/yr·unit
Entire unit	Surface area and duty cycle[d]	0.08 lb/hr·ft^2	0.4 kg/hr·m^2
Open top vapor			
Entire unit	Units in operation	10.5 tons/yr·unit	9.5 MT/yr·unit
Entire unit	Surface area and duty cycle[e]	0.15 lb/hr·ft^2	0.7 kg/hr·m^2
Conveyorized, vapor			
Entire unit	Units in operation	26 tons/yr·unit	24 MT/yr·unit
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[a] 100% nonmethane hydrocarbons or volatile organic compounds.

[b] Solvent consumption data will provide much more accurate emission estimates than any of the other factors presented.

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[e] For trichloroethane degreaser. Does not include waste solvent losses.

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	Cold cleaner		Vapor degreaser		Conveyorized degreaser	
System	A	B	C	D	E	F
Control devices						
Cover or enclosed design	X	X	X	X	X	X
Drainage facility	X	X	X			X
Water cover, refrigerated chiller, carbon adsorption or high freeboard[b]		X		X		X
Solid, fluid spray stream[c]						
Safety switches and thermostats				X		X
Emission reduction from control devices (%)	13-38	NA[e]	20-40	30-60		40-60
Operating procedures						
Proper use of equipment	X	X	X	X	X	X
Use of high volatility solvent		X				
Waste solvent reclamation	X	X	X	X	X	X
Reduced exhaust ventilation			X	X	X	X
Reduced conveyor or entry speed			X	X	X	X
Emission reduction from operating procedures (%)	15-45	NA[e]	15-35	20-40	20-30	20-30
Total emission reduction (percentage)	28-83[d]	55-69[f]	30-60	45-75	20-30	50-70

[a] Reference 2. Ranges of emission reduction present poor to excellent compliance. X indicates devices or procedures which will effect the given reductions.

[b] Only one of these major control devices would be used in any degreasing system. System B could employ any of them; system D could employ any except water cover; system F could employ any except water cover and high freeboard.

[c] If agitation by spraying is used, the spray should not be a shower type.

[d] A manual or mechanically assisted cover would contribute 6-18% reduction; draining parts 15 seconds within the degreaser, 7-20%; and storing waste solvent in containers, an additional 15-45%.

[e] Breakout between control equipment and operating procedures is not available.

[f] Percentages represent average compliance.

4.6.1.3 Conveyorized Degreasers – Conveyorized degreasers may operate with either cold or vaporized solvent, but they merit separate consideration because they are continuously loaded and are almost always hooded or enclosed. About 85 percent are vapor types, and 15 percent are nonboiling.

4.6.2 Emissions and Controls[1,2,3]

Emissions from cold cleaners occur through (1) waste solvent evaporation, (2) solvent carry-out (evaporation from wet parts), (3) solvent bath evaporation, (4) spray evaporation, and (5) agitation (Figure 4.6-1). Waste solvent loss, cold cleaning's greatest emission source, can be minimized through distillation and sending waste solvent to special incineration plants. Draining cleaned parts for at least 15 seconds reduces carry-out emissions. Bath evaporation can be controlled by regularly using a cover, allowing an adequate freeboard height and avoiding excessive drafts in the workshop. If the solvent used is insoluble in, and heavier than, water, a layer of water about two to four inches thick covering the halogenated solvent can also reduce bath evaporation. This is known as a "water cover". Spraying at low pressure helps to reduce solvent loss from this part of the process. Agitation emissions can be controlled by using a cover, agitating no longer than necessary, and avoiding the use of agitation with low volatility solvents. Emissions of low volatility solvents increase significantly with agitation. However, contrary to what one might expect, agitation causes only a small increase in emissions of high volatility solvents. Solvent type, particularly its volatility at the operating temperature, is the variable which most affects cold cleaner emission rates.

As with cold cleaning, open top vapor degreasing emissions relate heavily to proper operating methods. Most emissions are due to (6) diffusion and convection, which can be minimized by using an automated cover, regularly using a manual cover, spraying below the vapor level, optimizing work loads, or using a refrigerated freeboard chiller (for which a carbon adsorption unit would be substituted on larger units). Safety switches and thermostats that prevent emissions during malfunctions and abnormal operation also reduce diffusion and convection from the vaporized solvent. Additional sources are (7) solvent carry-out, (8) exhaust systems and (9) waste solvent evaporation (Figure 4.6-1). Carry-out is directly affected by the size and shape of the workload, racking of parts, and cleaning and drying time. Exhaust emissions can be nearly eliminated by a carbon adsorber that collects the solvent vapors for reuse. Waste solvent evaporation is not so much a problem with vapor degreasers as it is with cold cleaners, because the halogenated solvents used are often distilled and recycled by solvent recovery systems.

Because of their large workload capacity and the fact that they are usually enclosed, conveyorized degreasers emit less solvent per part cleaned than either of the other two types of degreaser. Compared to operating practices, design and adjustment are major factors affecting emissions, the main source of which is carry-out of vapor and liquid solvents.

References for Section 4.6

1. P.J. Marn, *et al.*, *Source Assessment: Solvent Evaporation - Degreasing*, EPA Contract No. 68-02-1874, Monsanto Research Corporation, Dayton, OH, January 1977.

2. Jeffrey Shumaker, *Control of Volatile Organic Emissions from Solvent Metal Cleaning*, EPA-450/2-77-022, U.S. Environmental Protection Agency, Research Triangle Park, NC, November 1977.

3. K.S. Suprenant and D.W. Richards, *Study To Support New Source Performance Standards for Solvent Metal Cleaning Operations*, EPA Contract No. 68-02-1329, Dow Chemical Company, Midland, MI, June 1976.

BOARD OF COUNTY COMMISSIONERS
PINELLAS COUNTY, FLORIDA
315 COURT STREET
CLEARWATER, FLORIDA 33516

January 22, 1985

DER
JAN 28 1985
BAQM

Ms. Lilian Jack
Florida Dept. of Environmental
Regulation - BAQM
2600 Blairstone Road
Tallahassee, FL 32301

Re: Silor Optical of Florida - AC52-097471

Dear Ms. Jack:

Enclosed for your reference is a copy of pertinent file material on Silors proposed project. Per our telecon on 1/18/85 the file contains the existing source permit as well as the background documents on the existing source and proposed system.

Please note that the key to the entire case is that the proposed new system will eventually phase-out the existing operation. This will effectively reduce the facility emissions by about 75%. Also, the firm has requested an expeditious review as they are tied into deadlines for contracts, ordering and primarily the time frames for emission reductions built into the existing sources permit conditions.

If you have any questions on this material or if I can be of further assistance please call me at Suncom 570-6522.

Sincerely,

Peter A. Hessling, Environmental Engineer
Division of Air Quality

PAH/wn
Enclosure

cc: DER - J. Estler

No. 0155804

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED—
NOT FOR INTERNATIONAL MAIL
(See Reverse)

SENT TO Edgar J. Vallar		
STREET AND NO. 4900 Park St North		
P.O., STATE AND ZIP CODE St. Petersburg, FL 33709		
POSTAGE		$
CONSULT POSTMASTER FOR FEES	CERTIFIED FEE	¢
OPTIONAL SERVICES	SPECIAL DELIVERY	¢
	RESTRICTED DELIVERY	¢
RETURN RECEIPT SERVICE	SHOW TO WHOM AND DATE DELIVERED	¢
	SHOW TO WHOM, DATE, AND ADDRESS OF DELIVERY	¢
	SHOW TO WHOM AND DATE DELIVERED WITH RESTRICTED DELIVERY	¢
	SHOW TO WHOM, DATE AND ADDRESS OF DELIVERY WITH RESTRICTED DELIVERY	¢
TOTAL POSTAGE AND FEES		$
POSTMARK OR DATE		

PS Form 3800, Apr. 1976

PS Form 3811, July 1983

DOMESTIC RETURN RECEIPT

SENDER: Complete items 1, 2, 3 and 4.

Put your address in the "RETURN TO" space on the reverse side. Failure to do this will prevent this card from being returned to you. The return receipt fee will provide you the name of the person delivered to and the date of delivery. For additional fees the following services are available. Consult postmaster for fees and check box(es) for service(s) requested.

1. ☒ Show to whom, date and address of delivery.
2. ☐ Restricted Delivery.

3. Article Addressed to:
Edgar J. Vallar
SILOR OPTICAL of FLORIDA, Inc.
4900 Park Street North
St. Petersburg, FL 33709

4. Type of Service:
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail

Article Number
0155804

Always obtain signature of addressee or agent and DATE DELIVERED.

5. Signature – Addressee
X K. Mason

6. Signature – Agent
X

7. Date of Delivery
1-22-8

ST. PETERSBURG USPO JAN 22

8. Addressee's Address *(ONLY if requested and fee paid)*

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301-8241

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

January 18, 1985

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Edgar J. Vallar
Manager - Engineering & Development
Silor Optical of Florida, Inc.
4900 Park Street North
St. Petersburg, Florida 33709

Dear Mr. Vallar:

RE: Silor Optical of Florida, Inc., Conveyorized Lens Washer, Application to Construct; Request for additional information, AC 52-097471.

The department has initially reviewed your application for construction and has determined that additional information is needed to complete this review. Please respond to the following questions and comments as soon as possible so that our review may be completed.

1. What is the reason for changing to the alternative system from the present VOC system used? Is the solvent currently used trichloroethylene (Section II.A) or trichlorotrifluoroethane as referred to in Attachment A? Include data to show the relative non-volatility of N-Methyl-2-Pyrolloidone (NMP).

Rinse ge! final dry
5 tns/yr.

2. Section II.D of the application indicates an eventual replacement of the current VOC source. Provide additional information for the conveyorized lens washer operation projections. Will you operate a double line or phase out to a single line of the lens washing system? List dates for phasing out the current VOC source and starting up the proposed alternative system. Will the equipment continue to operate 16 hrs/day, 5 days/week?

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO.

ACTION DUE DATE

1. TO: (NAME, OFFICE, LOCATION) Lillian — INITIAL — DATE

2. — INITIAL — DATE

3. Telephone call from Pete Hessling — INITIAL — DATE

4. 2/13/85, 10 AM — INITIAL — DATE

REMARKS:

Pete Hessling
Pinellas County Division of Air Quality
16100 Fairchild Dr
Bldg. V102
Clearwater, Fla 33520
SC/570-6522

wants to talk about
Silor Optical permit

[illegible] 0045-225

INFORMATION
☐ REVIEW & RETURN
☐ REVIEW & FILE
☐ INITIAL & FORWARD
☐

DISPOSITION
☐ REVIEW & RESPOND
☐ PREPARE RESPONSE
☐ FOR MY SIGNATURE
☐ FOR YOUR SIGNATURE
☐ LET'S DISCUSS
☐ SET UP MEETING
☐ INVESTIGATE & REPT
☐ INITIAL & FORWARD
☐ DISTRIBUTE
☐ CONCURRENCE
☐ FOR PROCESSING
☐ INITIAL & RETURN

FROM: Ed Rae

DATE 1/17/85

PHONE

Provide projections for emissions at the facility corresponding to the phase out of the current lens washing operation. Provide fugitive emission data for the lens washing system. What percentage (%) of the threshold limit value (TLV) is anticipated at the plant boundaries? What percentage of TLV currently exist? (No data available)

enclosed feed system

3. Section III.B of the application requires a process rate. For this particular process, provide solvent inventory data. annual operations based on inventory
4. Section III.C of the application requires basis of emission estimate. Provide data for the test procedure or method used by Allied Chemical Corporation for obtaining the evaporation rate of trichlorotrifluoroethane, and include data to show relative values for trichlorotrifluoroethane and NMP. Provide additional details for the factors used in the emission calculation. List assumptions and basis used to arrive at factor 4 and factor 5 (addendum). BASF Manual

   No data available for the test procedure
5. Provide a written process description indicating where/how the raw materials (i.e. solvent) enter, where waste materials exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained. Is the operation fully automated or is manual loading used?
6. What effect will the alternate system have upon auxiliary operations within the plant? None Provide information on current auxiliary operations (i.e. an overall process description) and the emissions values.
7. Section II.C of the application indicates that no pollution control devices are involved. What are the permitted and actual VOC emissions at the entire facility in tons/yr? What is the major air pollutant at your facility? Please indicate chemical composition and vapor pressure of the VOC compounds at your facility.

Plastic poly-carbonic
1000 employees

1983 - 19 tons/yr ((evaporative fugitive emissions))
material balance

ISP - 2 tons/yr
methanol .2 tons/yr

8. Please submit an updated inventory of all air pollutant sources (each emission point) at your facility.
9. Section III.H of the application indicates a variation in stack height from previous permit AC 52-090650. Please clarify. 2' ft. down stack height
10. Please send an application to construct that includes the professional engineer seal (p. 2 of 12) for our files. Since the application to construct must be a part of the public notice, please separate all information that you consider confidential and indicate this in the application.

A request has been made to Mr. Peter Hessling, Pinellas County Division of Air Quality, for copies of the previous permit, AC 52-090650 and the reference memo dated October 8, 1984. Please check with Mr. Hessling in forwarding the additional information requested to this department.

If you have any questions, please call Ms. Lillian Jack, Review Engineer, at (904)488-1344, or write to me at the above address.

Sincerely,

C.H. Fancy, P.E.
Deputy Bureau Chief
Bureau of Air Quality
Management

CHF/LJ/rw

cc: Bill Thomas, Tampa
Peter Hessling, Pinellas County
Reading File
Lillian Jack

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

January 4, 1985

D. E. R.
JAN 7 1985
SOUTH WEST DISTRICT
TAMPA

Mr. James Estler
Air Permitting Engineer
Department of Environmental Regulation
Southwest District
7601 Highway 301 North
Tampa, Florida 33610

Dear James:

Enclosed please find three additional signed copies of our application for a permit to construct a stationary source of VOC. One copy was sent to your office on December 20, 1984.

If you have any questions, please call.

Sincerely,

Sidney S. White, Jr.
Lead Engineer/Chemist

SSW/bd

Enc.

cc: Ed Vallar

DER
JAN 14 1985
BAQM

52-097992

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

D.E.R.
JAN 7 1985
SOUTH WEST DISTRICT
TAMPA

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Conveyorized Lens Washer [X] New[1] [ ] Existing[1]

APPLICATION TYPE: [X] Construction [ ] Operation [ ] Modification

COMPANY NAME: Silor Optical of Florida, Inc. COUNTY: Pinellas

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) __________

SOURCE LOCATION: Street 4900 Park Street North City St. Petersburg

UTM: East 17-327.5 KME North 3077.8 KMN

Latitude 27 ° 48 ' 54 "N Longitude 82 ° 45 ' 06 "W

APPLICANT NAME AND TITLE: Edgar J. Vallar, Manager-Engineering & Development

APPLICANT ADDRESS: 4900 Park Street No., St. Petersburg, Florida 33709

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Silor Optical of Fla. Inc.

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: __________

Hubert Dreckmann, VP & General Manager
Name and Title (Please Type)

Date: 1/2/85 Telephone No. (813) 541-5733

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

---

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed Edgar Vallar

Edgar J. Valla
Name (Please Type)

Silor Optical of Florida, Inc.
Company Name (Please Type)

4900 Park St. No., St. Petersburg, FL 33709
Mailing Address (Please Type)

Florida Registration No. 16156 Date: 1/2/85 Telephone No. (813) 541-5733

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Obtaining construction permit for cold temperature conveyorized lens washer to replace major VOC source involving trichloroethylene. Ultrasonic dip tanks with relatively non-volatile solvent replaces high ventilated solvent spray system.

(See Attachment A)

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction December 1984 Completion of Construction October 1985

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

No pollution control devices involved; however, present VOC source is being replaced with an expensive alternative system.

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

This conveyorized lens washer system will eventually replace VOC source with Permit Number AO52-55878 and renewal permit A052-90650 dated October 25, 1984

E. Requested permitted equipment operating time: hrs/day 16 ; days/wk 5 ; wks/yr 50 ;

if power plant, hrs/yr ____; if seasonal, describe: ____

Note: New syster will be phased in and present VOS source equipment will be phased out according to permit renewal A052-90650, dated October 25, 1984.

F. If this is a new source or major modification, answer the following questions. ([✓ Yes] or No)

1. Is this source in a non-attainment area for a particular pollutant? Yes

   a. If yes, has "offset" been applied? No

   b. If yes, has "Lowest Achievable Emission Rate" been applied? No

   c. If yes, list non-attainment pollutants. Ozone precusors (VOC's)

2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. No

3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. No

4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? No

5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? (non-RACT plastics being cleaned) No

   a. If yes, for what pollutants? ____

   b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
N-methyl -2-pyrollidone	VOC	100	See note below	See attached flow diagram

Note: Material is recycled through process with minimal loss of material

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): NA - see addendum

2. Product Weight (lbs/hr): NA - see addendum

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/yr	T/yr	
N-methyl-2-pyrollidone	1.74 [1]	3.49 [1]	NA RACT	NA	10440[1]	5.22[1]	See flow diagram

[1] See Section V, Item 2. [1] Estimated values based on assumptions and calculations given in addendum

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
NA - RACT Control Technology				

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
NA			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis:

Percent Sulfur: ________ Percent Ash: ________

Density: ________ lbs/gal Typical Percent Nitrogen: ________

Heat Capacity: ________ BTU/lb ________ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ________

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average NA Maximum ________

G. Indicate liquid or solid wastes generated and method of disposal.

N-methyl-2 -pyrollidone is biodegradeable; however, disposal will involve recycle or proper disposal.

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 22 feet above ground ft. Stack Diameter: 1 ft.

Gas Flow Rate: 600 ACFM ~~DSCFM~~ Gas Exit Temperature: ambient °F.

Water Vapor Content: ambient condition % Velocity: FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type 0 (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated	NA						
Uncontrolled (lbs/hr)							

Description of Waste

Total Weight Incinerated (lbs/hr) Design Capacity (lbs/hr)

Approximate Number of Hours of Operation per day day/wk wks/yr.

Manufacturer

Date Constructed Model No.

	Volume $(ft)^3$	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ft. Stack Diamter: Stack Temp.

Gas Flow Rate: ACFM DSCFM* Velocity: FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: ☐ Cyclone ☐ Wet Scrubber ☐ Afterburner

☐ Other (specify)

Brief description of operating characteristics of control devices: ______________________

____

____

____

____

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

____

____

____

____

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).

6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

[ ] Yes [ ] No

Contaminant	Rate or Concentration
NA	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

[ ] Yes [ ] No

Contaminant	Rate or Concentration

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration

D. Describe the existing control and treatment technology (if any).

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life:
6. Operating Costs:

7. Energy:
8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft.
b. Diameter: ft.

c. Flow Rate: ACFM
d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1.

a. Control Device:
b. Operating Principles:

c. Efficiency:[1]
d. Capital Cost:

e. Useful Life:
f. Operating Cost:

g. Energy:[2]
h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:
b. Operating Principles:

c. Efficiency:[1]
d. Capital Cost:

e. Useful Life:
f. Operating Cost:

g. Energy:[2]
h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

---

[1] Explain method of determining efficiency.

[2] Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device:	b. Operating Principles:
c. Efficiency:[1]	d. Capital Cost:
e. Useful Life:	f. Operating Cost:
g. Energy:[2]	h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device:	b. Operating Principles:
c. Efficiency:[1]	d. Capital Costs:
e. Useful Life:	f. Operating Cost:
g. Energy:[2]	h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

1. Control Device:	2. Efficiency:[1]
3. Capital Cost:	4. Useful Life:
5. Operating Cost:	6. Energy:[2]
7. Maintenance Cost:	8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

---

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

[1] Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. NA no. sites ________ TSP ________ ( ) SO^2* ________ Wind spd/dir

Period of Monitoring ____/____/____ to ____/____/____
month day year month day year

Other data recorded ________

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? ☐ Yes ☐ No

b. Was instrumentation calibrated in accordance with Department procedures?

☐ Yes ☐ No ☐ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. _____ Year(s) of data from ____/____/____ to ____/____/____
month day year month day year

2. Surface data obtained from (location)______________________________

3. Upper air (mixing height) data obtained from (location)______________________________

4. Stability wind rose (STAR) data obtained from (location)______________________________

C. Computer Models Used

1. ______________________________ Modified? If yes, attach description.

2. ______________________________ Modified? If yes, attach description.

3. ______________________________ Modified? If yes, attach description.

4. ______________________________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate	
TSP	______________________________	grams/sec
SO^2	______________________________	grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

ATTACHMENT A

DESCRIPTION OF N-METHYL-2-PYROLLIDONE LENS WASHER

Dirty lenses are moved automatically through a six tank conveyorized ultrasonic cleaning line with the following tanks.

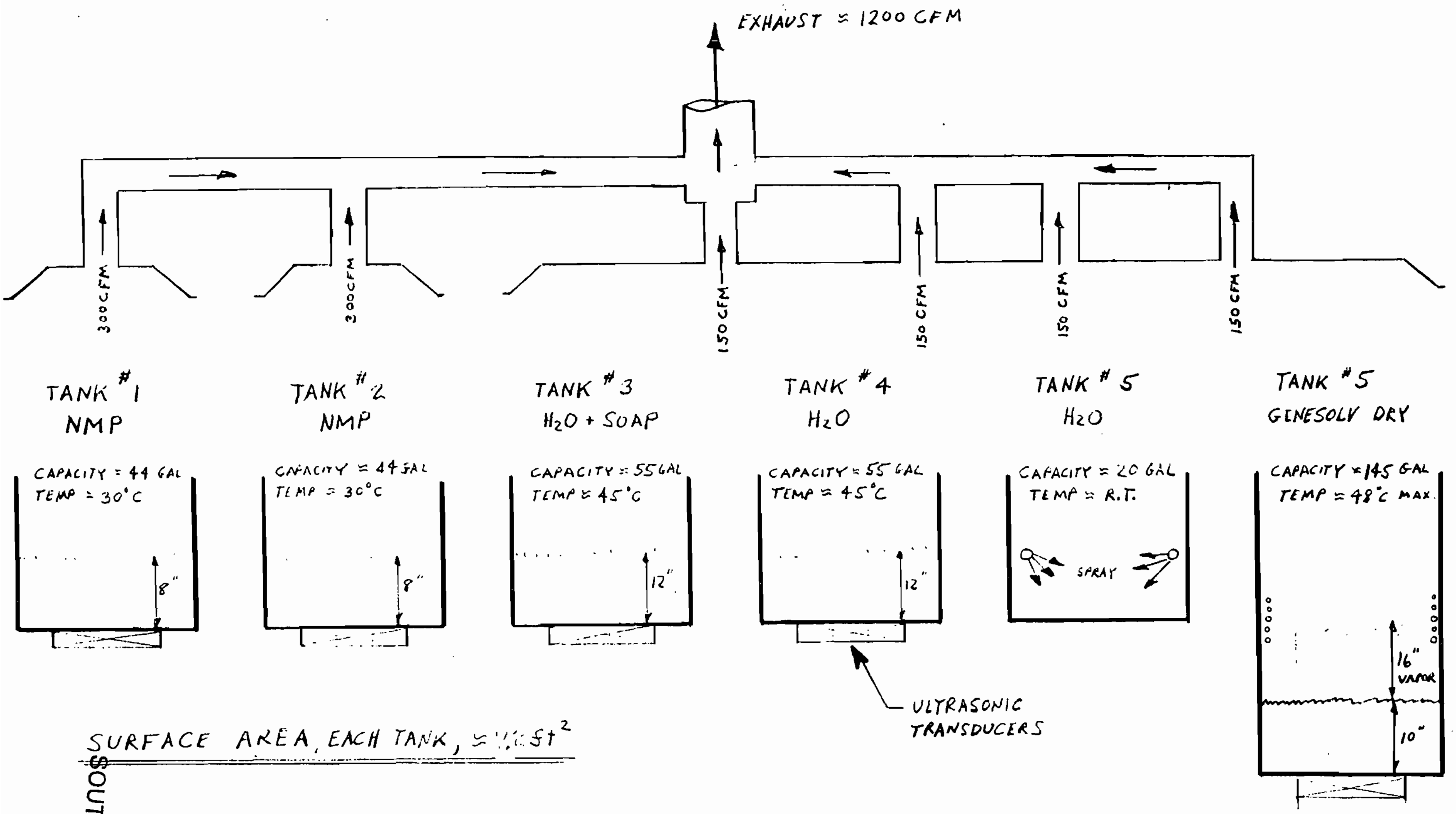
Tank	Contents	Ultrasonics
1	N-methyl-2-pyrollidone	Yes
2	N-methyl-2-pyrollidone	Yes
3	Water and soap	Yes
4	Water	Yes
5	Water	No
6	Gensolve dryer *	No

N-methyl-2-pyrollidone in Tanks 1 and 2 is continuously recycled through a pump and filtration system. Ventilation is necessary only to remove a small amount of odor.

Liquid wastes are generated from Tanks 1 and 2 whenever they become sufficiently contaiminated to prevent proper cleaning of lens. Although N-methyl-2-pyrollidone is biodegradable, the wastes from these tanks will be recycled or properly disposed of.

---

* Trichlorotrifluoroethane dryer

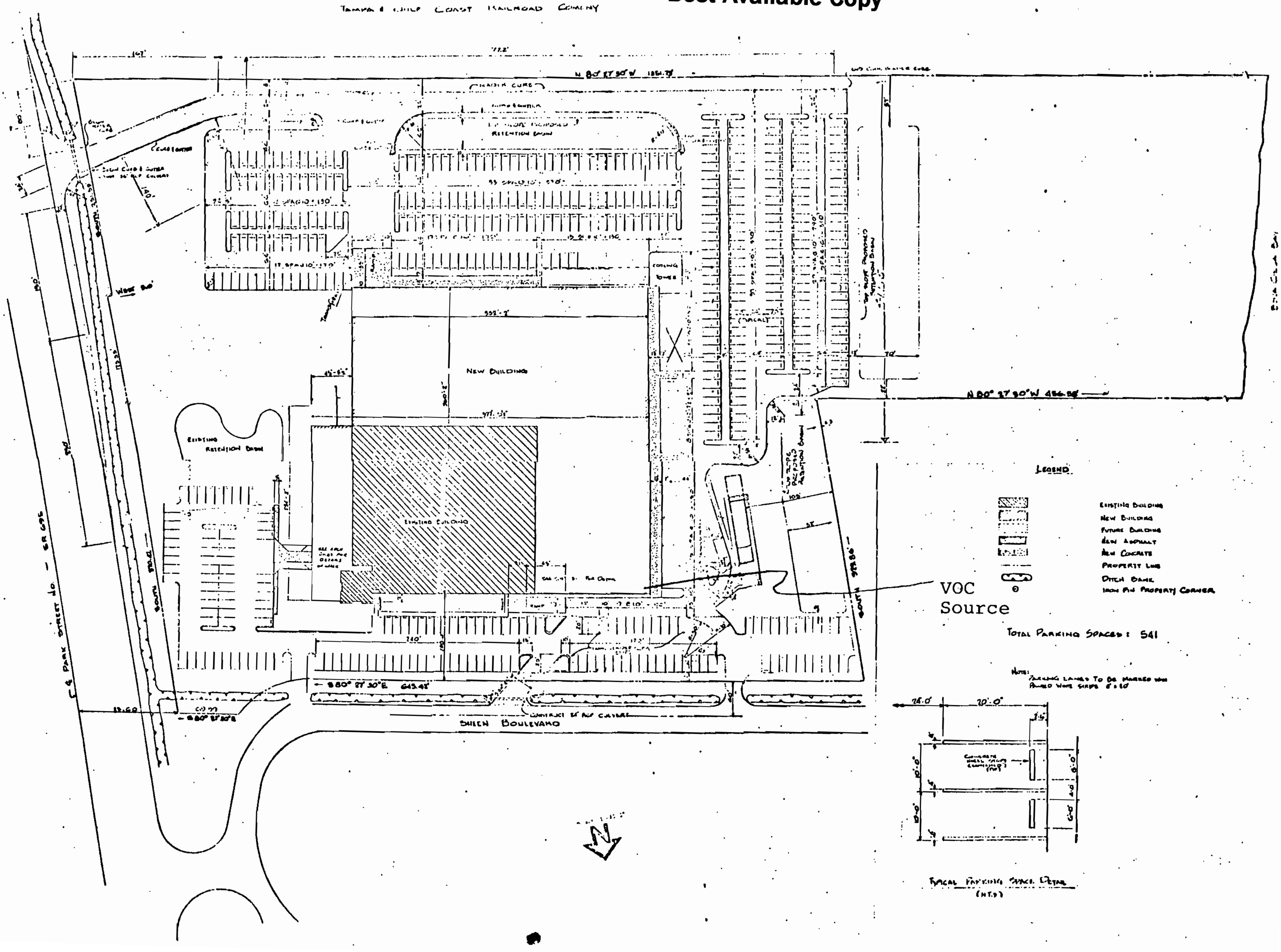


SURFACE AREA, EACH TANK, ≈ [illegible] ft^2

SCALE ——	DATE 12-10-84	TITLE 1-METHYL-2-PYROLLIDONE LENS CLEANING PROCESS (TENTATIVE)	REV / DESCRIPTION / DATE
TOLERANCES UNLESS OTHERWISE SPECIFIED	DRAWN BY P.J.S.		**silor optical** of florida, Inc. St. Petersburg, Florida 33709
METRIC —— / DECIMAL —— / ANGULAR ——	APPROVED		DRAWING NO. SKETCH / REV


SEMINOLE
Seminole
GARDENS
INOLE
BARDMOOR
BARDMOOR GOLF & COUNTRY CLUB
SEMINOLE PARK
PINELLAS PARK
METROPOLITAN GENERAL HOSPITAL
74TH AV. N.
PARK
STARKEY RD
66TH ST. N.
COAST LINE R.R.
AMTRACK
Joe's Creek
SEMINOLE LAKE GOLF & COUNTRY CLUB
Long Bayou
AIR STRIP
Cross Bayou
NORTHSIDE CHRISTIAN SCHOOL
62ND AV
FIVE TOWNS
BAY PINES
SEABOARD
SILOR OPTICAL
PARK ST.
46TH AV. N.
KENNETH CITY
DIXIE HOLLINS HIGH SCHOOL
BAY PINES BLVD.
SEMINOLE BRIDGE
BAY PINES VETERANS ADMINISTRATION HOSPITAL
WAR VETERANS' MEMORIAL PARK
ABERCROMBIE PARK
38TH AV
ST. PETERSBURG GENERAL HOSPITAL
ALT 19
TYRONE
NORTHWEST
HOLIDAY PARK
SHERYL MANOR
Jungle Lake
A19A
22ND
TYRONE SQUARE MALL
PINELLAS COUNTY EXCE CENTER
CROSSROADS
TYRONE
AZALEA
NORTHWEST YOUTH CENTER
JUNGLE
POST OFFICE
ST PETERSBURG CATHOLIC HIGH SCH
9TH
BLVD
Boca Ciega
Crystal Island
Johns Pass
CAPRI ISLE
Isle of Capri
Bay
5TH AV. N.
ISLE OF PALMS
CAUSEWAY ISLES
TREASURE ISLAND CAUSEWAY
CENTRAL
ST PETERSBURG MUNICIPAL BEACH
GULF
TREASURE
1ST AV.
BEAR CREEK

Best Available Copy


VOC Source

ADDENDUM
TO
STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO CONSTRUCT AIR POLLUTION SOURCES
SILOR OPTICAL OF FLORIDA, INC.
DECEMBER 12, 1984

ESTIMATED EMISSION CALCULATIONS FOR
N-METHYL-2-PYROLLIDONE LENS WASHER

Two obvious sources of emission from this system are emissions from open tanks and emissions from dragout or carryover (the material left on lenses after removal from liquid N-methyl-2-pyrollidone).

EMISSIONS OF N-METHYL-2-PYROLLIDONE FROM TANKS 1 AND 2

An estimate of the emissions of N-methyl-2-pyrollidone tanks can be obtained with a knowledge of the evaporation rate of a known compound (for example, trichlorotrifluoroethane) under relevant conditions and relative evaporation rates of this known compound and N-methyl-2-pyrollidone.

In a study of trichlorotrifluoroethane evaporation from a stagnate container with 6½" freeboard, Allied Chemical Corporation found an observed evaporation rate of 0.135 pounds per hour per square foot.

If one assumes a factor of 4 for air and liquid turbulence, an estimated emission of 0.54 pounds per hour per square foot is obtained for trichlorotrifluoroethane.

Calculate a relative evaporation rate of N-methyl-2-pyrollidone and trichlorotrifluoroethane using data in ASTM D1901-67 tables. A relative evaporation rate of 29 is obtained when trichlorotrifluoroethane is compared to N-methyl-2-pyrollidone.

Calculate the quantity of N-methyl-2-pyrollidone emitted from a tank by dividing the relative evaporation factor of 29 into the estimated emission rate of trichlorotrifluoroethane (0.54 pounds per hour per square foot).

Estimated emission rate for N-methyl-2-pyrollidone from a tank =

$$\frac{0.54 \text{ pounds/hour/square foot}}{29} \quad (5)^*$$

= 0.0931 pounds/hour/square foot or 0.093 pounds/hour/square foot

Calculate the estimated emission rate for N-methyl-2-pyrollidone for both tanks with 7.2 square foot survace area each.

Estimated hourly emission rate for two tanks N-methyl-2-pyrollidone =

(0.093 pounds/hour/square foot) (2) (7.2 square feet)

= 1.34 pounds/hour

Calculate the total quantity of N-methyl-2-pyrollidone emitted per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of N-methyl-2-pyrollidone emitted per year =

(1.34 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 5360 pounds/year.

EMISSIONS OF N-METHYL-2-PYROLLIDONE FROM DRAGOUT

Although total dragout has experimentally determined by Crest Ultrasonics Corporation to be about 1.05g per lens, only a very small amount of this dragout actually evaporates. Crest has determined that only about 0.012g or less is lost to evaporation even after 35 minutes in air. Since the transfer time is only about 1-2 minutes instead of 35 minutes, the value of 0.012g per lens should represent the maximum emission rate for dragout.

Calcualte the total quantity per hour of N-methyl-2-pyrollidone emitted from dragout by multiplying the estimated evaporation quantity per lens times the total number of lenses cleaned per hour.

Total quantity per hour of N-methyl-2-pyrollidone emitted from dragout =

(0.012g/lens) (3060 lenses/hour) (5)* = 183.6 per hour or 0.404 pounds/hour

Calculate the quantity of N-methyl-2-pyrollidone emitted from dragout per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of N-methyl-2-pyrollidone emitted from dragout per year =

(0.404 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 1616 pounds/year

ESTIMATED TOTAL EMISSIONS FOR N-METHYL-2-PYROLLIDONE LENS WASHER

The total emissions for the N-methyl-2-pyrollidone lens washer is obtained by adding the yearly emission from both tanks and from dragout.

Total yearly emissions for N-methyl-2-pyrollidone =

5360 pounds/year + 1616 pounds/year = 6976 pounds/year or 3.49 tons/year

SECTION III

AIR POLLUTION SOURCES & CONTROL DEVICES

C. Airborne Contaminants Emitted:

Emission
maximum (16 hours)

The maximum emission is obtained by dividing the total yearly emission for N-methyl-2-pyrollidone by the number of hours in working year.

$$\text{Maximum pounds/hour} = \frac{\text{6976 pounds/year}}{\text{(16 hours/day) (5 days/week) (50 weeks/year)}}$$

= 1,74 pounds/hour

$$\text{Actual tons/year} = \frac{6976 \text{ pounds/year}}{2000 \text{ pounds/ton}} = 3.49 \text{ tons/year}$$

POTENTIAL EMISSION
(For 24 hours/day operation)

The total potential yearly emissions for a 24 hour operation is obtained by multiplying the hourly emission rates of both tanks and from dragout times the number of working hours in a year.

Total potential yearly emission for 24 hours/day operation =

(1.34 pounds/hour + 0.404 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = (1.74 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = 10440 pounds/year or 5.22 tons/year.

* This factor is required to cover uncertainties in actual system and emission measurements.

silor optical
of Florida inc.

4900 PARK STREET NORTH
ST. PETERSBURG, FLORIDA 33709-2299
PHONE (813) 541-5733 - TWX 810-863-0380

December 20, 1984

D. E. R.
DEC 21 1984
SOUTH WEST DISTRICT
TAMPA

Mr. James Estler
Air Permitting Engineer
Department of Environmental Regulation
Southwest District
7601 Highway 301 North
Tampa, Florida 33610

Dear James:

This letter is written in response to the request from you organization for an application for a permit to construct a stationary source of VOC (Reference: Peter Hessling memo of October 8, 1984). The original application has been completed and attached to this letter for your consideration. Three additional signed copies will be sent to you on January 2, 1984.

We do request that you keep the use of N-methyl-2-pyrollidone to clean plastic parts, especially plastic lenses, confidential.

If you have any questions regarding this construction permit, please contact me at 541-5733.

Sincerely,

Sidney S. White, Jr.
Lead Engineer/Chemist

SSW/bd

Enc.
cc: Ed Vallar

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

INTEROFFICE MEMORANDUM

For Routing To District Offices
And/Or To Other Than The Addressee

To: ______________ Loctn.: ______________
To: ______________ Loctn.: ______________
To: ______________ Loctn.: ______________
From: ______________ Date: ______________
Reply Optional [ ] Reply Required [ ] Info. Only [ ]
Date Due: ________ Date Due: ________

TO: Clair Fancy

FROM: Bill Thomas

DATE: January 3, 1985

SUBJECT: Silor Optical of Florida
Construct Permit Application
AC52-097471

Attached is the above subject application. This is an addition to a major facility and should be processed by CAPS.

This application was received in the air section today. However, it was logged in almost two weeks ago.

DER
JAN 7 1985
BAQM

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO

ACTION DUE DATE

1. TO: (NAME, OFFICE, LOCATION) Bill	Initial Date
2.	Initial Date
3. 114 lbs, used (max. hourly input rate)	Initial Date
4. Trichlor	Initial Date

REMARKS:

New Application - Received in Tampa 10/21/84

$100 paid

30 days - 1/19/85

055878

AC052-090650

Issue 10/25/84

INFORMATION

☐ Review & Return

☐ Review & File

☐ Initial & Forward

☐

DISPOSITION

☐ Review & Respond

☐ Prepare Response

☐ For My Signature

☐ For Your Signature

☐ Let's Discuss

☐ Set Up Meeting

☐ Investigate & Report

☐ Initial & Forward

☐ Distribute

☐ Concurrence

☐ For Processing

☐ Initial & Return

FROM:

10/24/84

DATE

PHONE

TLV - threshold limit value?

```
                           APPLICATION TRACKING SYSTEM                            12/26/84
APPL NO:097471
 APPL RECVD:12/21/84  TYPE CODE:AC  SUBCODE:99                    LAST UPDATE:12/26/84
 DER OFFICE RECVD:TPA DER OFFICE TRANSFER TO:___  APPLICATION COMPLETE:__/__/__
 DER PROCESSOR:RICHARDSON
 APPL STATUS:AC DATE:12/21/84 (ACTIVE/DENIED/WITHDRAWN/EXEMPT/ISSUED/GENERAL)
                      RELIEF:__ (SSAC/EXEMPTIONS/VARIANCE)
 (Y/N) N MANUAL TRACKING                                   DISTRICT:40 COUNTY:52
 (Y/N) N DNR REVIEW REQD?                                  LAT/LONG:27.48.54/82.45.06
 (Y/N) N PUBLIC NOTICE REQD?                               BASIN-SEQMENT:__.___
 (Y/N) N GOV BODY LOCAL APPROVAL REQD?                     COE #:__________
 (Y/N) Y LETTER OF INTENT REQD? _ (I/ISSUE D/DENY)         ALT#:___-__________

 PROJECT SOURCE NAME:CONVEYORIZED LENS WASHER
              STREET:4900 PARK STREET N.                 CITY:ST. PETERSBURG
               STATE:FL      ZIP:33709       PHONE:813-541-5733
    APPLICATION NAME:SILOR OPTICAL OF FLORIDA, INC.
              STREET:4900 PARK STREET N.                 CITY:ST. PETERSBURG
               STATE:FL      ZIP:33709       PHONE:813-541-5733
          AGENT NAME:SAME
              STREET:______________________________ CITY:_________________
               STATE:__      ZIP:_____       PHONE:___-___-____
 FEE #1 DATE PAID:12/21/84    AMOUNT PAID:0100    RECEIPT NUMBER:00067959

B DATE APPLICANT INFORMED OF NEED FOR PUBLIC NOTICE - - - __/__/__
C DATE DER SENT DNR APPLICATION/SENT DNR INTENT - - - - - - __/__/__--__/__/__
D DATE DER REQ. COMMENTS FROM GOV. BODY FOR LOCAL APP. -.  __/__/__
E DATE #1 ADDITIONAL INFO REQ--REC FROM APPLICANT - - - - __/__/__--__/__/__
E DATE #2 ADDITIONAL INFO REQ--REC FROM APPLICANT - - - - __/__/__--__/__/__
E DATE #3 ADDITIONAL INFO REQ--REC FROM APPLICANT - - - - __/__/__--__/__/__
E DATE #4 ADDITIONAL INFO REQ--REC FROM APPLICANT - - - - __/__/__--__/__/__
E DATE #5 ADDITIONAL INFO REQ--REC FROM APPLICANT - - - - __/__/__--__/__/__
E DATE #6 ADDITIONAL INFO REQ--REC FROM APPLICANT - - - - __/__/__--__/__/__
F DATE GOVERNING BODY REQUESTED SURVEY RESULTS/REPORTS - - __/__/__
G DATE FIELD REPORT WAS REQ--REC - - - - - - - - - - - - - - - __/__/__--__/__/__
H DATE DNR REVIEW WAS COMPLETED - - - - - - - - - - - - - - - __/__/__

I DATE APPLICATION WAS COMPLETE - - - - - - - - - - - - - - - __/__/__
J DATE GOVERNING BODY PROVIDED COMMENTS OR OBJECTIONS - - __/__/__
K DATE NOTICE OF INTENT WAS SENT--REC TO APPLICANT - - - - __/__/__--__/__/__
L DATE PUBLIC NOTICE WAS SENT TO APPLICANT - - - - - - - - - __/__/__
M DATE PROOF OF PUBLICATION OF PUBLIC NOTICE RECEIVED - - __/__/__
N WAIVER DATE BEGIN--END (DAY 90) - - - - - - - - - - - - - - __/__/__--__/__/__

COMMENTS:
```

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

№ 87959

RECEIPT FOR APPLICATION FEES AND MISCELLANEOUS REVENUE

Received from Silor Optical of Fla Date 12/21/84

Address 4900 Park. St N St. Petersburg Dollars $ 100.00

Applicant Name & Address Same

Source of Revenue [illegible] Lens Washer

Revenue Code 001031 Application Number AC 52-097471

24667

By Mary S Brown

52-097471

PAID DEC 21 1984

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

D. E. R.

DEC 21 1984

SOUTH WEST DISTRICT
TAMPA

SOUTHWEST DISTRICT

7601 HIGHWAY 301 NORTH
TAMPA, FLORIDA 33610

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

WILLIAM K. HENNESSEY
DISTRICT MANAGER

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Conveyorized Lens Washer [X] New[1] [ ] Existing[1]

APPLICATION TYPE: [X] Construction [ ] Operation [ ] Modification

COMPANY NAME: Silor Optical of Florida, Inc. COUNTY: Pinellas

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired)

SOURCE LOCATION: Street 4900 Park Street North City St. Petersburg

UTM: East 17-327.5 KME North 3077.8 KMN

Latitude 27 ° 48 ' 54 "N Longitude 82 ° 45 ' 06 "W

APPLICANT NAME AND TITLE: Edgar J. Vallar, Manager-Engineering & Development

APPLICANT ADDRESS: 4900 Park Street No., St. Petersburg, Florida 33709

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Silor Optical of Fla. Inc.

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed:

Hubert Dreckmann, VP & General Manager
Name and Title (Please Type)

Date: 12/20/84 Telephone No. (813) 541-5733

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

---

[1] See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed Edgar J. Vallar

Edgar J. Vallar
Name (Please Type)

Silor Optical of Florida, Inc.
Company Name (Please Type)

4900 Park St. No., St. Petersburg, FL 33709
Mailing Address (Please Type)

Florida Registration No. 16156 Date: 20 DEC 84 Telephone No. (813) 541-5733

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Obtaining construction permit for cold temperature conveyorized lens washer to replace major VOC source involving trichloroethylene. Ultrasonic dip tanks with relatively non-volatile solvent replaces high ventilated solvent spray system.

(See Attachment A)

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction December 1984 Completion of Construction October 1985

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

No pollution control devices involved; however, present VOC source is being replaced with an expensive alternative system.

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

This conveyorized lens washer system will eventually replace VOC source with Permit Number AO52-55878 and renewal permit A052-90650 dated October 25, 1984

E. Requested permitted equipment operating time: hrs/day 16 ; days/wk 5 ; wks/yr 50 ;

if power plant, hrs/yr _____ ; if seasonal, describe: __________

Note: New syster will be phased in and present VOS source equipment will be

phased out according to permit renewal A052-90650, dated October 25, 1984.

F. If this is a new source or major modification, answer the following questions. ([✓ Yes] or No)

1. Is this source in a non-attainment area for a particular pollutant? Yes

   a. If yes, has "offset" been applied? No

   b. If yes, has "Lowest Achievable Emission Rate" been applied? No

   c. If yes, list non-attainment pollutants. Ozone precusors (VOC's)

2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. No

3. Does the State "Prevention of Significant Deterioriation" (PSD) requirement apply to this source? If yes, see Sections VI and VII. No

4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? No

5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

H. Do "Reasonably Available Control Technology" (RACT) requirements apply to this source? (non-RACT plastics being cleaned) No

   a. If yes, for what pollutants? __________

   b. If yes, in addition to the information required in this form, any information requested in Rule 17-2.650 must be submitted.

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants Type	Contaminants % Wt	Utilization Rate - lbs/hr	Relate to Flow Diagram
N-methyl -2-pyrollidone	VOC	100	See note below	See attached flow diagram

Note: Material is recycled through process with minimal loss of material

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): NA - see addendum

2. Product Weight (lbs/hr): NA - see addendum

C. Airborne Contaminants Emitted: (Information in this table must be submitted for each emission point, use additional sheets as necessary)

Name of Contaminant	Emission[1] Maximum lbs/hr	Emission[1] Actual T/yr	Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission lbs/yr	Potential[4] Emission T/yr	Relate to Flow Diagram
N-methyl-2-pyrollidone	1.74 [1]	3.49 [1]	NA RACT	NA	10440 [1]	5.22 [1]	See flow diagram

---

[1] See Section V, Item 2. [1] Estimated values based on assumptions and calculations given in addendum

[2] Reference applicable emission standards and units (e.g. Rule 17-2.600(5)(b)2. Table II, E. (1) - 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated without control (See Section V, Item 3).

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
NA - RACT Control Technology				

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
NA			

*Units: Natural Gas--MMCF/hr; Fuel Oils--gallons/hr; Coal, wood, refuse, other--lbs/hr.

Fuel Analysis:

Percent Sulfur: ______ Percent Ash: ______

Density: ______ lbs/gal Typical Percent Nitrogen: ______

Heat Capacity: ______ BTU/lb ______ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating.

Annual Average NA Maximum ______

G. Indicate liquid or solid wastes generated and method of disposal.

N-methyl-2 -pyrollidone is biodegradeable; however, disposal will involve recycle or proper disposal.

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 22 feet above ground ft. Stack Diameter: 1 ft.

Gas Flow Rate: 600 ACFM ~~DSCFM~~ Gas Exit Temperature: ambient °F.

Water Vapor Content: ambient condition % Velocity: ____ FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type 0 (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq.& Gas By-prod.)	Type VI (Solid By-prod.)
Actual lb/hr Incinerated	NA						
Uncontrolled (lbs/hr)							

Description of Waste ____

Total Weight Incinerated (lbs/hr) ____ Design Capacity (lbs/hr) ____

Approximate Number of Hours of Operation per day ____ day/wk ____ wks/yr. ____

Manufacturer ____

Date Constructed ____ Model No. ____

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ____ ft. Stack Diamter: ____ Stack Temp. ____

Gas Flow Rate: ____ ACFM ____ DSCFM* Velocity: ____ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner

[ ] Other (specify) ____

Brief description of operating characteristics of control devices: ____________________

____

____

____

____

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

____

____

____

____

NOTE: Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable.

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight -- show derivation [Rule 17-2.100(127)]

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, design pressure drop, etc.)

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent: actual emissions = potential (1-efficiency).

6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. The appropriate application fee in accordance with Rule 17-4.05. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

[ ] Yes [ ] No

Contaminant	Rate or Concentration
NA	

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

[ ] Yes [ ] No

Contaminant	Rate or Concentration

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration

D. Describe the existing control and treatment technology (if any).

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:

*Explain method of determining

5. Useful Life: 6. Operating Costs:

7. Energy: 8. Maintenance Cost:

9. Emissions:

Contaminant	Rate or Concentration

10. Stack Parameters

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F.

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

3.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

4.

a. Control Device: b. Operating Principles:

c. Efficiency:[1] d. Capital Costs:

e. Useful Life: f. Operating Cost:

g. Energy:[2] h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

1. Control Device: 2. Efficiency:[1]

3. Capital Cost: 4. Useful Life:

5. Operating Cost: 6. Energy:[2]

7. Maintenance Cost: 8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

---

[1] Explain method of determining efficiency.
[2] Energy to be reported in units of electrical power - KWH design rate.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

---

[1] Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. NA no. sites ____________ TSP ____________ ( ) SO^2* ____________ Wind spd/dir

Period of Monitoring ______/______/______ to ______/______/______
month day year month day year

Other data recorded ____

Attach all data or statistical summaries to this application.

*Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

a. Was instrumentation EPA referenced or its equivalent? [ ] Yes [ ] No

b. Was instrumentation calibrated in accordance with Department procedures?

[ ] Yes [ ] No [ ] Unknown

B. Meteorological Data Used for Air Quality Modeling

1. _____ Year(s) of data from ____/____/____ to ____/____/____
month day year month day year

2. Surface data obtained from (location)________________

3. Upper air (mixing height) data obtained from (location)________________

4. Stability wind rose (STAR) data obtained from (location)________________

C. Computer Models Used

1. ________________ Modified? If yes, attach description.

2. ________________ Modified? If yes, attach description.

3. ________________ Modified? If yes, attach description.

4. ________________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate
TSP	________________ grams/sec
SO^2	________________ grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

ATTACHMENT A

DESCRIPTION OF N-METHYL-2-PYROLLIDONE LENS WASHER

Dirty lenses are moved automatically through a six tank conveyorized ultrasonic cleaning line with the following tanks.

Tank	Contents	Ultrasonics
1	N-methyl-2-pyrollidone	Yes
2	N-methyl-2-pyrollidone	Yes
3	Water and soap	Yes
4	Water	Yes
5	Water	No
6	Gensolve dryer *	No

N-methyl-2-pyrollidone in Tanks 1 and 2 is continuously recycled through a pump and filtration system. Ventilation is necessary only to remove a small amount of odor.

Liquid wastes are generated from Tanks 1 and 2 whenever they become sufficiently contaiminated to prevent proper cleaning of lens. Although N-methyl-2-pyrollidone is biodegradable, the wastes from these tanks will be recycled or properly disposed of.

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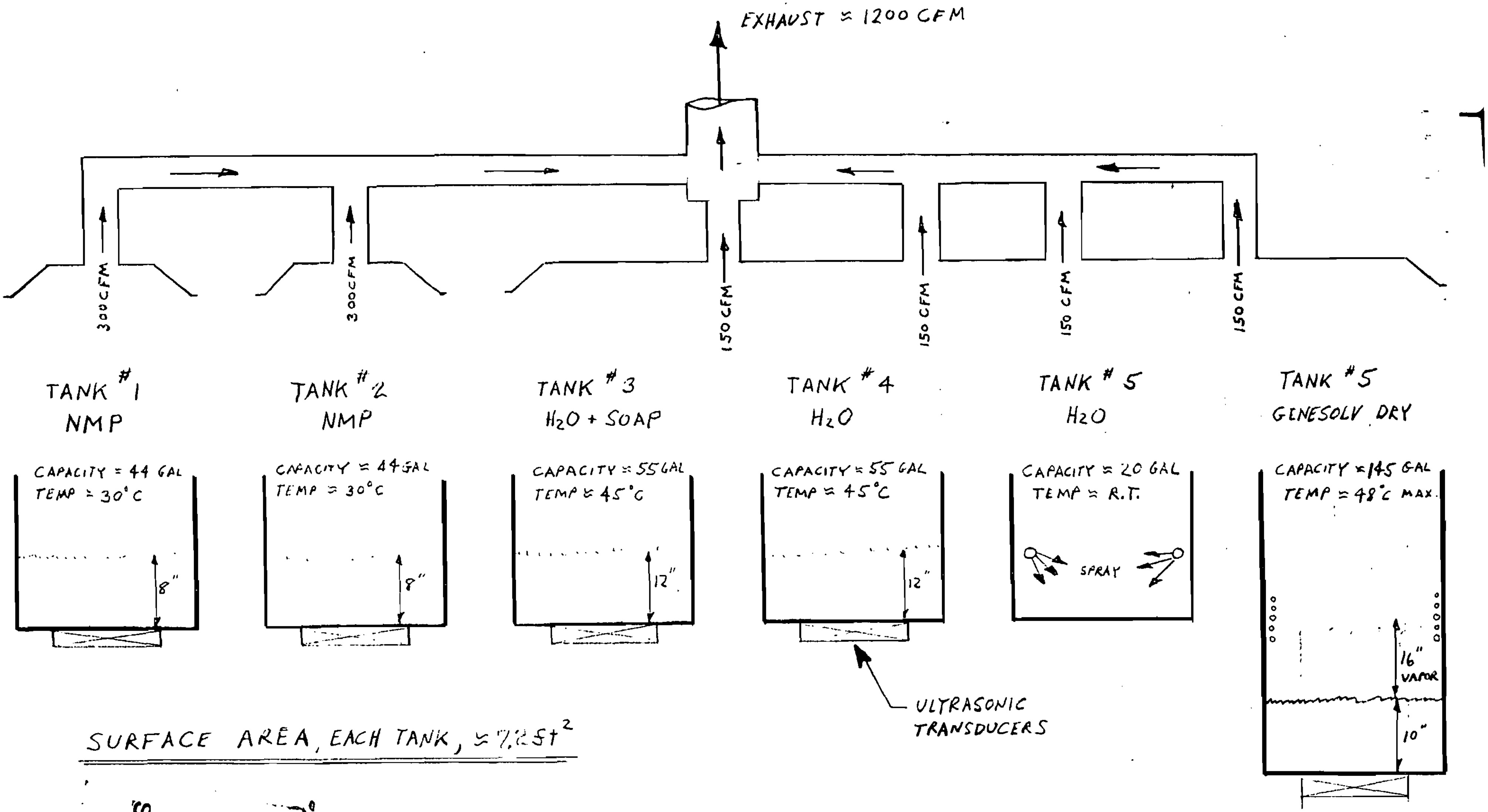
* Trichlorotrifluoroethane dryer



SURFACE AREA, EACH TANK, ≃ 7.25 ft^2

SCALE —		DATE 12-10-84	TITLE 1-METHYL-2-PYROLLIDONE LENS CLEANING PROCESS (TENTATIVE)
TOLERANCES UNLESS OTHERWISE SPECIFIED		DRAWN BY P. J. S.	
METRIC —	DECIMAL —	ANGULAR —	APPROVED

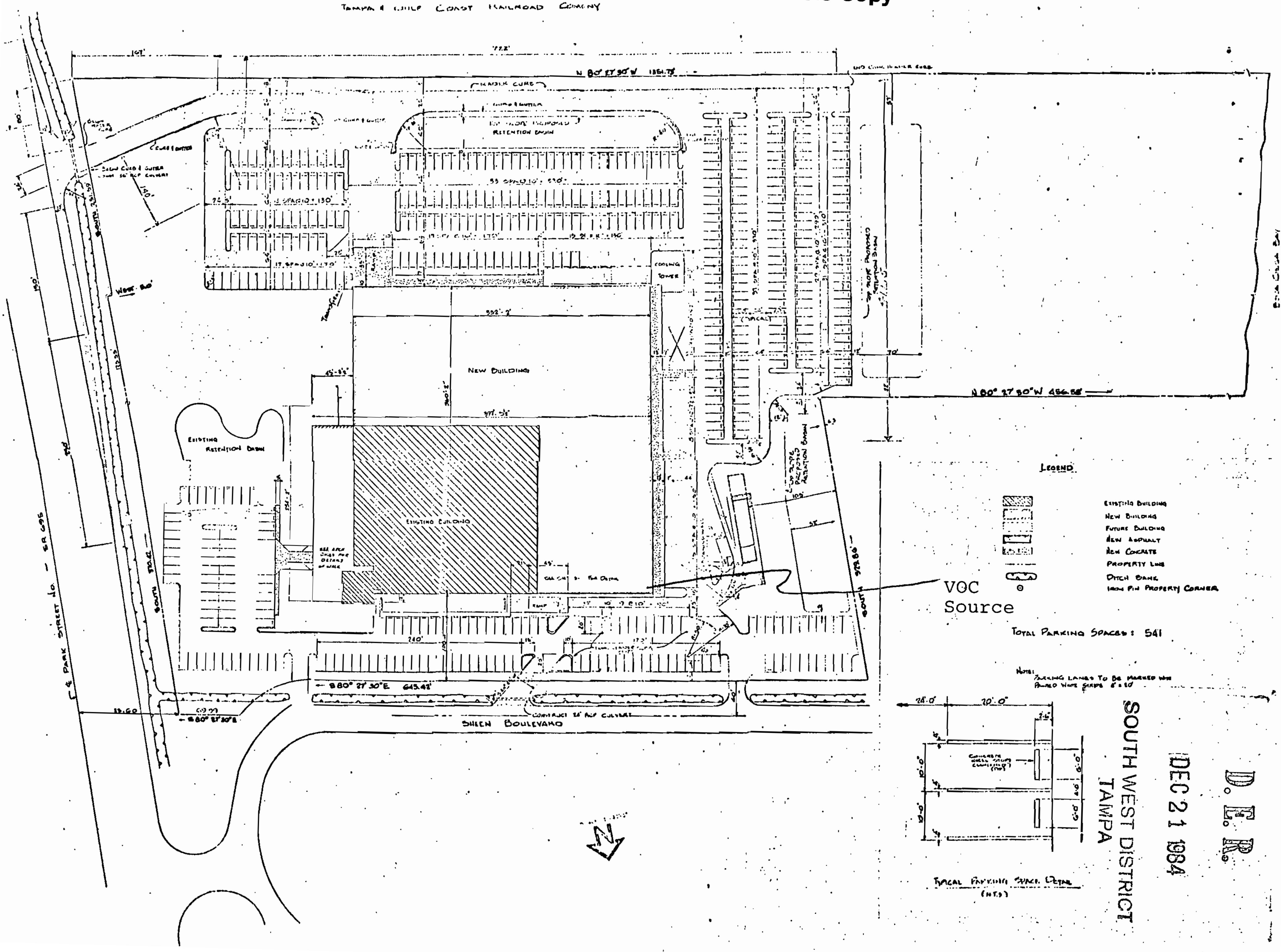
REV	DESCRIPTION	DATE

silor optical
of florida, inc. St. Petersburg, Florida 33709

DRAWING NO.	REV
SKETCH	

Best Available Copy

TOURTELOT INC.,
REALTORS
10645 GULF BLVD.
TREASURE ISLAND
(Beach)


Tampa & Gulf Coast Railroad Company
N 80° 27' 30" W 1351.78'
Header Curb
Proposed Retention Basin
Cooling Tower
New Building
Existing Building
Existing Retention Basin
Proposed Retention Basin
South 351.59'
South 570.42'
South 978.86'
N 80° 27' 30" W 456.58'
S 80° 27' 30" E 645.43'
S 80° 27' 30" E
Park Street No. — SR 695
Sheen Boulevard
Construct 24" RCP Culvert
VOC Source
Legend
Existing Building
New Building
Future Building
New Asphalt
New Concrete
Property Line
Ditch Bank
Iron Pin Property Corner
Total Parking Spaces: 541
Note:
Parking lanes to be marked with painted white stripes 6" x 10'
24'.0"
20'.0"
2.6'
10'.0"
6'.0"
4'.0"
Concrete wheel stops
Typical Parking Space Detail
(N.T.S.)

ADDENDUM

TO

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO CONSTRUCT AIR POLLUTION SOURCES

SILOR OPTICAL OF FLORIDA, INC.

DECEMBER 12, 1984

ESTIMATED EMISSION CALCULATIONS FOR

N-METHYL-2-PYROLLIDONE LENS WASHER

Two obvious sources of emission from this system are emissions from open tanks and emissions from dragout or carryover (the material left on lenses after removal from liquid N-methyl-2-pyrollidone).

EMISSIONS OF N-METHYL-2-PYROLLIDONE FROM TANKS 1 AND 2

An estimate of the emissions of N-methyl-2-pyrollidone tanks can be obtained with a knowledge of the evaporation rate of a known compound (for example, trichlorotrifluoroethane) under relevant conditions and relative evaporation rates of this known compound and N-methyl-2-pyrollidone.

In a study of trichlorotrifluoroethane evaporation from a stagnate container with 6½" freeboard, Allied Chemical Corporation found an observed evaporation rate of 0.135 pounds per hour per square foot.

If one assumes a factor of 4 for air and liquid turbulence, an estimated emission of 0.54 pounds per hour per square foot is obtained for trichlorotrifluoroethane.

Calculate a relative evaporation rate of N-methyl-2-pyrollidone and trichlorotrifluoroethane using data in ASTM D1901-67 tables. A relative evaporation rate of 29 is obtained when trichlorotrifluoroethane is compared to N-methyl-2-pyrollidone.

Calculate the quantity of N-methyl-2-pyrollidone emitted from a tank by dividing the relative evaporation factor of 29 into the estimated emission rate of trichlorotrifluoroethane (0.54 pounds per hour per square foot).

Estimated emission rate for N-methyl-2-pyrollidone from a tank =

$$\frac{0.54 \text{ pounds/hour/square foot}}{29} (5)^*$$

= 0.0931 pounds/hour/square foot or 0.093 pounds/hour/square foot

Calculate the estimated emission rate for N-methyl-2-pyrollidone for both tanks with 7.2 square foot survace area each.

Estimated hourly emission rate for two tanks N-methyl-2-pyrollidone =

(0.093 pounds/hour/square foot) (2) (7.2 square feet)

= 1.34 pounds/hour

Calculate the total quantity of N-methyl-2-pyrollidone emitted per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of N-methyl-2-pyrollidone emitted per year =

(1.34 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 5360 pounds/year.

EMISSIONS OF N-METHYL-2-PYROLLIDONE FROM DRAGOUT

Although total dragout has experimentally determined by Crest Ultrasonics Corporation to be about 1.05g per lens, only a very small amount of this dragout actually evaporates. Crest has determined that only about 0.012g or less is lost to evaporation even after 35 minutes in air. Since the transfer time is only about 1-2 minutes instead of 35 minutes, the value of 0.012g per lens should represent the maximum emission rate for dragout.

Calcualte the total quantity per hour of N-methyl-2-pyrollidone emitted from dragout by multiplying the estimated evaporation quantity per lens times the total number of lenses cleaned per hour.

Total quantity per hour of N-methyl-2-pyrollidone emitted from dragout =

(0.012g/lens) (3060 lenses/hour) (5)* = 183.6 per hour or 0.404 pounds/hour

Calculate the quantity of N-methyl-2-pyrollidone emitted from dragout per year by multiplying the hourly emission rate by the total number of working hours in one year.

Quantity of N-methyl-2-pyrollidone emitted from dragout per year =

(0.404 pounds/hour) (16 hours/day) (5 days/week) (50 weeks/year)

= 1616 pounds/year

ESTIMATED TOTAL EMISSIONS FOR N-METHYL-2-PYROLLIDONE LENS WASHER

The total emissions for the N-methyl-2-pyrollidone lens washer is obtained by adding the yearly emission from both tanks and from dragout.

Total yearly emissions for N-methyl-2-pyrollidone =

5360 pounds/year + 1616 pounds/year = 6976 pounds/year or 3.49 tons/year

SECTION III

AIR POLLUTION SOURCES & CONTROL DEVICES

C. Airborne Contaminants Emitted:

Emission
maximum (16 hours)

The maximum emission is obtained by dividing the total yearly emission for N-methyl-2-pyrollidone by the number of hours in working year.

$$\text{Maximum pounds/hour} = \frac{\text{6976 pounds/year}}{\text{(16 hours/day) (5 days/week) (50 weeks/year)}}$$

= 1,74 pounds/hour

$$\text{Actual tons/year} = \frac{\text{6976 pounds/year}}{\text{2000 pounds/ton}} = \text{3.49 tons/year}$$

POTENTIAL EMISSION
(For 24 hours/day operation)

The total potential yearly emissions for a 24 hour operation is obtained by multiplying the hourly emission rates of both tanks and from dragout times the number of working hours in a year.

Total potential yearly emission for 24 hours/day operation =

(1.34 pounds/hour + 0.404 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = (1.74 pounds/hour) (24 hours/day) (5 days/week)

(50 weeks/year) = 10440 pounds/year or 5.22 tons/year.

* This factor is required to cover uncertainties in actual system and emission measurements.

served in the presence of the quenchers which indicated that the photoproduced quencher competes with the added quencher in the energy transfer process. Thus, the decrease in stabilization efficiency by the hydroxybenzophenones with time may be attributed to the corresponding increase in energy transfer with time to the photoproduced quencher, which is less capable of preventing yellowing. Furthermore, increased yellowing by PBD and triphenylamine, relative to the unstabilized films, may reflect more effective stabilization by the photoproduced quencher. It should be noted that degradation or volatilization of an added quencher, while not precluded, would be expected to result in an increase in fluorescence intensity from the polymer films with time.

Since photostabilization of the polymer films appears to depend upon stabilization of the photoproduced quenchers, the prospect of quenching the quencher and the effectiveness of various antioxidants were investigated with the epoxy, but these approaches were unsuccessful. On the other hand, it seems likely that the loss in fluorescence intensity which accompanies photoproduct formation in these films is a more general phenomenon which may prove useful as a means for determining the feasibility of photostabilization, i.e., as an early detection method for weatherability.

ACKNOWLEDGMENT

The authors are grateful to DeSoto, Inc. for financial assistance, and also thank Dr. James Glass, Physics Dept., and Dr. Zeno Wicks, Jr., Polymers and Coatings Dept., North Dakota State University, for their assistance and helpful comments. ☐

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Trademark References

Eponol	Shell Chemical Co.
Epi-Rez	Celanese Corp.
NBC	E. I. du Pont de Nemours & Co., Inc.
Antioxidant 2246	American Cyanamid Co.
Cyasorb	CIBA-GEIGY Corp.
Stabilizer AM	Ferro Corp.

THIS PAPER WAS AWARDED SECOND PRIZE OF $500 IN THE 1976 ROON AWARDS COMPETITION

Evaporation Phenomena: Precise Comparison Of Solvent Evaporation Rates From Different Substrates

ALBERT L. ROCKLIN
Shell Development Company*

Based on a simple modification of the Shell Automatic Thin Film Evaporometer, a precise method has been developed for measuring evaporation rates from a smooth surface. Relative rates of pure solvents evaporating from a smooth surface do not parallel the corresponding relative evaporation rates from filter paper. The greatest differences are observed with water and with alcohols, for which evaporations from filter paper are much slower than from a smooth surface.

KEY WORDS: Evaporation; Evaporometer; Solvents; Water; Alcohols: Smooth surfaces; Relative rate.

INTRODUCTION AND BACKGROUND

Evaporation of solvents is of considerable importance to the coatings industry. Surface coatings such as paints or inks which are deposited from solvent-based formulations can be distressing failures if the solvent components of those formulations do not have the right combination of evaporation characteristics. If the solvents are not chosen carefully, differential evaporation can result in premature loss of active solvent which could degrade film quality because of resin precipitation from the residual inadequate solvent blend. Other problems such as blush, orange peel, and prolonged tackiness can also be caused by unsuitable evaporation rates. Consequently, much effort has gone into developing methods of predicting evaporation characteristics of coatings formulations from known or easily obtained properties of the components.

In the perfect world of exact predictions it would be possible to compute the evaporation profile and residual solvent balance of a complete formulation purely on the basis of the properties of all its ingredients and their proportions. The real world is less accommodating; technology has not yet advanced to the stage where satisfactory predictions can be made from scratch. Since experience has shown that evaporation characteristics of a coatings formulation will usually be unchanged if its solvent portion is replaced by one of different composition but with the same evaporation characteristics as the original, this means that if a coating with satisfactory evaporation characteristics contains solvent components which must be replaced or curtailed for reasons of cost, legality, or availability, it can be done by selecting a new solvent blend with the same evaporation characteristics as the one being replaced.

An elaborate technology now exists for calculating evaporation characteristics of solvent blends from properties of the neat components. The methods vary from highly theoretical creations to easy calculations based on evaporation rates of the neat solvents as measured under standardized and simplified conditions. Predictions of solvent blend evaporation characteristics are based on evaporation rates of the individual components of the blend as measured with an appropriate instrument. The manner in which the observed evaporation rates are mathematically combined in equations which predict rates for the blends is a complete subject in itself, and one in which considerable ingenuity and sophistication have been shown. However, this paper is not concerned with either the derivation or

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* Westhollow Research Center, P.O. Box 1380, Houston, Tex. 77001.

Presented at the 54th Annual Meeting of the Federation of Societies for Coatings Technology in Washington, D.C., October 28, 1976.

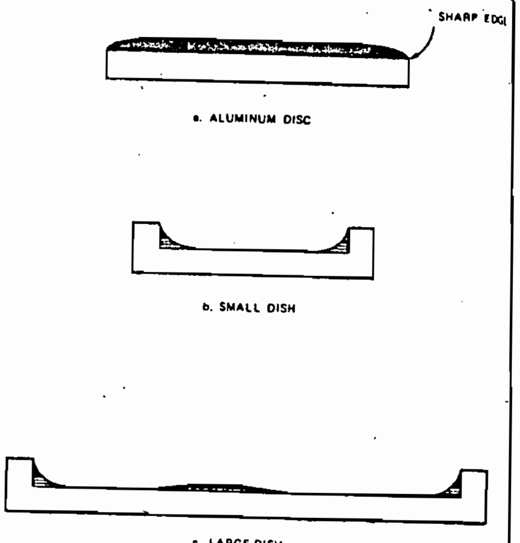
the application of those equations. The chief concern in this study is with the methods by which the evaporation rates are measured and with their pertinance to evaporation of solvents from actual coatings, with emphasis on those coatings which are based on water as the chief component of the solvent system.

The leading instrument used for measuring solvent evaporation rates in the laboratory is the Shell Automatic, Thin Film Evaporometer.[1] With this, and some similar instruments, the evaporation rate of a solvent is measured by observing the weight loss as that solvent evaporates from a piece of filter paper onto which it has been deposited. There the evaporation takes place from a porous substrate which is soaked in the solvent, yet when solvents evaporate from a coating deposited on metal, that evaporation takes place from a smooth surface. Consequently, evaporation rates as calculated from porous surface evaporation data may not coincide with evaporation rates from smooth paint films. It was because of this that the system for measuring evaporation from smooth surfaces was developed. This paper describes that system and also contains close comparisons of evaporation rates from smooth and porous surfaces for most of the solvents commonly used in the coatings industry. The significant finding is that for many solvents, evaporation rates from smooth surfaces do not parallel those from filter paper, and that the greatest disparities are observed with water and alcohols.

CONVENTIONAL METHODS FOR MEASURING EVAPORATION RATE

The earliest methods of measuring evaporation rates of liquids were from smooth surfaces.[2] These were based on the simple technique of timing evaporation of liquids from shallow dishes. That technique is illustrated by the work of Gilbert[3] who measured the time for small portions of a liquid to evaporate from a large reservoir of that liquid contained in a metal ointment jar and placed on an analytical balance pan in a hood in a carefully controlled air conditioned room and in the path of a constant air flow. The method is precise but it could certainly not be used to obtain evaporation rates of solvent blends from thin liquid films.

What is essentially a thin film method has been used by Union Carbide Corp.[4] to obtain the evaporation rates reported in their compendium on solubility parameters.[5] In their method, a thin layer of liquid is allowed to evaporate from the flat bottom of a 5 cm diameter shallow dish which can be capped and weighed periodically to obtain points along the evaporation curve. Although the method could probably be used with solvent blends, it would require considerable attention because frequent weighings would have to be made to delineate the curve accurately. Furthermore the large size of the dish would make the evaporating solvent subject to crawling and bunching, especially if the solvent is water. This problem had been recognized by Bent and Wik[6] of Shell Development Co., whose early paper described a hybrid method by which they measured evaporation of solvents from shallow dishes containing closely fitting discs of filter paper to keep the solvents spread out during the final stages of evaporation. With their system the evaporations started out from a smooth liquid surface but ended up from filter paper.



a. ALUMINUM DISC

b. SMALL DISH

c. LARGE DISH

Figure 1—Liquid behavior on variously shaped solvent holders

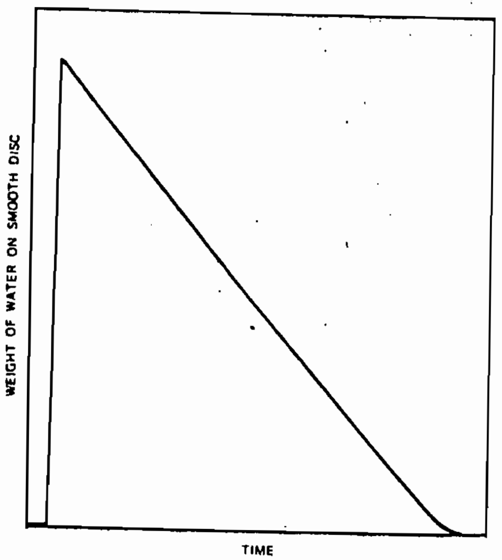


Figure 2—Evaporation of water from smooth disc

The concept of using filter paper to spread out the solvent during evaporation was adopted as a basic feature of a Shell evaporation instrument which, in its present form as the Shell Automatic Thin Film Evaporometer,[1] provides the convenience of unattended and accurate generation of the complete evaporation curve. With this instrument the thin film is produced by spreading a limited amount of solvent on a piece of filter paper, and the evaporation curve is drawn automatically from a signal generated by an electrobalance as the solvent evaporates from the filter paper under easily controlled conditions within the compact apparatus. Other instruments such as the one described by Saary and Goff[7] incorporate modifications of the Shell design, but they are based on the same principle — they measure evaporation of solvents soaked onto a blotter or filter paper.

NEW METHOD FOR MEASURING SMOOTH SURFACE EVAPORATION RATES

The new method described here employs the Shell Evaporometer with a simple modification for automatically measuring evaporation rates of thin liquid films from a smooth surface. Evaporation takes place from a thin film of liquid deposited on the flat surface of a smooth aluminum disc (*Figure* 1a) which is substituted for the filter paper in the Evaporometer. The top of the disc is machined flat. It has no sides. This is to avoid capillary coving of liquid which occurs at the junction between sides and bottom when liquid is contained in a shallow cup. That effect is severely aggravated with smaller containers (*Figure* 1b) where thin films are impossible because the liquid will shrink away completely from the center to form a coved ring of indeterminate area which changes as the liquid evaporates. The disc was made small (15 mm diameter) to overcome liquid bunching and crawling, these being effects which can arise with larger surfaces (*Figure* 1c) and which, of course, would distort the evaporation curves. To keep the liquid completely spread out on top of the disc, the surface was prepared by treatment with dilute base, and to prevent the liquid from creeping down the sides, the top and sides were machined very smooth to form a sharp edge. All solvents which were tested, including water and hydrocarbons, spread rapidly up to the edge without running off, the surface remaining completely wetted until more than 98% of the liquid had evaporated. *Figure* 2 shows the shape of the evaporation curve obtained with water.

With the aluminum disc substituted for the filter paper in the Evaporometer it was possible to obtain curves for known amounts of solvents evaporating from a smooth surface of known fixed area, and under the same controlled and reproducible conditions as those which are used for evaporations from filter paper.

DR. ALBERT L. ROCKLIN received the Ph.D. Degree in physical chemistry at the University of Toronto. Following a period at Dow Chemical Co., he joined Shell in 1958 where his interest in synthetic organic chemistry led to the development of phenolic oxidation inhibitors and solid propellants. Currently he is a Senior Research Chemist at the Shell Westhollow Research Center in Houston.

DEFINITIONS

The original goal in this work was to produce a table of relative evaporation rates from a smooth surface. This would be a counterpart to the table of relative evaporation rates from filter paper that appears in the Shell Solvent Properties Chart.[8] That goal has been achieved, and the relative evaporation rates obtained by the smooth disc method are listed in *Tables* 1-5. Therefore, for calculating evaporation rates of solvent blends from smooth surfaces, the formulator can now use the smooth surface rates reported here instead of rates based on the conventional filter paper method.

Although the use of smooth surface evaporation rates is just as straightforward as the use of evaporation rates from filter paper, this investigation revealed that the whole topic of evaporation rates is far more complicated than it appeared to be. The superficial simplicity of this topic is deceptive. In actuality, misunderstandings can arise because evaporation rates can have different meanings according to how they were obtained and calculated. Since these meanings are rarely defined, it is possible for someone who wishes to make practical use of published rates to be misled through being unaware of the importance of knowing what the rates really mean, especially if data from different sources are being used. Values which are reported for rates obtained by differing methods can be highly misleading if the units are not precisely defined. In view of the tremendous industrial and scientific importance of evaporation phenomena, and of the complexity of the topic, the following discussion is presented in some detail.

90% Evaporation Time

Evaporation time refers to the length of time in seconds for a standard amount of liquid to evaporate under the test conditions. To be useful, the evaporation time should be for a period during which the liquid evaporates from a surface of constant area, but since the filter paper as used in the Shell Evaporometer and in similar instruments starts to dry from the edges inward after about 95% of the liquid has evaporated from it, the characteristic evaporation time has been arbitrarily chosen as the time required to evaporate 90% of the sample. As commonly reported, these 90% times are the characteristic evaporation times of *equal volumes* of solvents when the instrument has been standardized to give a 90% time of 468 sec with n-butyl acetate, a generally accepted evaporation standard. Equal volumes are used because the samples are applied by syringe and it is easy to dispense the same volume in each determination.

In going to evaporations from the smooth surface the 90% evaporation time concept was retained. The evaporation standard for the smooth surface was chosen as the time to evaporate 90% of an arbitrarily chosen standard volume of n-butyl acetate from the smooth disc in an instrument which had first been adjusted to give a 468 sec 90% evaporation time of n-butyl acetate from filter paper.

Evaporation times are convenient. They can be read directly from the recording chart and can be related to the drying of a surface coating. However, they depend on the type of instrument that is used to measure them and on the agreed-upon set of measuring conditions. An undefined 90% evaporation time is meaningless; the instrument and measurement method must be clearly specified. For example, as measured in the Shell Evaporometer under the standardized conditions recommended for it, the 90% evaporation time of toluene is 238 sec, but with the instrument described by Saary and Goff the measured time is 756 sec.

Comparison of Time And Rate of Evaporation

The ease with which a solvent evaporates can be reported either as an evaporation time or as an evaporation rate. Unfortunately, these two concepts have opposite meanings. This can lead to confusion, especially if both concepts appear in the same context or are used interchangeably. Evaporation time answers the question: How long does it take to do a specific job? Like the 4 min mile, which tells us that it took 4 min to do the specific job or running that standard distance, a 468 sec 90% time for n-butyl acetate means that it took 468 sec to do the job of evaporating 90% of a standard amount of that solvent. But evaporation rate answers the complementary question: How much of the job would get done in one unit of time? If a car is moving at 44 fps, this means that during a 1 sec unit of time, the car, whose job is to move, has accomplished 44 ft of that job. Similarly, an evaporation rate tells us what quantity of solvent will evaporate during one unit of time. To sum up, if a solvent is very volatile, its evaporation time will be small but its evaporation rate will be large.

Relative Evaporation Rate

To minimize the effects of instrument peculiarities and variations in standardization, solvent volatility can be described in terms of evaporation rate as compared with the evaporation rate of a standard material (n-butyl acetate) which has been evaporated under the same conditions, i.e., in the same instrument and at the same settings. The supposition is that solvent and standard are equally affected by changes in evaporation conditions. Therefore, if solvent and standard rates are determined under a set of identical conditions, the ratio of the two rates will be the same as that obtained from rate measurements determined under a somewhat different set of conditions. The rates may change, but the ratio of those rates remains constant. To a practical extent this appears to be true. In the Shell Evaporometer the ratio of the evaporation rate of toluene to n-butyl acetate is 1.97, whereas in the instrument that Saary and Goff worked with, in which the settings are such that the 90% evaporation times are totally different from the Evaporometer 90% evaporation times, the toluene to n-butyl acetate evaporation rate ratio is 1.90, a reasonably close match to the Evaporometer value. This ratio of evaporation rates is called the relative evaporation rate, and its use is widespread because it is a measure of solvent volatility that is largely independent of the measuring instrument. However, the independence is restricted to measurements based on the same principle. As described in this paper, relative evaporation rates of some solvents are strongly affected by the nature of the surface from which the evaporation takes place.

Volume and Weight Basis For Rate Comparisons

Although the concept of relative evaporation rate is straightforward, published values of relative rates can be deceptive if the comparison basis is not understood. Since evaporation rate is a numerical value which describes the amount of material which evaporates in a unit of time, relative evaporation rate is actually a ratio of the amount of test and standard liquids which evaporate during the same time period and under the same conditions. If we start with identical volumes of test solvent and n-buytl acetate, and in each case determine the length of time required to evaporate those liquids, and if the evaporation rates are uniform, we can then calculate what fractions of those volumes would each disappear during a unit period of time. It follows that the ratio of the evaporated fraction of test liquid to that of n-butyl acetate will be the relative evaporation rate, the *volume-based* relative evaporation rate. The ratios, i.e., relative rates, that are reported by Shell,[6] Chevron,[7] and Eastman[8] are actually volume-based ratios, for although the instruments which are used determine weight loss as a function of time, that weight loss is used for showing the proportion of a standardized sample *volume* that is disappearing during the evaporation. The ratio of the volume proportions which evaporate in the same time is therefore a volume-based relative evaporation rate. If the evaporation rates have been uniform, this is simply the ratio of the 90% time of n-butyl acetate to that of the test liquid. Otherwise the ratio so obtained will be that of average evaporation rates over the 0-90% range.

Table 1—Evaporation of Hydrocarbons at 25° C

Solvent	Sp Grav ρ	Vap Press mm	90% Evap. Time, Sec		Rel Rate (Vol)		Rel Rate (Wt)		Rate Ratio[a]
			Filt[b]	Smooth	Filt[b]	Smooth	Filt	Smooth	Filt/Smooth
n-Pentane	0.621	512.5	38	76	12.3	38.2	8.71	27.0	0.323
n-Hexane	0.655	151.3	63	237	7.43	12.2	5.54	9.13	0.607
Cyclohexane	0.774	98.0	113	430	4.14	6.75	3.65	5.95	0.614
n-Heptane	0.680	45.7	132	677	3.55	4.29	2.75	3.32	0.827
n-Octane	0.698	14.0	323	2020	1.45	1.44	1.15	1.14	1.01
Isooctane	0.688	49.0	117	576	4.00	5.04	3.13	3.95	0.794
n-Decane	0.726	1.30	2637	18630	0.177	0.156	0.147	0.129	1.14
n-Dodecane	0.745	0.12	23580	163300	0.0198	0.0178	0.0168	0.0151	1.12
Benzene	0.874	95.2	124	505	3.77	5.75	3.76	5.72	0.657
Toluene	0.862	28.5	238	1357	1.97	2.14	1.93	2.10	0.919
Ethylbenzene	0.863	9.6	627	3828	0.746	0.758	0.734	0.745	0.985
o-Xylene	0.876	6.6	829	5240	0.565	0.554	0.563	0.553	1.02
m-Xylene	0.860	8.3	657	4085	0.712	0.710	0.698	0.696	1.00
p-Xylene	0.857	8.7	611	3855	0.766	0.753	0.748	0.735	1.02

(a) Calculated directly from 90% evaporation times.

(b) Includes or corresponds to values listed in the Shell Solvent Properties Chart.[6]

However, some evaporation rates are measured, reported, and used on a weight basis. For example, T. E. Gilbert[3] determined the times required to evaporate standard weights of various liquids, from which he calculated absolute evaporation rates in terms of weight loss per unit time. The relative rates which were obtained by dividing each by the absolute evaporation rate of n-butyl acetate were therefore weight-based relative rates. Those reported by Union Carbide Corp.[4] also appear to be weight-based as a function of time.

Of course, weight-based relative rates can be used instead of volume-based ones. The important thing is to recognize which is which so as to avoid misinterpretations. Furthermore, it is easy to convert from one to the other by applying simple specific gravity corrections as described in the Calculations section.

Ratio of Relative Rates

Relative evaporation rate compares solvent volatility to that of some standard under the same conditions. As shown by the agreement between the relative rates as measured with the Evaporometer and with the instrument of Saary and Goff, it brings uniformity to evaporation measurements obtained with instruments operating *on the same principle*, even though the designs may vary. However, the work described here, as well as results obtained by other investigators, show that relative evaporation rates from smooth surfaces can be significantly different from the rates of those same materials when they evaporate from filter paper, i.e., the relative evaporation rates can be influenced by the nature of the surface. A convenient comparison of relative evaporation rates of a material as measured from two different surfaces can be made by taking the ratio of the evaporation rates so obtained. The advantage of this is that it is independent of weight or volume basis choice, since the ratio of volume-based relative rates is identical to the ratio of weight-based

Table 2—Relative Evaporation Rates of Esters at 25°C

Solvent	Volume-Based		Weight-Based		Ratio[a]
	Filt[b]	Smooth	Filt	Smooth	Filt/ Smooth
Methyl acetate	5.03	10.6	5.16	10.9	0.475
Ethyl acetate	4.00	5.95	4.09	6.08	0.673
n-Propyl acetate	2.13	2.60	2.12	2.59	0.820
Isopropyl acetate	3.49	4.46	3.44	4.40	0.782
n-Butyl acetate	1.00	1.00	1.00	1.00	1.00
Isobutyl acetate	1.53	1.51	1.51	1.49	1.01
sec-Butyl acetate	1.82	1.93	1.78	1.90	0.941
tert-Butyl acetate	3.10	3.52	3.05	3.46	0.881
Methylamyl acetate	0.466	0.437	0.453	0.425	1.07
Isobutyl isobutyrate	0.485	0.438	0.470	0.424	1.11
Methyl cellosolve® acetate	0.317	0.287	0.363	0.329	1.10
Cellosolve acetate	0.199	0.190	0.220	0.210	1.05
Butyl cellosolve acetate	0.037	0.035	0.040	0.038	1.07
Ethyl lactate	0.182	0.190	0.214	0.222	0.965

(a) Calculated directly from 90% evaporation times.

(b) Includes or corresponds to values listed in the Shell Solvent Properties Chart.[6]

Cellosolve is a registered trademark of Union Carbide Corp.

Table 3—Relative Evaporation Rates of Ketones at 25°C

	Volume-Based		Weight-Based		Ratio[a]
Solvent	Filt[b]	Smooth	Filt	Smooth	Filt/ Smooth
Acetone	5.71	10.4	5.12	9.33	0.549
Methyl ethyl ketone	3.87	5.26	3.53	5.08	0.736
Diethyl ketone	2.28	2.60	2.12	2.41	0.879
Methyl n-propyl ketone	2.33	2.63	2.13	2.41	0.885
Methyl isopropyl ketone	2.85	3.64	2.60	3.32	0.784
Cyclohexanone	0.299	0.306	0.322	0.330	0.976
Mesityl oxide	0.872	0.725	0.846	0.703	1.20
Diacetone alcohol	0.122	0.118	0.130	0.126	1.03
Methyl n-butyl ketone	0.971	0.970	0.892	0.891	1.00
Methyl isobutyl ketone	1.66	1.67	1.51	1.52	0.995
Methyl n-amyl ketone	0.340	0.353	0.315	0.328	0.963
Methyl isoamyl ketone	0.461	0.453	0.429	0.421	1.02
Pentoxone® solvent	0.249	0.226	0.257	0.233	1.10
Ethyl amyl ketone	0.265	0.249	0.246	0.232	1.06
Diisobutyl ketone	0.192	0.185	0.176	0.169	1.04
Isophorone	0.0234	0.0255	0.0245	0.0235	1.04

(a) Calculated directly from 90% evaporation times.

(b) Includes or corresponds to values listed in the Shell Solvent Properties Chart.[8]

Pentoxone is a registered trademark of Shell Chemical Co.

relative rates. The only values which are used in the calculation are the 90% evaporation times, the stipulation being that all must be on the same basis, either on a weight or volume basis. If the evaporation rates of the test solvent and the reference solvent are equally affected in going from one measuring system to another, the ratio of relative rates for those two systems will be unity. Otherwise the ratio will differ from unity, the disparity being a measure of the degree to which evaporation rates of test solvent and standard are affected unequally by the two systems. It is that inequality, between a rate measurement determined from filter paper and a corresponding one determined from a smooth surface, which is the subject of this investigation.

Absolute Rates

The classical form for reporting evaporation rates would be in units of quantity per unit area per unit time, e.g., mg $cm^{-2}min^{-1}$. Although this avoids the ploy of tying a rate measurement to the properties of some chosen standard, it also restores the sensitivity to instrument and method variation. Theoretically, this might reveal differences in solvent evaporation from different surfaces, but in actuality it is of limited value because of the uncertainty that evaporations from those different surfaces have proceeded under really identical conditions. When the smooth aluminum disc is substituted for the filter paper in the Evaporometer, absolute rate differences might arise because of indeterminate changes in air flow patterns. For this reason, absolute rates have been ignored, and relative rates only have been relied upon for surface effect comparisons.

The preceding discussion has dealt with a number of concepts having to do with evaporation rate. To avoid confusion between relative rate and rate ratio it should be kept in mind that a relative rate compares a solvent with a standard material (n-butyl acetate), whereas a rate ratio shows how a solvent behaves under two different evaporation conditions.

EXPERIMENTAL

Smooth surface evaporations were conducted using an aluminum disc having a diameter of 15.0 mm and weighing 0.80 g. The newly machined disc was cleaned with toluene, dried, then etched for about 1 min with 0.5% sodium hydroxide, rinsed with water, boiled for 2 min in dilute nonionic detergent, rinsed again, and air dried. Thereafter, the detergent and rinsing procedure sufficed to keep it clean. Before doing smooth surface evaporations, the Evaporometer was adjusted in the conventional mode to give a 90% evaporation time of 468 ± 3 sec at 25.0° C with 0.7 ml of 99% n-butyl acetate on a 9 cm disc of filter paper. The filter paper was then replaced by the disc which was held at the same level by a wire stirrup support.

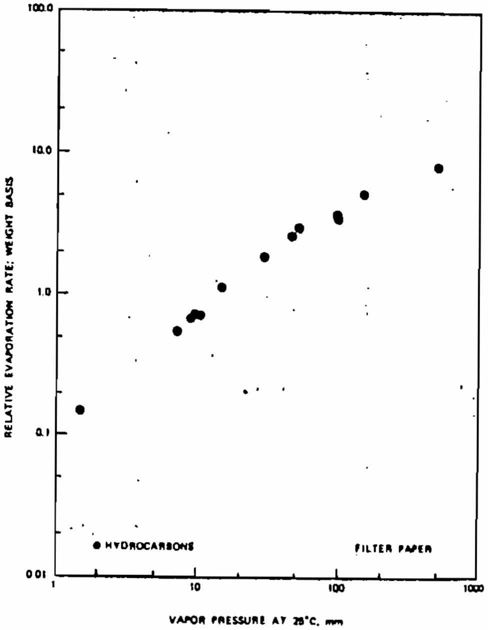


Figure 3—Evaporation of hydrocarbons from filter paper

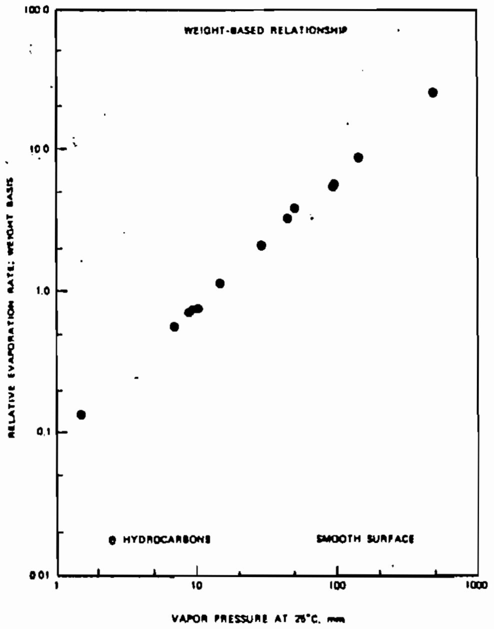


Figure 4—Evaporation of hydrocarbons from smooth surface, weight-based relationship

As with the filter paper system, samples were dispensed by syringe and deposited on the surface via a long needle penetrating to the interior of the cabinet through a septum in the side. A 0.25 ml syringe fitted with a Chaney adapter delivered uniform 0.130 ml samples through a 20 gage needle. Delivery took less than 5 sec as compared with the 10 sec usually required for the filter paper mode.

Reproducibility was checked with n-butyl acetate for which the average of 10 determinations of the 90% evaporation time was 2902 ± 25 sec. This value was taken as the reference standard for the smooth surface evaporations.

Solvents were reagent grade, usually at least 99% pure. Most of the 90% times reported for the evaporations from the smooth surface are averages of duplicate determinations that differed from each other by no more than one percent. Where the difference was greater than one percent a third determination was made and the three values averaged; in no case did these values differ among each other by more than two percent. Evaporation times from filter paper for those pure solvents listed in the Shell Solvent Properties Chart[8] were checked by single determinations. If discrepancies were found, or if the solvents were not listed in the chart, new values were obtained from duplicate or triplicate determinations.

Table 4—Relative Evaporation Rates of Glycol Ethers And of Miscellaneous Solvents at 25°C

	Volume-Based		Weight-Based		Ratio[a]
Solvent	Filt[b]	Smooth	Filt	Smooth	Filt/ Smooth
Methyl Oxitol® glycol ether	0.525	0.606	0.576	0.664	0.867
Oxitol glycol ether	0.370	0.376	0.391	0.397	0.983
Butyl Oxitol glycol ether	0.0768	0.0728	0.0788	0.0747	1.05
Methyl Dioxitol® glycol ether	0.0178	0.0164	0.0207	0.0191	1.09
Dioxitol glycol ether	0.0134	0.0135	0.0150	0.0152	0.989
Butyl Dioxitol glycol ether	0.0031	0.0032	0.0034	0.0034	0.983
Isopropyl ether	8.21	13.2	6.73	10.8	0.622
Tetrahydrofuran	4.82	8.32	4.86	8.37	0.580
Dimethyl-formamide	0.205	0.242	0.219	0.258	0.849
2-Nitropropane	1.13	1.17	1.27	1.32	0.961
N-Methyl-pyrrolidone	0.0304	0.0307	0.0357	0.0361	0.989

(a) Calculated directly from 90% evaporation times.

(b) Includes or corresponds to values listed in the Shell Solvent Properties Chart.[8]

Dioxitol is a registered trademark of Shell Chemical Co.

Table 5—Relative Evaporation Rates of Alcohols and of Water At 25°C

	Volume-Based		Weight-Based		Ratio[a]
Solvent	Filt[b]	Smooth	Filt	Smooth	Filt/ Smooth
Water	0.314	0.563	0.357	0.639	0.558
Methanol	1.97	3.60	1.77	3.24	0.548
Ethanol	1.66	2.55	1.49	2.28	0.650
n-Propanol	0.870	1.22	0.796	1.19	0.711
Isopropanol	1.47	2.36	1.31	2.11	0.621
n-Butanol	0.440	0.477	0.405	0.439	0.923
Isobutanol	0.628	0.775	0.573	0.707	0.811
sec-Butanol	0.934	1.15	0.856	1.06	0.811
tert-Butanol[c]	—	2.56	—	2.28	—
Methylisobutyl carbinol	0.274	0.285	0.251	0.261	0.961
2-Ethylhexanol	0.0182	0.0162	0.0172	0.0154	1.12

(a) Calculated directly from 90% evaporation times.

(b) Includes or corresponds to values listed in the Shell Solvent Properties Chart.[8]

(c) At 25°C tert-butanol crystallizes on filter paper, but can remain super-cooled on the smooth surface for the complete duration of the experiment.

CALCULATIONS

Volume-Based Relative Evaporation Rate

This is calculated by dividing the 90% evaporation time of n-butyl acetate by that of an equal volume of the test solvent.

$$\text{Relative Rate} = \frac{t_{90}(\text{n-butyl acetate})}{t_{90}(\text{test solvent})} \qquad (1)$$

With filter paper, t_{90} for n-butyl acetate is 468 sec and t_{90} for toluene is 238 sec. Therefore, the relative evaporation rate of toluene on filter paper is 468/238 = 1.97. For evaporation from the smooth surface

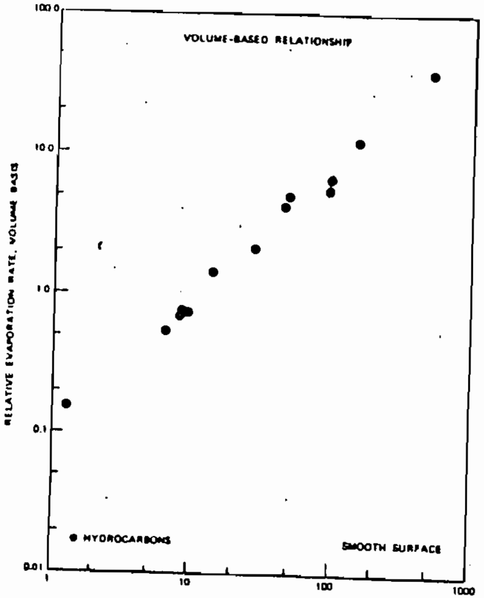


Figure 5—Evaporation of hydrocarbons from smooth surface, volume-based relationship

for which the corresponding values of t_{90} are 2902 sec and 1357 sec, the relative evaporation rate of toluene is 2902/1357 = 2.14.

Weight-Based Relative Evaporation Rate

This is the ratio of 90% evaporation times of equal weights of n-butyl acetate to test solvent. Weight-based evaporation times are calculated from volume-based values by dividing by the specific gravity — this gives what the 90% evaporation times would have been if a standard weight instead of a standard volume of sample had been used.

$$t_{90},\text{wt} = \frac{t_{90},\text{vol}}{\text{sp gr}} \qquad (2)$$

$$\text{Relative Rate, wt} = \frac{t_{90},\text{wt(n-butyl acetate)}}{t_{90},\text{wt(test solvent)}} \qquad (3)$$

$$= \frac{t_{90},\text{vol(n-butyl acetate)}}{t_{90},\text{vol(test solvent)}} \cdot \frac{\text{sp gr (test solvent)}}{\text{sp gr (n-butyl acetate)}} \qquad (4)$$

Using specific gravity values of 0.878 and 0.862 for n-butyl acetate and toluene, and the t_{90} values given in the previous example, the weight-based relative evaporation rate of toluene from filter paper would be:

$$\frac{468}{238} \cdot \frac{0.862}{0.878} = 1.93$$

The corresponding relative rate from the smooth surface would be:

$$\frac{2902}{1357} \cdot \frac{0.862}{0.878} = 2.10$$

Ratio of Relative Rates

This involves only the volume-based t_{90} values of n-butyl acetate and test solvent from filter paper and from the smooth surface.

$$\text{Rate Ratio} = \frac{\text{Rel Rate,filt}}{\text{Rel Rate,smooth}} \qquad (5)$$

$$= \frac{t_{90},\text{filt(n-butyl acetate)}}{t_{90},\text{filt(test solvent)}} \cdot \frac{t_{90},\text{smooth(test solvent)}}{t_{90},\text{smooth(n-butyl acetate)}} \qquad (6)$$

For toluene, the ratio of relative rate on filter paper to that on the smooth surface is:

$$\frac{468}{238} \cdot \frac{1357}{2902} = 0.919$$

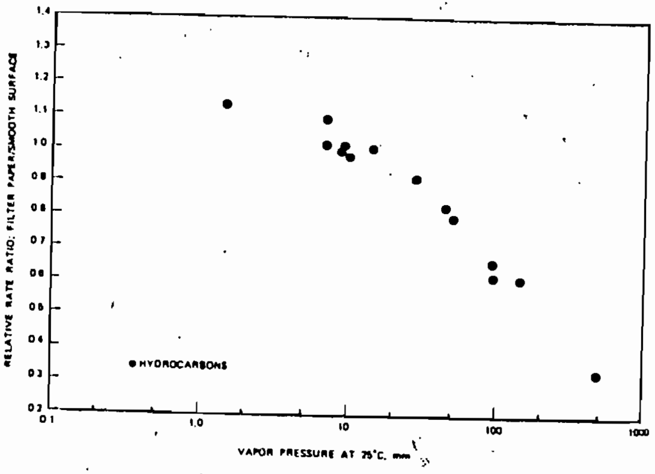


Figure 6—Comparison of evaporation rates of hydrocarbons from filter paper and from a smooth surface

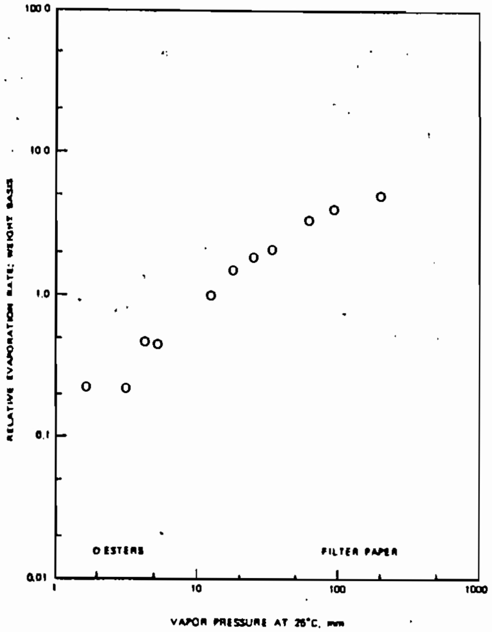


Figure 7—Evaporation of esters from filter paper

RESULTS AND DISCUSSION

Evaporation curves were obtained for more than 60 pure solvents commonly used in the coatings industry. These included hydrocarbons, esters, ketones, alcohols, ether-alcohols, and water. *Table* 1 lists the 90% times for hydrocarbons evaporating from a smooth surface as well as the corresponding values for evaporation from filter paper. The table also includes volume-based and weight-based relative rates as well as relative rate ratios. Relative rates and ratios for the other solvents are listed in *Tables* 2-5. All rates were calculated directly from observed 90% evaporation times.

As illustrated by the hydrocarbons evaporation data, the 90% times for evaporations from the smooth surface are as much as six times as long as the corresponding ones for evaporation from filter paper. This is because the solvent film on the smooth surface is about six times as thick as that on the filter paper, and so would be expected to take about six times as long to evaporate.

Although evaporation times are useful for direct comparisons of solvents with each other under a fixed set of conditions, they cannot be used in the same sense for comparing solvent behavior under differing conditions. The wide disparity between evaporation times from filter paper and those from a smooth surface rules out their use to show up the effects of the different surfaces. As previously explained, this can be done by using relative evaporation rates. However, even here the important consideration is not what the effect of going from one surface to another may be on the relative evaporation rate of any particular solvent; instead, it is the question of how the evaporation rates of different solvents compare with each other in going from filter paper to a smooth surface, i.e., what is the effect of the change in surface on the rank order of relative evaporation rates for different solvents? Is that order maintained in going from one surface to the other? The answer is that it is not.

If relative evaporation rates of all solvents were affected to the same extent in going from the one surface to the other, all the rate ratios would be identical. But they are not identical. They vary widely, and it is this variation that reveals, and is an accurate index of, the differing comparative evaporation behavior among solvents in going from filter paper to a smooth surface. This means that the pattern or line-up of comparative evaporation rates among solvents as determined on filter paper can become quite different in going to a smooth surface, so that solvent blend evaporation rates and solvent balance as calculated from filter paper data may be inexact or misleading when applied to smooth surfaces. To calculate smooth surface evaporation characteristics of solvent blends one must start with smooth surface solvent evaporation data if a close fit is to be obtained.

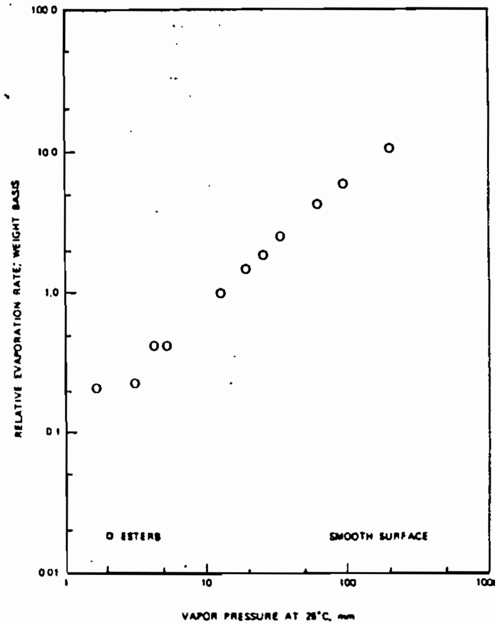


Figure 8—Evaporation of esters from smooth surface

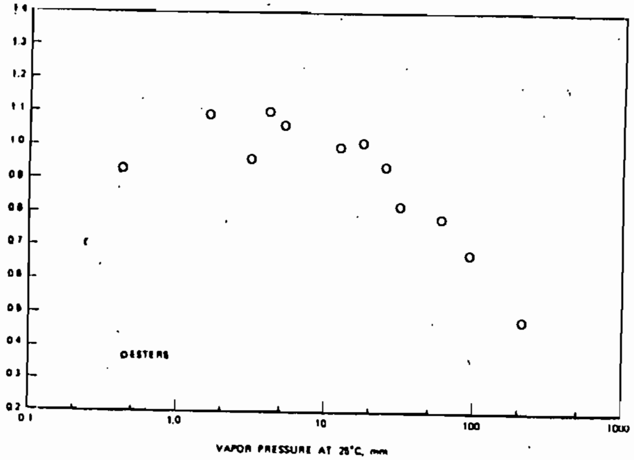


Figure 9—Comparison of evaporation rates of esters from filter paper and from a smooth surface

The relationship among relative evaporation rates of a number of solvents shows up clearly if these are plotted as a function of vapor pressure. *Figure* 3 shows a plot for weight-based relative rates of hydrocarbons evaporating from filter paper. Although relative rate increases with increasing vapor pressure, the relationship is not linear. There is considerable drop-off at the high vapor pressure end, presumably because of the cooling effect as the volatile liquids evaporate. By contrast, *Figure* 4 shows that a better relationship, one that comes closer to a straight line, is obtained with relative evaporation rates of the same materials evaporating from a smooth surface. As shown in *Figure* 4, the drop-off at the high end of the smooth surface relative evaporation rate plot is not significant, and the points line up with somewhat better regularity than the values obtained from the filter paper evaporations.

The reason for choosing weight rather than volume basis to illustrate the difference between evaporations from filter paper and those from a smooth surface is apparent on comparing the weight-based *Figure* 4 with its volume-based counterpart, *Figure* 5, in which the variation from linearity is much more pronounced. However, there is no implied preference for weight instead of volume basis for describing solvent volatility. The differences between evaporations from the two surfaces exist irrespective of the manner in which they are evaluated. In this presentation, the only reason for using the weight basis is that it gives a more immediate coherent picture of those differences. In practice, volume basis would probably be used for the smooth surface relative rates wherever it is now used for relative rates determined from filter paper.

Except for the down-trend at the high end of the relative rate plot for filter paper, the differences between evaporations from filter paper and those from a smooth surface, *Figures* 3 and 4, do not appear to be very great, yet they are, and this shows up when the ratios of the evaporation rates on filter paper to those on the smooth surface are plotted against vapor pressure, as shown in *Figure* 6. The general down-trend at the high vapor pressure end undoubtedly reflects an increasing cooling effect disparity between filter paper and the smooth aluminum disc in going toward increasing vapor pressure of the evaporating liquid. This is to be expected, but what is not expected is that so much scatter exists. Since hydrocarbons do not interact with filter paper, that can hardly be claimed as a reason for the variation in relative rates between filter paper and smooth surface evaporations. The reasons for this phenomenon are certainly not obvious, but whatever they are, the important issue is that relative evaporation rates as determined from filter paper can differ significantly from those as determined from a smooth surface even though no obvious interactions can be blamed for the difference.

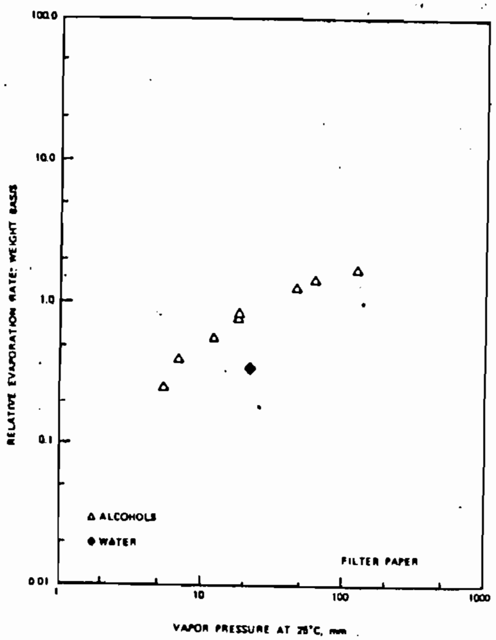


Figure 10—Evaporation of alcohols and of water from filter paper

Most of the other compounds show similar behavior. For example, the relative rate patterns for esters, *Figures* 7 and 8, look just like those for hydrocarbons. As with the hydrocarbons, the smooth surface data come closer to a straight line than do the filter paper data. In fact, as shown later, they and the hydrocarbon data fall on or near the same straight line. Also, as with the hydrocarbons, the ratios of relative evaporation rates are erratic (*Figure* 9). But with alcohols and water (*Figures* 10 and 11), none of the relative rate data come close to linearity. Not only is the filter paper plot badly distorted, but so also is the plot for evaporation from the smooth surface. Clearly, these hydroxylic compounds are different from the other solvents.

The extent of the departure of alcohols and wa-

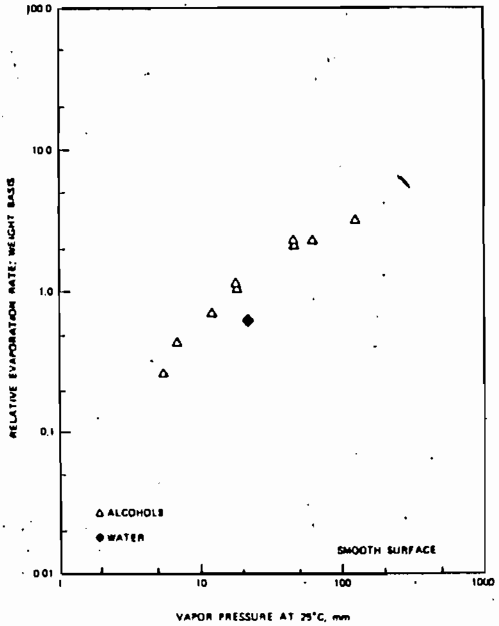


Figure 11—Evaporation of alcohols and of water from smooth surface

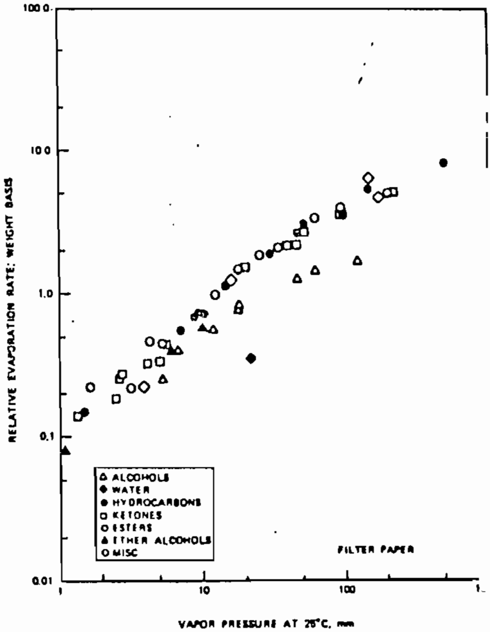


Figure 12—Evaporation of solvents from filter paper

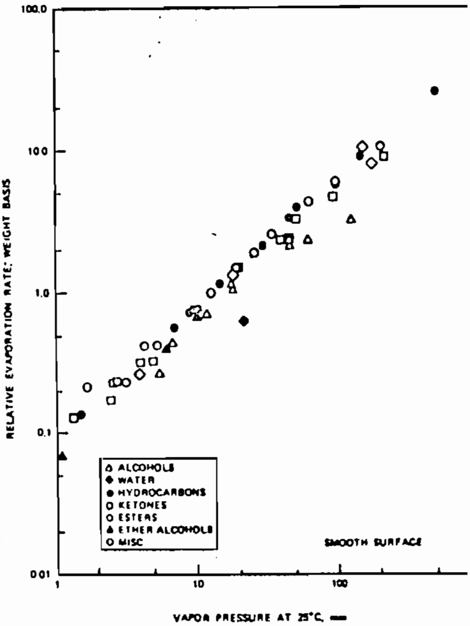


Figure 13—Evaporation of solvents from smooth surfaces

ter from the general pattern of relative evaporation rates displayed by other solvents can be appreciated by examining the composite plots of all the relative rate data, shown in *Figures* 12 and 13. For alcohols and water, evaporation rates from filter paper are much lower than those of other compounds with the same vapor pressure. This effect carries over even to the smooth surface, although in that case it is far less pronounced.

Figure 13 shows that, except for the case of water and some of the alcohols, relative rates of most solvents evaporating from the smooth surface hover close to the same straight line. But with filter paper, the pattern revealed by *Figure* 12 is one of greater scatter and worse linearity. The disparity between relative evaporation rates from filter paper and those from a smooth surface is shown on the composite rate ratio plot in *Figure* 14. If the relative rates from a smooth surface paralleled those from filter paper the rate ratios would be identical. Instead, they vary widely. Therefore, a blend made up of components having widely differing relative rate ratios would display greatly different individual component evaporation rates from a smooth surface than from filter paper. The practical significance of this is that drying time and solvent balance for evaporation from a smooth surface such as a paint film on metal could be found to be quite different from that which is calculated for evaporation from filter paper. For example, the calculated 90% evaporation time for a blend of 25% methyl ethyl ketone, 10% methyl Oxitol®, 15% isopropyl alcohol, and 50% toluene evaporating from filter paper is 191 sec. But if the calculation is done on the basis of the relative rates of the component solvents as determined from a smooth surface, the 90% time for the blend becomes 159 sec.

Of the variety of solvents represented in *Figure* 14, the ones which, as a group, deviate most from the others are the hydroxylic solvents, and of these the worst deviant is water, the very solvent that is of greatest interest in water-based systems. With these solvents, the relative evaporation rates from filter paper are substantially lower than from a smooth surface. This means that for evaporations from a smooth surface, these components could be lost much faster from solvent blends containing them than would be predicted on the basis of calculations using evaporation rates which had been determined from filter paper.

CONCLUSIONS

For pure solvents evaporating in the Shell Automatic Thin Film Evaporometer, significant differences exist between relative evaporation rates when the solvents evaporate from filter paper, and the corresponding rates when those same solvents evaporate from a smooth surface in the same instrument and at the same settings. Differences among the solvents are displayed to varying extents, but the greatest deviations occur with water and alcohols. Compared with others, these hydroxylic solvents evaporate much more slowly from filter paper than from a smooth surface. This is really not surprising, since it could be expected that water and alcohols would be held back on filter paper because of hydrogen bonding interaction with the cellulosic substrate. The reasons for the disparities among the other solvents are obscure, but the important issue is that these disparities exist and can be measured precisely. This should be of considerable value in promoting informed use of the large body of rate data which is available to the industry and which is based on evaporations from filter paper. This could assume increasing importance as the trend toward water-based systems develops further. From the standpoint of methodology the system described here for measuring evaporations from a smooth surface is an enhancement of the Evaporometer. It involves a simple modification which leaves the instrument unaltered but which enlarges its scope and which provides a background for more useful interpretation of the rate data obtained from conventional evaporations from filter paper.

Oxitol is a registered trademark of Shell Chemical Co.

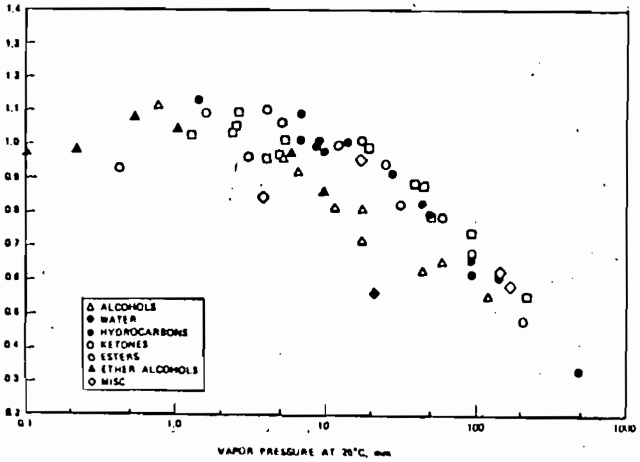


Figure 14—Comparison of evaporation rates of solvents from filter paper and from a smooth surface

ACKNOWLEDGMENTS

Evaporation rates were determined by Vytas I. Cirpulis, whose diligence and meticulous technique contributed greatly to the progress of the study. I am also indebted to Granville D. Edwards, Roy W. Tess, and Elder C. Larson for their helpful advice, and to Shell Development Co. for providing the opportunity to conduct this investigation and for their policy of encouraging prompt publication of the results. ☐

References

(1) a. For description of concept see: Sletmoe, G. M., *Official* DIGEST, 28 1060 (1956).
  b. The automatic model is described in the Shell Chemical Co. Bulletin IC: 69-39, "Evaporation Rates of Solvents" (1969).
  c. The current model is described in the "Apparatus Number Series 109" bulletin, Roxana Machine Works, 300 Michigan Ave., South Roxana, Ill. 62087.

(2) Gardner, H. A. and Sward, G. G., "Paint Testing Manual," 12th Ed., Gardner Laboratories, Inc. Bethesda (1962). Note: Descriptions of some of the earlier methods have been omitted from the 13th ed.

(3) Gilbert T. E., JOURNAL OF PAINT TECHNOLOGY, 43, No. 562, 93 (1971).

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(6) Bent, F. A. and Wik, S. N. *Ind. Eng. Chem.*, 28, No. 3, 312 (1936).

(7) Saary, Z. and Goff, P. L., JOURNAL OF PAINT TECHNOLOGY, 45, No. 538, 45 (1973).

(8) Shell Chemical Co., "Solvent Properties Chart," SC: 48-75 (1975).

(9) Eastman Chemical Products, Inc., "Solvent Selector Chart," Publication No. M-167C (1973).

FREON ®

1/7/85

SOLVENT PROPERTIES

BULLETIN NO. FS-6

SOLVENT PROPERTIES COMPARISON CHART

A wide variety of solvent materials is necessary to satisfy industrial demand. The properties of each solvent determine its applications. Special requirements of many industries greatly limit the field of choice. Solvent action, flammability, toxicity, and other properties must be considered along with cost in choosing the most suitable solvent for each application.

Properties of a number of commonly used solvents have been assembled and are listed in this chart.

The "Freon" solvents are nonflammable, nonexplosive and have a low order of toxicity. They range in solvent power somewhat above aliphatic hydrocarbons and below chlorinated solvents. This selective solvent action permits their use for removing oil, grease, dirt, etc., from many objects without harm to metal or plastic parts.

NOTES ON HEADINGS IN TABLE

Most of the headings in the table on the following pages are self-explanatory but a few may need further clarification.

Evaporation Rate

The rate listed is not an absolute value but is based on the evaporation of carbon tetrachloride under a particular set of conditions. The relative rate will probably be similar under other conditions. However, the value listed in the table should be considered only as a guide and not as a precise value.

Coefficient of Expansion

In most cases, the coefficient shown in the tables is the change in liquid volume at 68°F. For the "Freon" solvents and a few others, the coefficient is an average for a range from about 20°F to 100°F. The coefficient does not change very much with temperature and the values listed can be used for ordinary ambient temperatures. Calculations are made on a volume per volume basis. $V_2 = V_1 (1 + m\Delta t)$ where m is the coefficient of expansion.

Toxicity, TWA

The 8-hour Time Weighted Averages (TWAs) shown here are those listed by the Occupational Safety and Health Administration (OSHA) in the *Federal Register* of June 27, 1974. They correspond closely with the Threshold Limit Values (TLVs) adopted by the American Conference of Governmental Industrial Hygienists for the year 1970.* The TWAs are parts of solvent vapor or gas per million parts of contaminated air by volume at 25°C. and 760 min. Hg pressure. An employee's exposure to solvent vapors should not exceed the TWA in any 8-hour work shift of a 40-hour work week. For further details, the latest OSHA regulations should be consulted.

*Tables have been updated to include 1977 ACGIH adopted TWA values.

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SOLVENT PROPERTIES COMPARISON CHART

E. I. DU PONT DE NEMOURS & CO. (INC.), "FREON" PRODUCTS DIVISION

FREON®
SOLVENTS

FLUOROCARBON SOLVENTS	DESCRIPTION Formula	Molecular Weight
"FREON" MF	CCl_3F	137.38
"FREON" TF	CCl_2FCClF_2	187.39
"FREON" TA	Azeotrope of "Freon" TF and Acetone	
"FREON" TE	Azeotrope of "Freon" TF and Ethanol	
"FREON" TES	Azeotrope of "Freon" TF, Ethanol and Nitromethane	
"FREON" TMC	Azeotrope of "Freon" TF and Methylene Chloride	
"FREON" TMS	Azeotrope-like blend of "Freon" TF, Methanol and Nitromethane	
"FREON" T-E 35	Blend of "Freon" TF and Ethanol	
"FREON" T-P 35	Blend of "Freon" TF and Isopropanol	
"FREON" T-WD 602	Emulsion of water in "Freon" TF	

CHLORINATED HYDROCARBONS	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Sol % By Wei In Water
n-PROPYL CHLORIDE	$CH_3(CH_2)_2Cl$	78.54	7.43	113–117	−189.0	187	0.00080	–	0.27
ISOPROPYL CHLORIDE	$CH_3CHClCH_3$	78.54	7.17	94–104	−178.6	–	0.00088	–	0.31
METHYLENE CHLORIDE	CH_2Cl_2	84.94	11.07	102–106	−142.1	147	0.00076	28.0	1.38
DICHLOROETHYLENE (1,1)	$CH_2{:}CCl_2$	96.95	$10.43^{59°F}$	99	−188.5	105	–	–	–
ETHYLENE DICHLORIDE	CH_2ClCH_2Cl	98.97	10.45	180–183	−31.5	79	0.00065	32.2	0.90
MONOCHLOROBENZENE	C_6H_5Cl	112.56	9.23	266–273	−49.4	32	0.00051	33.2	0.05
PROPYLENE DICHLORIDE	$CH_2ClCHClCH_3$	112.99	9.65	204–208	<−94.0	71	0.00064	$31.4^{77°F}$	0.27
CHLOROFORM	$CHCl_3$	119.39	12.43	142	−82.3	118	0.00071	27.2	0.82
TRICHLOROETHYLENE	$ClCH{:}CCl_2$	131.40	12.22	188-190	−123.5	69[b]	0.00065	29.2	0.11
TRICHLOROETHANE (1,1,2)	$CH_2ClCHCl_2$	133.42	12.04	230–239	−34.1	21	–	33.6	0.44
1,1,1, TRICHLOROETHANE (Methyl Chloroform)	CH_3CCl_3	133.42	11.03	162–190	−58.0	139	–	25.9	$<0.10^{77°F}$
ORTHO DICHLOROBENZENE	$C_6H_4Cl_2$	147.01	10.89	351–361	1.0	7	0.00046	–	$0.01^{77°F}$
CARBON TETRACHLORIDE	CCl_4	153.84	13.30	171–172	−9.3	100	0.00069	26.9	0.08
PERCHLOROETHYLENE	$CCl_2{:}CCl_2$	165.85	13.55	250–254	−8.2	27[b]	0.00057	32.3	0.02
TETRACHLOROETHANE (Symmetrical)	$CHCl_2CHCl_2$	167.86	13.35	295–297	−32.8	14	0.00057	36.0	$0.29^{77°F}$
TETRACHLOROETHANE (Unsymmetrical)	CH_2ClCCl_3	167.86	13.25	264 267	−91.7	–	–	–	0.02
TRICHLOROBENZENE (Mixed Isomers)	$C_6H_3Cl_3$	181.46	$12.15^{77°F}$	415-423	62.6	–	0.00048	$38.9^{77°F}$	$<0.01^{77°F}$

ALIPHATIC PETROLEUM	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Sol. % By Wei In Water
n-PENTANE	$CH_3(CH_2)_3CH_3$	72.15	5.22	91-106	−201.5	271	0.00079	–	$0.04^{60°F}$
TEXTILE SPIRITS	–	–	$5.75^{60°F}$	145–175	–	–	0.00072	22.5	–
n-HEXANE	$CH_3(CH_2)_4CH_3$	86.17	5.51	151–160	−139.5	139	0.00075	18.4	$0.014^{60°F}$
n-HEPTANE	$CH_3(CH_2)_5CH_3$	100.20	5.71	196-214	−131.1	97	0.00068	–	$0.005^{60°F}$
VM & P NAPHTHA	–	–	$6.29^{60°F}$	236–292	<−50	37	0.00061	25.4	–
HI-FLASH VM & P NAPHTHA	–	–	$6.33^{60°F}$	240–320	<−50	8	0.00061	25.8	–
MINERAL SPIRITS NO. 10	–	–	$6.51^{60°F}$	307-385	−92	–	0.00054	27.6	–
STODDARD SOLVENT	–	–	$6.47^{60°F}$	310-388	<−45	4[b]	0.00061	27.6	–
MINERAL SPIRITS	–	–	$6.58^{60°F}$	314–390	<−50	–	0.00050	27.8	–
VARSOL-1	–	–	$6.58^{60°F}$	322–386	–	–	–	–	–
ODORLESS MINERAL SPIRITS	–	–	$6.31^{60°F}$	352–398	–	–	0.00061	27.0	–
KEROSENE	–	–	$6.77^{60°F}$	374–503	–	–	0.00050	30.0	–
INK SOLVENT	–	–	$6.79^{60°F}$	512–610	–	–	–	–	–

ALCOHOLS	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Solu % By Wei In Water
METHANOL	CH_3OH	32.04	6.61	147–151	−144.0	50	0.00066	22.6	∞
ETHANOL, ANHYDROUS	C_2H_5OH	46.07	6.59	171–176	−174.1	–	0.00063	22.3	∞
ETHANOL, 95%	C_2H_5OH	46.07	6.76	166–175	−198.4	37	0.00062	22.8	∞
ISOPROPANOL, 99%	$(CH_3)_2CHOH$	60.09	6.55	179–181	−126.0	34	0.00062	71.7	∞
n-PROPANOL	C_3H_7OH	60.09	6.74	207–208	−196.6	34	0.00053	23.8	∞
ISOBUTYL ALCOHOL	$(CH_3)_2C_2H_3OH$	74.12	6.72	225–232	−162.4	16	0.00053	22.8	10
n-BUTYL ALCOHOL	C_4H_9OH	74.12	6.75	239–245	−129.6	13	0.00052	24.6	7.7
sec-BUTYL ALCOHOL	$C_2H_5CHOHCH_3$	74.12	6.73	208–214	−174.5	21	0.00055	23.5	20.1
AMYL ALCOHOL, (Mixed Isomers)	$C_5H_{11}OH$	88.15	6.76	230–293	–	7	0.00052	23.6	$2.4^{59°F}$
CYCLOHEXANOL	$C_6H_{11}OH$	100.16	7.91	320–324	77.2	2	0.00043	$34.2^{61°F}$	3.6
n-HEXANOL	$C_6H_{13}OH$	102.17	6.83	307–320	−60.9	–	0.00050	24.5	0.58

NOTES: [a] Initial boiling point (continued boiling leads to composition changes which produce corresponding changes in the boiling point).

[b] ASTM D-1901-67.

[c] As calculated by procedure prescribed by OSHA for mixtures of air contaminants

[d] None until 30% evaporation has

[e] None until 40% evaporation has

[f] In oxygen.

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Pounds Per Gallon At 77°F	Boiling Point °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coefficient Of Expansion Per °F	Surface Tension At 77°F Dynes/cm	Solubility % By Weight At 77°F In Water	Solubility % By Weight At 77°F Of Water	Flash Point (Tag Closed Cup) °F	Flammab % By Volu Lower
12.32	74.87	−168	225	0.00084	$18.8^{70^\circ F}$	0.11	0.009	None	Nonflar
13.06	117.63	−31	280[b]	0.00089	17.3	0.017	0.011	None	Nonflar
11.73	110.5	−55	–	0.00088	18.7	–	$0.15^{75^\circ F}$	None	Nonflar
12.56	112.3	−43	–	0.00078	17.7	–	–	None	Nonflan
12.48	111.9	−44	–	–	17.2	–	0.28	None	Nonflan
11.85	97.2	−126	–	0.00076	21.4	–	$0.09^{75^\circ F}$	None	Nonflan
12.33	103.5	−66.1	–	–	17.4	–	$0.27^{75^\circ F}$	None	Nonflan
9.75	119.0[a]	−108	–	0.00066	19.6	–	$6.3^{75^\circ F}$	None[d]	–
9.60	120.0[a]	−94	–	0.00066	21.0	–	$9.1^{75^\circ F}$	None[e]	–
12.47	112.0[a]	32	–	–	17.3	–	–	None	Nonflan

Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Flammable Limits % By Volume in Air Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu /(lb)(°F)	Latent Heat At B. P. Btu /lb	Kauri-Butanol Value cc
0	2.6	10.5	–	–	–	–
−26	2.8	10.7	–	–	–	–
None	15.5[f]	66.4[f]	500/200[i]	0.28	141	136
57	5.6	13.0	–	–	–	–
56	6.2	15.9	100/50[i]	0.31	139	–
85	$1.8^{212^\circ F}$	$9.6^{302^\circ F}$	75	0.32	140	–
59	3.4	14.5	75	$0.33^{77^\circ F}$	123	102
None	Nonflammable		50/10[j]	0.23	106	208
None	12	86	100	0.23	103	130
None	Nonflammable		10	0.27	109	–
None	–	–	350	0.26	102	124
151	–	–	50	0.27	117	–
None	Nonflammable		10	0.21	84	114
None	Nonflammable		100	0.21	90	90
None	Nonflammable		5	0.27	99	–
–	–	–	–	–	–	–
212	–	–	–	0.20	105	–

Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Flammable Limits % By Volume in Air Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu /(lb)(°F)	Latent Heat At B. P. Btu /lb	Kauri-Butanol Value cc
<−40	1.4	8.0	1000/600[i]	0.54	154	26.0
−20	1.2	6.8	–	–	–	32.8
−7	1.2	6.9	500/100[i]	0.54	145	32.5
25	1.2	6.7	500/400[i]	0.53	138	35.5
48	$0.9^{212^\circ F}$	$6.0^{212^\circ F}$	100	–	–	38.5
57	1.2	6.0	300[j]	–	–	36.4
105	1.1	6.0	–	–	–	34.0
105	1.1	6.0	500/100[i]	–	–	34.0
110	1.1	6.0	–	–	–	39.0
113	1.1	6.0	–	–	–	38.0
128	1.1	6.1		–	–	26.2
145	1.2	6.0	–	–	–	29.5
250	–	–	–	–	–	22.1

Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Flammable Limits % By Volume in Air Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu /(lb)(°F)	Latent Heat At B. P. Btu /lb	Kauri-Butanol Value cc
54	6.0	36.5	200	0.60	473	–
57	3.3	19.0	1000	$0.58^{77^\circ F}$	361	–
57	3.3	19.0	1000	$0.62^{73^\circ F}$	–	–
56	2.5	5.2	400	0.60	287	–
59	2.5	13.5	200	$0.57^{77^\circ F}$	296	–
64	1.7	–	100/50[i]	0.58	249	–
84	1.7	18.0	100/50[i]	0.56	254	–
76	–	–	150	0.67	242	–
111	1.2	–	–	–	–	–
154	–	–	50	$0.42^{68^\circ F}$	195	–
145	–	–	100	$0.50^{75^\circ F}$	209	–

g Open cup.
h Very slightly soluble.
i ACGIH, 1977.
j ACGIH, 1977 intended change.

ETHERS AND ETHER ALCOHOLS	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coeffic Of Expan Per
ETHYL ETHER	$(C_2H_5)_2O$	74.12	5.96	93–95	−177.3	263	0.000
METHYL CELLOSOLVE‡	$CH_3O(CH_2)_2OH$	76.09	8.03	250–259	−121.2	12	0.000
CELLOSOLVE‡	$C_2H_5O(CH_2)_2OH$	90.12	7.74	270–279	−94.0	9	0.000
ISOPROPYL ETHER	$(CH_3)_2CHOCH(CH_3)_2$	102.17	6.04	145–158	−121.9	187	0.000
n-BUTYL CELLOSOLVE‡	$C_4H_9OC_2H_4OH$	118.17	7.51	331–343	<−40	3	0.000
DIETHYL CELLOSOLVE‡	$(C_2H_5OCH_2)_2$	118.17	7.02	243–264	−101.2	–	0.000
METHYL CARBITOL‡	$CH_3OC_2H_4OC_2H_4OH$	120.15	8.56	370–388	–	–	0.000
n-BUTYL ETHER	$(C_4H_9)_2O$	130.22	6.40	279–289	−139.4	–	–
CARBITOL‡	$C_2H_5O(CH_2)_2O(CH_2)_2OH$	134.17	8.55	365–401	<−104.8	–	0.000
BUTYL CARBITOL‡	$C_4H_9O(CH_2)_2O(CH_2)_2OH$	162.22	7.95	428–455	−90.6	–	0.000

KETONES	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coeffic Of Expans Per
ACETONE	CH_3COCH_3	58.08	6.58	132–134	−138.6	139	0.000
METHYL ETHYL KETONE	$CH_3COC_2H_5$	72.10	6.71	174–177	−123.5	97	0.000
CYCLOHEXANONE	$(CH_2)_5CO$	98.14	7.88	266–343	−49.0	12	0.000
METHYL ISOBUTYL KETONE	$(CH_3)_2CHCH_2COCH_3$	100.16	6.68	234–244	−120.5	47	0.000
METHYL n-BUTYL KETONE	$CH_3COC_4H_9$	100.16	6.83	237–279	−70.4	32	0.000
METHYL CYCLOHEXANONE (Mixed Isomers)	$(CH_3)C_6H_9{:}O$	112.17	7.67	237–343	–	7	0.000
METHYL n-AMYL KETONE	$CH_3(CH_2)_4COCH_3$	114.18	6.81	297–309	−31.9	15	0.000
DIACETONE	$(CH_3)_2C(OH)CH_2COCH_3$	116.16	7.82	266–356	−65.2	4	0.000

ESTERS	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coefficie Of Expansi Per °F
METHYL ACETATE	$CH_3CO_2CH_3$	74.08	7.58	127–136	−145.6	118	0.000
ETHYL ACETATE (99%)	$CH_3CO_2C_2H_5$	88.10	7.50	169–174	−118.5	–	0.000
ISOBUTYL ACETATE	$CH_3CO_2CH_2CH(CH_3)_2$	116.16	7.24	220–246	−146.0	45	0.000
n-BUTYL ACETATE	$CH_3CO_2C_4H_9$	116.16	7.28	244–262	−100.3	34	0.000
sec-BUTYL ACETATE	$CH_3CO_2CH(CH_3)C_2H_5$	116.16	7.27	219–239	−146.0	50	0.000
METHYL CELLOSOLVE ACETATE	$CH_3CO_2C_2H_4OCH_3$	118.13	8.37	279–306	−85.2	12	0.000
AMYL ACETATE (Mixed Isomers)	$CH_3CO_2C_5H_{11}$	130.18	7.21	259–311	–	23	0.000
n-BUTYL PROPIONATE	$C_2H_5CO_2C_4H_9$	130.18	7.27	255–340	−129.2	16	0.000
CELLOSOLVE ACETATE	$CH_3CO_2C_2H_4OC_2H_5$	132.16	8.10	302–320	−79.1	2	0.000

AROMATICS	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coeffici Of Expansi Per °F
BENZOL (Benzene)	C_6H_6	78.11	7.32	172–176	41.9	95	0.000
TOLUOL (Toluene)	$C_6H_5(CH_3)$	92.13	7.20	228–232	−139.0	58	0.000
XYLOL (Xylene) (Mixed Isomers)	$C_6H_4(CH_3)_2$	106.16	7.17	261–318	–	45	0.000
m-CRESOL	C_7H_7OH	108.13	8.66	396–406	51.6–53.6	–	–

TERPENES	Formula	Molecular Weight	Pounds Per Gallon At 68°F	Boiling Range °F	Freezing Point °F	Evaporation Rate (Carbon Tetrachloride = 100)	Coefficier Of Expansio Per °F
DIPENTENE (dl)	$C_{10}H_{16}$	136.23	7.10	342–374	−139.9	–	0.0004
TURPENTINE STEAM DISTILL.	$C_{10}H_{16}$	136.23	7.13	311–343	−58	<1	0.0004

‡Cellosolve and Carbitol are trademarks of Union Carbide Corp.

Flammable Limits % By Volume In Air ıwer	Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68 °F Btu/(lb)(°F)	Latent Heat At B. P. Btu/lb	Kauri-Butanol Value cc
Nonflammable		1000	0.21	78.31	60
Nonflammable		1000	0.22	63.12	31
Nonflammable		1000	0.31	85.4	51
Nonflammable		1000	0.27	77.2	–
Nonflammable		750^{c}	0.23	76.7	37
Nonflammable		$600^{c}/270^{ci}$	0.26	104.0	86
Nonflammable		475^{c}	0.24	90.7	45
–	–	750^{c}	0.47	149.0	–
–	–	700^{c}	0.36	119.0	–
Nonflammable		1000	–	–	21

tion on lo- 00)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Solubility % By Weight At 68°F In Water	Of Water	Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu/(lb)(°F)	Latent Heat At B. P Btu/lb	Kauri-Butanol Value cc
	0.00092	17.0	6.9	1.3	–20	1.9	36.5	400	0.55	151	–
	0.00052	$35.0^{77°F}$	∞	∞	107	$2.5^{257°F}$	$19.8^{284°F}$	25	0.53	243	–
	0.00054	$32.0^{77°F}$	∞	∞	104	2.6	15.7	200	0.56	234	–
	0.00083	32.0	0.90	0.57	–18	1.4	21.0	500/250i	0.51	123	–
	0.00048	$31.5^{77°F}$	∞	∞	141	$1.1^{339°F}$	$10.6^{356°F}$	50	0.58	171	–
	0.00067	–	21.0	3.4	95^{g}	–	–	–	–	178	–
	0.00048	$41.3^{77°F}$	∞	∞	200^{g}	–	–	–	$0.51^{73°F}$	163	–
	–	22.9	0.3	0.19	77	–	–	–	$0.49^{59°F}$	122	–
	0.00046	$35.5^{77°F}$	∞	∞	201	–	–	–	0.55	173	–
	0.00048	$33.6^{77°F}$	∞	∞	172	–	–	–	0.55	111	–

tion e on nlo- 00)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Solubility % By Weight At 68°F In Water	Of Water	Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu/(lb)(°F)	Latent Heat At B. P. Btu/lb	Kauri-Butanol Value cc
	0.00080	23.7	∞	∞	0	2.6	12.8	1000	0.51	224	–
	0.00076	24.6	26.8	11.8	28	1.8	11.5	200	0.53	191	–
	0.00051	–	2.3	8.0	145	1.1	–	50	0.49	–	–
	0.00063	22.7	2.0	1.8	64	1.4	7.5	100	0.50	157	–
	0.00055	25.5	$3.4^{77°F}$	$3.7^{77°F}$	73	1.2	8.0	100/25i	0.55	148	–
	0.00047	–	0.2	3.0	118	–	–	50i	$0.44^{59°F}$	–	–
	0.00057	–	0.4	1.5	120^{g}	–	–	100	–	149	–
	0.00055	29.8	∞	∞	48	–	–	50	$0.50^{59°F}$	200	–

ion i o- 0)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Solubility % By Weight At 68°F In Water	Of Water	Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu/(lb)(°F)	Latent Heat At B. P. Btu/lb	Kauri-Butanol Value cc
	0.00074	24.6	24.5	8.2	15	4.1	13.9	200	$0.47^{59°F}$	177	–
	0.00077	23.9	8.7	3.3	24	2.2	11.5	400	0.46	158	–
	0.00066	23.3	0.75	1.1	64	–	–	150	0.46	133	–
	0.00067	$27.6^{51°F}$	0.68	1.2	72	1.7	15.0	150	$0.51^{73°F}$	133	–
	0.00067	–	$0.74^{77°F}$	$2.1^{77°F}$	66	1.7	–	200	$0.46^{75°F}$	140	–
	0.00061	31.8	∞	∞	132	1.7	8.2	25	$0.50^{56°F}$	158	–
	0.00061	–	1.0	1.7	77	1.1	–	–	0.49	123	–
	0.00060	–	0.15	0.8	90	–	–	–	0.46	129	–
	0.00062	$31.8^{77°F}$	22.9	6.5	124	1.7	–	100	0.49	145	–

ion n o- 20)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Solubility % By Weight At 68°F In Water	Of Water	Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu/(lb)(°F)	Latent Heat At B. P. Btu/lb	Kauri-Butanol Value cc
	0.00069	28.9	0.09	0.05	12	1.4	8.0	10	$0.42^{59°F}$	170	105–150
	0.00061	28.4	0.05	0.04	40	1.3	7.0	200/100i	0.41	156	94–105
	0.00055	28.9	$0.02^{59°F}$	0.02	80	1.1	7.0	100	$0.40^{86°F}$	147	94
	–	37.4	2.35	–	86	$1.1^{302°F}$	–	5	0.55	181	–

on)	Coefficient Of Expansion Per °F	Surface Tension at 68°F Dynes/cm	Solubility % By Weight At 68 F In Water	Of Water	Flash Point (Tag Closed Cup) °F	Flammable Limits % By Volume in Air Lower	Upper	Toxicity TWA In PPM	Specific Heat Liquid At 68°F Btu/(lb)(°F)	Latent Heat At B. P. Btu/lb	Kauri-Butanol Value cc
	0.00048	$27.5^{82°F}$	VSS^{h}	–	109	–	–	–	–	125	62
	0.00049	$26.1^{91°F}$	VSS^{h}	–	95	0.8	–	100	–	123	55

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