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December 28, 2010

Trina Vielhauer
Bureau of Air Regulation, Title V Section
Division of Air Resource Management
Florida Department of Environmental Protection
2600 Blair Stone Road, MS #5505
Tallahassee, Florida 32399-2400

RE: FPL Turkey Point Fossil Plant BART Permit, 0250003-008-AC, Fuel Additive Test Report

Dear Ms. Vielhauer:

As per Condition #13 in Permit 0250003-008-AC, for Turkey Point Fossil Plant, enclosed please find the required Fuel Additive Test Report and associated MSDS. The submission of this report and MSDS satisfies the requirements under the aforementioned condition of the BART Permit for Turkey Point Fossil Plant. Please contact either myself at 305-242-3822, or Gary Andersen at 305-242-3826, if you have any questions or concerns.

Sincerely,



Rudy Sanchez
Plant General Manager
Turkey Point Fossil Plant

cc: Ray Gordon, DERM

Enclosure

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FLORIDA POWER & LIGHT

TURKEY POINT FOSSIL UNITS

FUEL ADDITIVE EVALUATION

DECEMBER 2010

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1. INTRODUCTION

As required by the Florida Department of Environmental Protection's Air Operating Permit No. 025003-008-AC, the overall goals of the Turkey Point Fuel Additive Study are: a) evaluate the potential benefits of fuel oil chemical treatment, b) quantify its impact on the formation of particulate matter, and c) make recommendations as to which additive(s) shall be used to achieve a PM emission target of 0.05 Lb/MBtu in lieu of the current limit of 0.07 Lb/MBtu.

2. FUEL ADDITIVE SELECTION

Fuel additives can help reduce emissions, improve efficiency, and increase operating reliability and availability of boilers. A wide range of products are offered by many fuel additive suppliers, for numerous functions. The difficulties facing power plants are sorting out the various claims and evaluating the products' performance.

The issues to be addressed by fuel additives are: (a) emissions reduction, (b) fuel carbon \rightarrow CO₂ conversion increase, (c) fouling reduction to minimize stack exit-gas temperature losses, and (d) corrosion control in order to improve boiler reliability and availability.

These areas are interrelated and are very much influenced by combustion, which in turn can be favored by chemical additive treatment. For this reason, combustion catalysts are commonly used to improve fuel oil carbon burnout and reduce particulate emissions in the power generation industry. Unburned carbon can exist in two distinct forms, soot and coke. Soot is an agglomeration of molecular size, carbon rich particles, created during the combustion of hydrocarbon gases. It has high specific surface, low density, and fine particle size (less than one micron) with high visibility (smoke). Coke is the residue of non-volatile part of fuel droplet. Coke particles are relatively large (often larger than 10 to 20 microns), porous cenospheres which contribute little to plume visibility but may represent measurable combustion loss and particulate matter increase.

There are three possible mechanisms for combustion catalytic action: ionization, acceleration of carbon oxidation, and promotion of OH⁻ radical formation. Ionization reduces coagulation of soot facilitating oxidation of the smaller particles. Accelerating carbon oxidation increases conversion to CO₂. Formation of OH⁻ radicals plays a major role in oxidizing soot particles and reducing visible carbon-based particulate matter.

Although many transition and alkaline-earth metals are effective combustion catalysts, two are generally used on boilers – iron and calcium. Most of the other elements have been ruled out because of health or performance considerations. Oil-soluble iron organo-metallics and water-based calcium nitrate are considered to be the most effective catalysts on mass basis.

3. FPL FUEL ADDITIVE SCREENING

FPL has an ongoing laboratory and technical evaluation process for predicting potential treatment performance of fuel additives. All additives are pre-screened on the basis of fuel oil compatibility, chemical and physical characteristics, storage and handling safety, technical references, and cost among other factors. As an example, Figure 1 shows a chemical comparison of fifteen different combustion catalysts. Note the large variability on their compositions. Also, note that the highest catalytic metal contents of calcium and iron are found in Product#03 (water-based calcium nitrate) and #10 (oil-soluble organo-metallic), respectively.

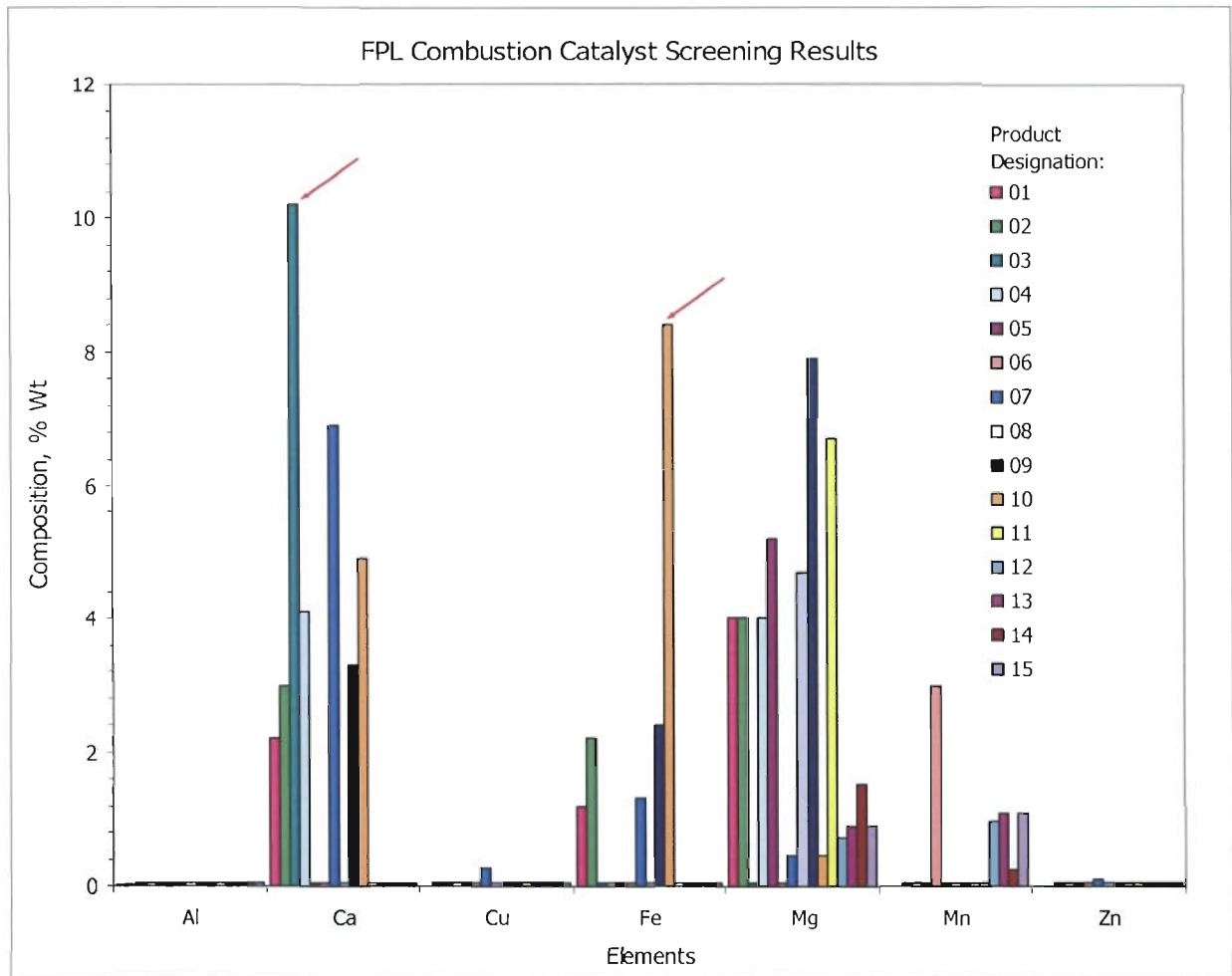


FIG.1 – CHEMICAL COMPARISON OF COMBUSTION CATALYST PRODUCTS

- Conclusions:
 - a. Combustion catalyst formulations vary significantly between products; and
 - b. Out of fifteen formulations, only two products have high content of key catalytic elements such as Ca and Fe.

4. FPL FLEET ADDITIVE TREATMENT EVALUATION

Based on the pre-screening results, the most promising products are then selected for full-scale field testing. To maximize the additive effectiveness, additional parameters are evaluated and the products are ranked against the operating conditions of the unit. As shown in Figure 2, fuel oil characteristics, boiler and combustion equipment design, unit fuel mix, and dispatch requirements are factored in the final selection process.

Factors		Possible Causes		Comments	
Combustion Catalyst Effectiveness	1 Product Formulation	1.1	Ca Concentration	1.1.1	Most effective C-conversion catalytic element
		1.2	Fe Concentration	1.2.1	Effective but also SO ₃ catalyst
		1.3	Inorganic vs. Organic	1.3.1	Inorganic typically formulated with higher Ca
	2 Injection Rate	2.1	Low vs. High Ratio	2.1.1	The higher, the better. Maximum limited by boiler fouling potential & economics.
	3 Fuel Oil Characteristics	3.1	Asphaltenes Content	3.1.1	High content indicative of large C-C molecules
		3.2	Fuel Viscosity	3.2.1	Viscous oils produces higher unburned carbon
		3.3	Sulfur Content	3.3.1	Higher Fuel-S generates more SO ₃ -Opacity
	4 Atomization Properties	4.1	Firing Temperature	4.1.1	Must be optimized for best atomization
		4.2	Atomizing Medium	4.2.1	Steam better than mechanical atomization
	5 Burner Stoichiometric	5.1	Excess Oxygen	5.1.1	Optimum excess oxygen maximizes C-conversion
5.2		Air/Fuel Burner Ratio	5.2.1	Optimum ratio per burner minimizes Opacity	
6 Burner/Atomizer Conditions	6.1	Swirlers Conditions	6.1.1	Impact significantly carbon conversion	
	6.2	Damper Conditions	6.2.1	Affect oil/air mixing	
	6.3	Tip Conditions	6.3.1	Impact significantly oil atomization	
7 Firing Rate	7.1	High vs. Low Load	7.1.1	Unburned carbon typically higher @ high loads	
	7.2	Ramping	7.2.1	Soot re-entrainment & acid mist Opacities	
8 Furnace Design	8.1	Front vs. T-Fired	8.1.1	T-Fired provides better mixing & C-conversion	
	8.2	Flame Temp	8.2.1	Higher flame temp improves C-conversion	
	8.3	Furnace Residence	8.3.1	Higher residence time improves C-conversion	
9 Additive & Oil Mixing	9.1	Mixing Effect	9.1.1	Good mixing allows equal distribution to burners	
	9.2	Mixing Efficiency	9.2.1	Better when additive is passed thru pumps	
10 Fuel Mix (Oil & Gas)	10.1	%Gas Mix	10.1.1	At high gas ratios, CombCat becomes less effective.	

FIG.2 – POTENTIAL FACTORS AFFECTING COMBUSTION CATALYST EFFECTIVENESS

Before proceeding to test combustion catalyst, Turkey Point (PTF) fly ash was analyzed to quantify its unburned carbon and other key chemical components. Figure 3 summarizes the lab results and compares PTF fly ash to other FPL oil firing units, where Ca-based treatment has been quite successful. Note that PTF fly ash has 40% unburned carbon (by weight), which is between Martin (PMR) and Manatee (PMT) results. The higher the unburned carbon is in the fly ash, the greater potential combustion catalyst has in reducing PM emissions.

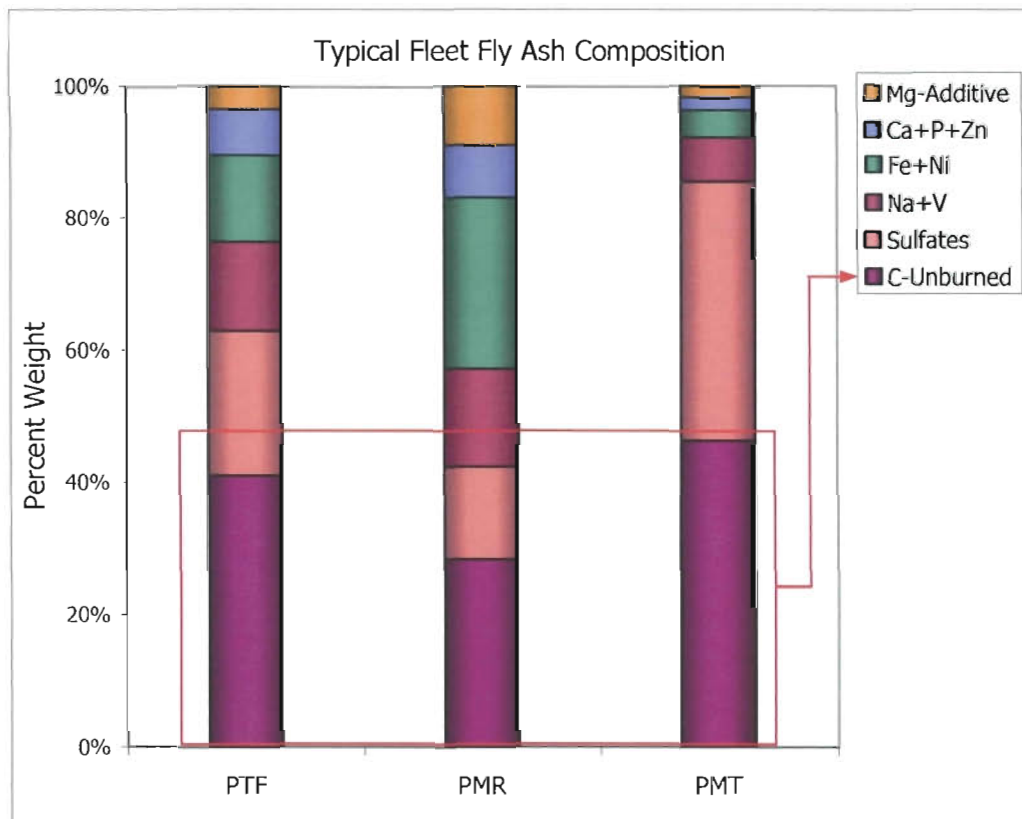


FIG.3 – PTF FLY ASH COMPOSITION COMPARED TO OTHER FPL SITES

- Conclusions:
 - a. PTF unburned carbon content in the fly ash is similar to other FPL oil firing units; and
 - b. Consequently, PTF particulate reduction with Ca-based catalyst treatment should be equivalent to other FPL units (e.g., Martin and Manatee).

- Recommendation:

Proceed to use Ca-based catalyst with greatest potential to maximize PM emission reduction at PTF.

5. PTF COMBUSTION CATALYST TEST PLANNING

To maximize PM emission reduction, a detailed cause and effect diagram was brainstormed for the PTF catalyst treatment program. As shown in Figure 4, factors with highest risk of affecting the additive performance were identified and considered in the test plan definition.

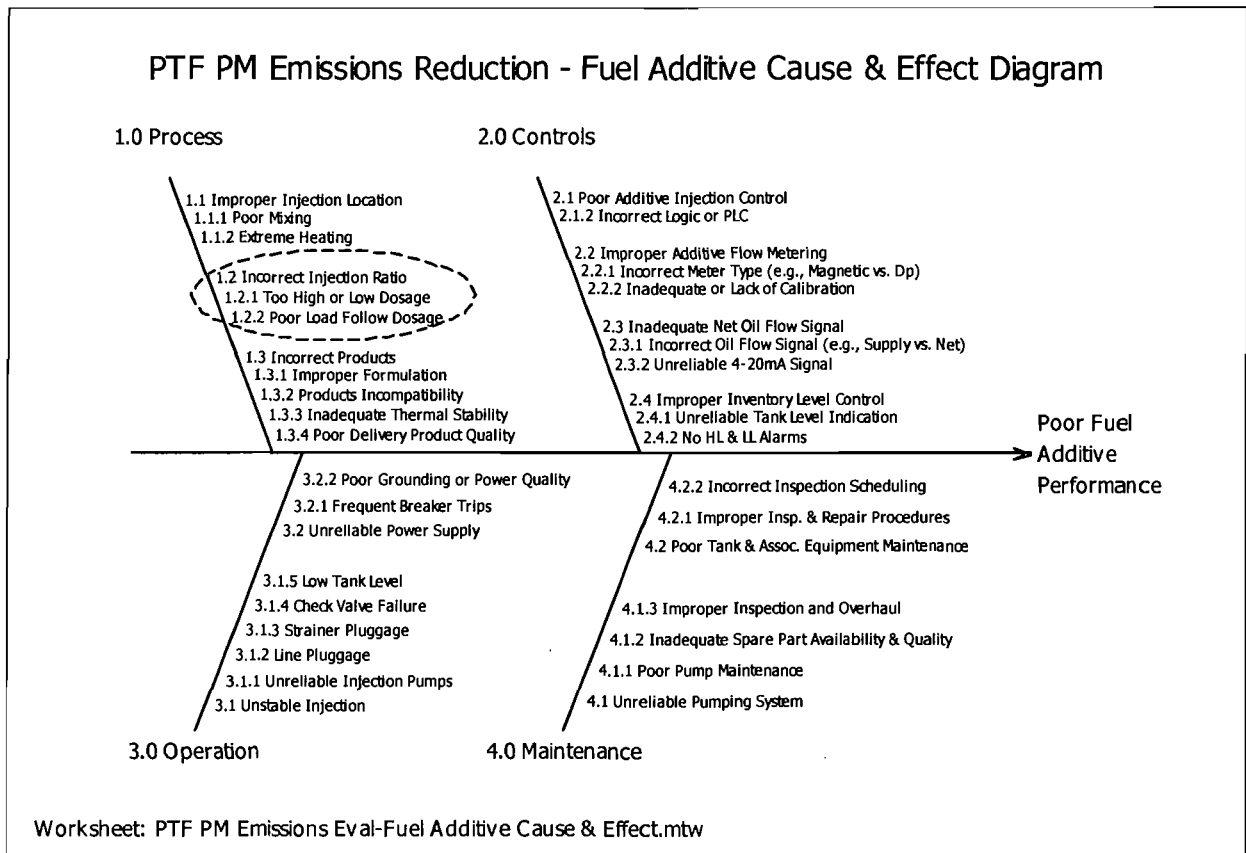


FIG.4 – PTF PM EMISSIONS REDUCTION-FUEL ADDITIVE CAUSE & EFFECT DIAGRAM

Therefore, the following optimization program was developed for Ca-based combustion catalyst tests at PTF to maximize reduction of particulate and Opacity emissions with combustion catalyst across the unit load.

6. PTF COMBUSTION CATALYST TEST RESULTS

A statistical design of experiment (DOE) methodology was used to evaluate the response of particulate emission (primary variable) as a function of combustion catalyst injection rate and unit load. Table 1 summarizes the planning phase of this DOE.

Response	Description	Unit	LSL	USL*
Particulates (Primary Variable)	Stack Particulate Emission	Lb/MBtu		0.07

Factors	Description	Unit	Levels		
Unit Load	Gross Generation	MWg	90	380	
Injection Rate	Feedrate (i.e., gal Additive/gal Oil)	ppm	250	333	500

*Upper specification limit

TABLE 1 – DESIGN OF EXPERIMENT PLAN FOR PARTICULATE REDUCTION OPTIMIZATION

Note: Please see Attachment A for conversion between ppm and ratio of injection rates.

Since PTF units normally operate at either minimum and full loads, a multilevel factorial DOE with two load levels and three additive rates was used. Table 2 shows the DOE randomized test runs.

Test Conditions					Test Settings		Response & Data Collection
Run	Day	Time Min	Test Start	Test End	Load MWg	CombCat Rate, ppm	Particulates, Lb/MBtu
B1	1	60	8:00	9:00	98	0	Stack Sampling
1		60	10:00	11:00	98	500	Stack Sampling
		120	11:00	13:00	90 min ramping & 30 min to reach steady state		
B2		60	13:00	14:00	380	0	Stack Sampling
2		60	15:00	16:00	380	333	Stack Sampling
3		60	17:00	18:00	380	500	Stack Sampling
B4	2	60	7:00	8:00	98	0	Stack Sampling
4		60	9:00	10:00	98	250	Stack Sampling
5		60	11:00	12:00	98	333	Stack Sampling
		120	12:00	14:00	90 min ramping & 30 min to reach steady state		
B6		60	14:00	15:00	380	0	Stack Sampling
6		60	16:00	17:00	380	250	Stack Sampling

TABLE 2 – MULTILEVEL FACTORIAL DOE TEST PROTOCOL

Note that four additional runs were required to properly establish baseline conditions for estimating particulate reductions.

DOE main plots for the optimization of particulate emissions as a function of unit load and injection rate are summarized here:

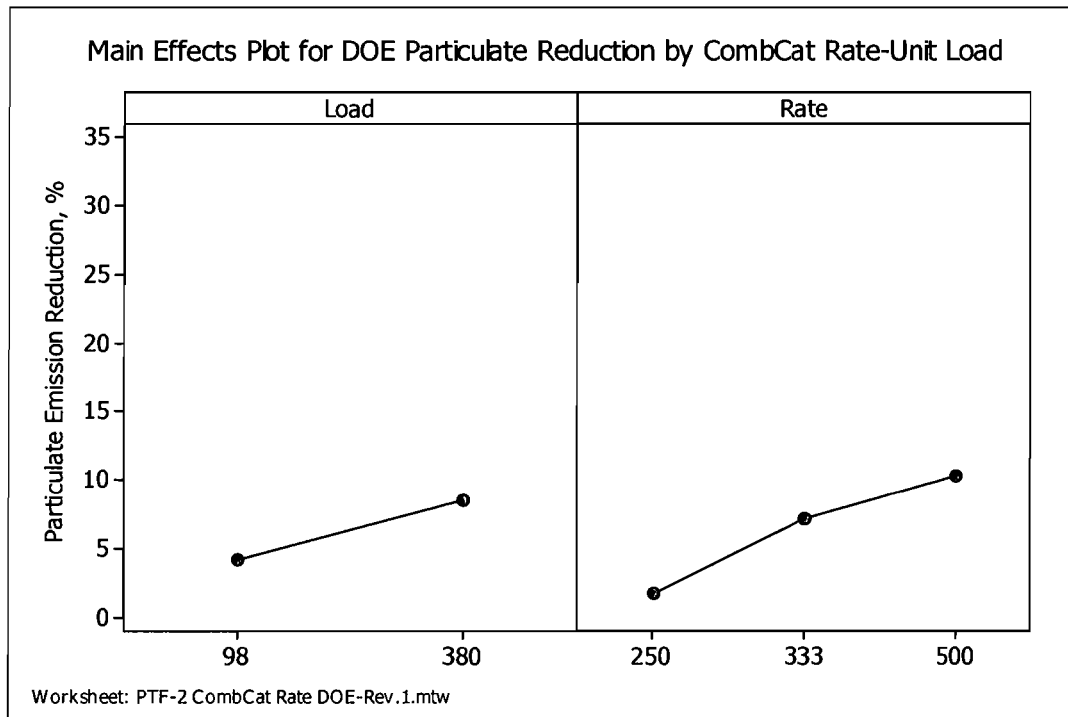


FIG.5 – PTF PARTICULATE REDUCTION PLOTS FOR UNIT LOAD & CATALYST RATE OPTIMIZATION

- Observations:
- Best reduction of 15% particulates was achieved at high unit load and catalyst injection rate; and
 - Low combustion catalyst dosage (i.e., less than 333 ppm) was not effective in reducing particulates.

This suggests that PTF particulate emissions are mostly fine particles (soot) of relatively low weight as in Type 1 case of Figure 6.

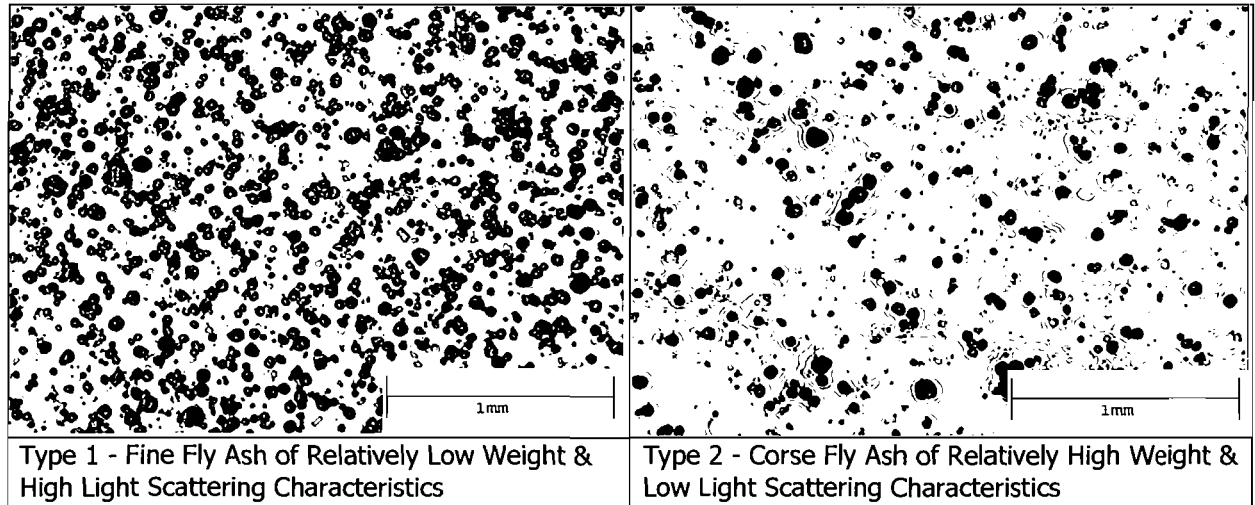


FIG.6 – TYPICAL PARTICLE CHARACTERISTICS OF OIL FIRED FLY ASH

7. TEST CONCLUSIONS AND RECOMMENDATIONS

➤ Conclusions:

- a. Combustion catalysts are considered the most effective fuel oil additives to improve carbon burnout and reduce particulate emissions in the power industry.
- b. FPL additive evaluation process confirmed the importance of pre-screening products in light of their wide formulations currently available in market.
- c. High content of key catalytic elements such as Fe and Ca were found in selective oil-soluble organo-metallics and water-based calcium nitrate additives.
- d. Water-based calcium nitrate was found the most promising formulation for PM emission reduction at PTF after comparing performance of both formulations with multiple combustion equipment designs, fuel properties, and fly ash compositions across the fleet.
- e. Using statistical DOE optimization, the best particulate reductions (i.e., 15%) was achieved at high unit load and catalyst injection rate. This PM emission improvement was short by half of the 30% reduction needed to reach the goal of 0.05 Lb/MBtu.
- f. Low catalyst dosage was not effective in reducing particulates.

➤ Recommendations:

- a. Keep current PM emission limit at 0.07 Lb/MBtu at Turkey Point.
- b. Continue PTF fuel additive treatment. Inject water-based calcium nitrate catalyst at a rate of 500 ppm (i.e., 1:2000 ratio) above 50% unit load when firing oil.

Appendix A – Additive Concentration Conversion

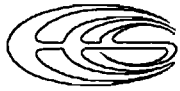
ppm ⁽¹⁾	Ratio ⁽²⁾
200	5000
250	4000
300	3333
333	3000
400	2500
500	2000
600	1667
700	1429
800	1250
900	1111
1000	1000
1100	909

Notes:

1. ppm as X gal of Additive/10⁶ gal of fuel oil
2. Ratio as 1 gal of Additive/X gal of fuel oil

Appendix B – Material Safety Data Sheet: PTF Combustion Catalyst

File: Opacitrol-M MSDS.pdf



Environmental Energy Services, Inc.

EES[®] OPACITROL-M[™]
Combustion Catalyst

Material Safety Data Sheet

Environmental Energy Services, Inc.
 5 Turnberry Lane
 Sandy Hook, CT 06482

Emergency Phone:
CHEMTREC: 800-424-9300
EES[®]: 203-270-0337
Business Phone: 203-270-0337

PART I: What is the material and what do I need to know in an emergency?

Section 1: PRODUCT IDENTIFICATION									
Trade Name (as labeled):	EES [®] - OPACITROL [™] -M								
Chemical Name/Class:	Inorganic Nitrate Solution								
Technical Bulletins:	EES [®] OPACITROL [™] -								
Product Use:	Variety of Industrial Applications								
MSDS Preparation Date:	May 1, 2005								
Health (Blue):	2								
Flammability (Red):	0								
Reactivity (Yellow):	0								
Protective Equipment:	D								
Respiratory:	See Section 8								
See Section 16 for definition of ratings.									
Section 2: COMPOSITION AND INFORMATION ON INGREDIENTS									
Chemical Name	CAS #	% v/v	Exposure Limits in Air						Other
			ACGIH		OSHA		IDLH Mg/m ³		
			TLV Mg/m ³	STEL Mg/m ³	PEL Mg/m ³	STEL Mg/m ³			
Calcium Nitrate Tetrahydrate	13477-34-4	> 50%	NE	NE	NE	NE	NE	NE	
Water	7732-18-5	Balance	NE	NE	NE	NE	NE	NE	

NE = Not Established

C = Ceiling

See Section 16 for definition of terms used.

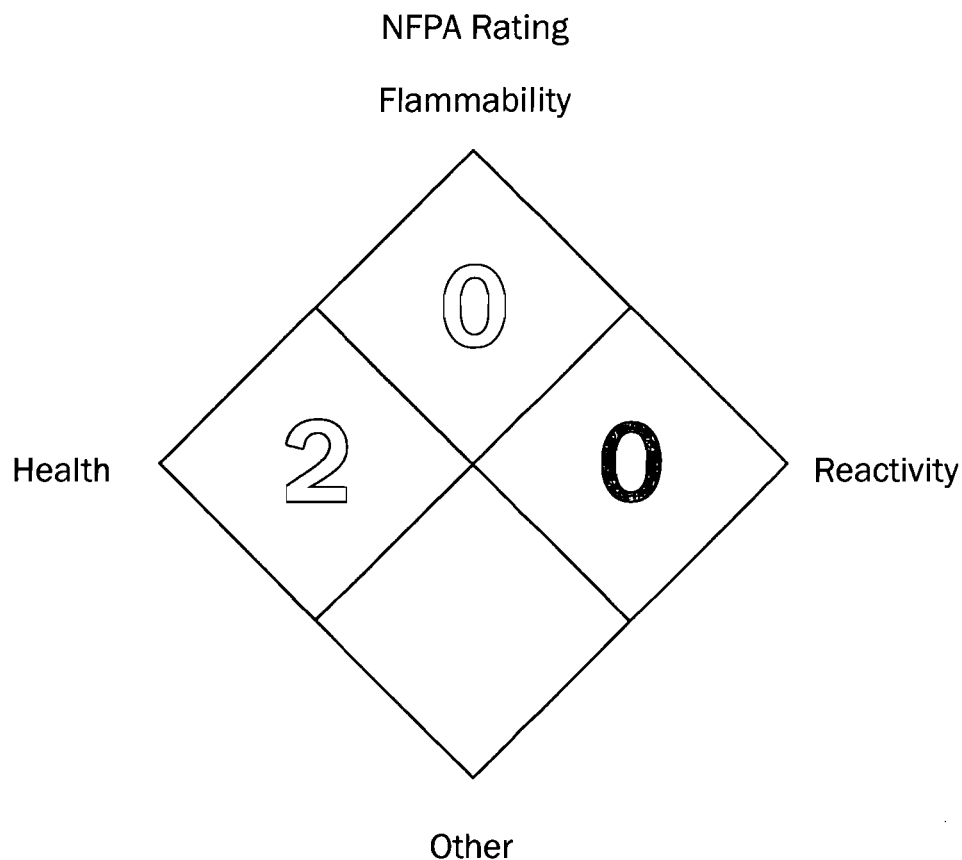
NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1993 format.

Section 3: HAZARD INFORMATION

Emergency Overview:	This product is a colorless, odorless solution. This primary health hazard associated with this product is the potential for moderate irritation of the eyes, skin, and other contaminated tissue. This product is not flammable or reactive. In its dry form, this product may act as an oxidizer to initiate and sustain the combustion of flammable materials. Emergency responders must wear the personal protective equipment suitable for the situation to which they are responding.
Symptoms of Overexposure by Route of Exposure:	The primary routes of overexposure for the solution are via inhalation and contact with skin and eyes. The following paragraphs describe the symptoms of overexposure to this material.
Inhalation:	If vapors, mists or sprays of this product are inhaled, they may irritate the nose, throat and lungs. Symptoms may include the following: sneezing, coughing, and difficulty breathing. Severe overexposure can result in damage to the respiratory system tissues. Most symptoms are generally alleviated when the overexposure ends.
Contact with Skin or Eyes:	Depending on the duration of overexposure, contact with the eyes will cause irritation, pain, and reddening. Severe eye exposure can cause conjunctivitis. Severe, prolonged exposures may cause tissue damage, which could lead to blindness. Depending on the duration of skin contact, skin overexposures will cause reddening, discomfort, moderate irritation and tissue damage. Dermatitis may result from prolonged or repeated skin contact.
Skin Absorption:	Skin absorption is not a significant route of overexposure for the components of this product.
Ingestion:	If this product is swallowed, irritation and burns of the mouth, throat, esophagus, and other tissues of the digestive system will occur immediately upon contact. Symptoms of such overexposure can include nausea, abdominal pain, vomiting and diarrhea. Severe ingestion overexposures can result in convulsions and collapse. The nitrate component of Calcium Nitrate, Tetrahydrate (a component of this product) may damage the oxygen transport system to the blood. Severe ingestion exposures can be fatal. Repeated ingestion of small amounts of this product (as may occur in the event of poor hygiene practices) may cause weakness, depression, headaches, and mental impairment.
Injection:	Accidental injection of this product, via laceration or puncture by a contaminated object, may cause pain and irritation in addition to the wound.
Health Effects or Risks from Overexposure: <i>An explanation in Lay Terms.</i>	
In the event of overexposure, the following symptoms may be observed:	
Acute:	The primary hazard associated with this product is the potential for moderate irritation of the skin, eyes, and other contaminated tissues. Prolonged contact can result in tissue damage. Ingestion of this product can be harmful or fatal.
Chronic:	Dermatitis (inflammation and redness of the skin) may result from prolonged or repeated skin contact. Repeated ingestion of small amounts of this product may cause weakness, depression, headaches, neurological effects, and mental impairment. See Section 11: Toxicology Information for additional information.
Target Organs:	Skin, eyes, nervous system.

PART II: What should I do if a hazardous situation occurs?

Section 4: FIRST-AID MEASURES	
Skin Exposure:	If this product contaminates the skin, begin decontaminated with running water. The minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek medical attention if any adverse effects occur.
Eye Exposure:	If this product's liquid or vapors enter the eyes, open contaminated individual's eyes while under gently running water. Use sufficient force to open eyelids. Have contaminated individual "roll" eyes. Minimum flushing is for 15 minutes. Contaminated individual must seek immediate medical attention.
Inhalation:	If vapors, mists, or sprays of this product are inhaled, remove contaminated individual to fresh air. If necessary, use artificial respiration to support vital functions. Remove or cover gross contamination to avoid exposure to rescuers.
Ingestion:	If this product is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, DO NOT INDUCE VOMITING. Contaminated individual should drink milk, egg whites, or large quantities of water. Never induce vomiting or give diluents (milk or water) to someone who is <u>unconscious, having convulsions, or unable to swallow.</u>
Contaminated individuals must be taken for medical attention if any adverse reaction occurs. Rescuers should be taken for medical attention, if necessary. Take a copy of the label and MSDS to health professional with contaminated individual.	
Section 5: FIRE-FIGHTING MEASURES	



See Section 16 for definition of ratings.

Section 5: FIRE-FIGHTING MEASURES (Continued)

Flash Point:	Not flammable
Autoignition Temperature:	Not flammable
Flammable Limits (in air by volume %)	Lower (LEL): Not applicable
	Upper (LEL): Not applicable
Fire Extinguishing Materials:	
Water Spray:	Yes
Foam:	Yes
Halon:	Yes
Carbon Dioxide:	Yes
Dry Chemical:	Yes
Other:	Any "ABC" Class
Unusual Fire and Explosion Hazards:	This product is a moderate irritant and presents a potential contact hazard to firefighters. When involved in a fire, this material may decompose and produce acrid vapors, calcium compounds, and oxides of nitrogen. Though not anticipated to be a significant hazard associated with this product, due to that fact that this is a solution, it is important to note that in its dry form, Calcium Nitrate is an oxidizer, which can act to initiate and sustain the combustion of flammable materials.
Explosion Sensitivity to Mechanical Impact:	Not sensitive
Explosion Sensitivity to Static Discharge:	Not sensitive
Special Fire-Fighting Procedures:	Incipient fire responders should wear eye protection. Structural fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Chemical resistant clothing may be necessary. Move containers from fire area if they have not been exposed to heat and if it can be done without risk to personnel. If this product is involved in a fire, fire run-off should be contained to prevent possible environmental damage. Rinse all contaminated equipment thoroughly with water before returning to service.
Section 6: ACCIDENTAL RELEASE MEASURES	
Spill and Leak Response:	Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a large spill, clear the affected area, and protect people. In the event of a non-incident release (e.g., 55-gallon release in which excessive splashes or sprays can be generated), minimum Personal Protective Equipment should be Level C: triple-gloves (rubber gloves and nitrile gloves over latex gloves), chemically resistant suit and boots, hard-hat and an air-purifying respirator with a high-efficiency particulate filter. Level B, which includes Self-Contained Breathing Apparatus, must be worn in situations in which excessive sprays or mists can be generated, or the oxygen level is less than 19.5% or unknown. Absorb spilled liquid with lime, polypads, or other suitable absorbent materials. Decontaminate the area thoroughly. Place all spill residues in a suitable container and seal. Dispose of in accordance with U.S. federal, state, and local waste disposal regulations, or the applicable Canadian standards (see Section 13: Disposal Considerations).

PART III: How can I prevent hazardous situations from occurring?

Section 7: HANDLING AND STORAGE	
Work and Hygiene Practices:	As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash hands after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. All work practices should minimize the generation of splashes and aerosols. Remove contaminated clothing immediately.
Storage and Handling Practices:	All employees who handle this material should be trained to handle it safely. Avoid breathing vapors or mists generated by this product. Use in a well-ventilated location. Open containers slowly, on a stable surface. Containers of this product must be properly labeled. Empty containers may contain residual liquid or vapors; therefore, empty containers should be handled with care. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Store away from incompatible materials (see Section 10: Stability and Reactivity). Material should be stored in secondary containers or in a diked area, as appropriate. Keep container closed tightly when not in use. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged.
Protective Practices During Maintenance of Contaminated Equipment:	Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely, if necessary. Collect all rinsates and dispose of according to applicable U.S. federal, state, or local procedures, or the appropriate Canadian Standards.
Section 8: EXPOSURE CONTROLS – PERSONAL PROTECTION	
Ventilation and Engineering Controls:	Exhaust directly to the outside. Use local exhaust ventilation, and process enclosure if necessary, to control mist formation. Supply sufficient replacement air to make up for air removed by system. Ensure eyewash/safety shower stations are available near areas where this product is used.
Respiratory Protection:	Maintain airborne containment concentrations below exposure limits listed in Section 2 (Composition and information on Ingredients). If respiratory protection is (e.g., air-purifying respirator with dust/mist/fume cartridge), use only protection authorized in 29 CFR 1910.134, or applicable U.S. state regulations (or the appropriate standards of Canada and its provinces). Use supplied air respiration protection during response procedures to non-incident releases and if oxygen levels are below 19.5% or unknown.
Eye Protection:	Splash goggles or safety glasses. Face shields recommended when using quantities of this product in excess of one (1) gallon.
Hand Protection:	Wear Neoprene or rubber gloves for routine industrial use. Use triple gloves for spill response, as stated in Section 6 (Accidental Release Measures) of this MSDS.
Body Protection:	Use body protection appropriate for task. An apron, or other impermeable body protection is suggested. Full-body chemical protective clothing is recommended for emergency response procedures.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES	
Vapor Density:	Not applicable
Specific Gravity @ 15 °C (59 °F):	1.465-1.475
Solubility in Water:	Completely
Vapor Pressure:	Not applicable
Odor Threshold:	Not applicable
Log Water/Oil Distribution Coefficient:	Not available
Appearance and Color:	This product is a colorless, odorless solution
How to detect this substance (Warning Properties):	There are no distinguishing characteristics of this product
Evaporation Rate (n-BuAc – 1):	Similar to water
Freezing Point or Range:	-35 °C (-31 °F)
Boiling Point:	>100 °C (>212 °F)
pH @ 15 °C (59 °F):	6.5-8.0
Section 10: STABILITY AND REACTIVITY	
Stability:	Stable
Decomposition Products:	Calcium compounds, nitrogen oxides
Materials with which Substance is Incompatible:	Flammable and combustible materials, strong reducing agents, finely powdered metals.
Hazardous Polymerization:	Will not occur
Conditions to Avoid:	Extreme heat and contact with incompatible chemicals

PART IV: Is there any other useful information about this material?

Section 11: TOXICOLOGICAL INFORMATION	
Toxicity Data:	The toxicology data available for the components of this product specifically listed in Section 2 (Composition and Information on Ingredients), and for a related compound, are as follows:
OPACITROL™ -M: Skin-rabbit, adult 500 mg/24 hours, mild irritation effects; Eye effects – rabbit, adult 500 mg/24 hours, mild irritation effects; Oral – rat LD ₅₀ , 3900 mg/kg	CALCIUM NITRATE: Oral – rat LD ₅₀ , 302 mg/kg
Suspected Cancer Agent:	The components of this product are not found on the following lists: U.S. Federal OSHA, NTP, IARC, and CAL/OSHA and therefore are not considered to be, nor suspected to be, cancer causing agents by these agencies.
Irritancy of Product:	This product is moderately irritating to contaminated tissue
Sensitization of Product:	This product contains no known sensitizers with repeated or prolonged use.
Reproductive Toxicity Information:	Listed below is information concerning the effects of this product and its components on the human reproductive system:
Mutagenicity:	This product is not reported to produce mutagenic effects in humans
Embryotoxicity:	
Teratogenicity:	

Section 11: TOXICOLOGICAL INFORMATION (continued)**Reproductive Toxicity:** This product is not reported to cause reproductive toxicity effects in humans

A **mutagen** is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An **embryotoxin** is a chemical that causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A **teratogen** is a chemical that causes damage to a developing fetus, but the damage does not propagate across generational lines.

A reproductive toxin is any substance that interferes in any way with the reproductive process.

Medical Conditions Aggravated by Exposure:

Pre-existing dermatitis, or other skin disorders, and conditions involving the other Target Organs (see Section 3, Hazard Identification) may be aggravated by over-exposure to this product.

Recommendations to Physicians:

Treat symptoms and eliminate over-exposure. Be observant for signs of pulmonary edema in the event of severe inhalation over-exposure.

ACGIH Biological Exposure Indices:

Currently, there are no ACGIH Biological Exposure Indices (BEI's) associated with components of this product.

Section 12: ECOLOGICAL INFORMATION**ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION****Environmental Stability:**

The components of this product are relatively stable under ambient, environmental conditions.

Effect of Materials on Plants or Animals:

This product may be harmful to terrestrial plant or animal life, especially if released in large quantities. Refer to Section 11 for clinical data on the effects of this product's components on test animals.

Effect of Chemical on Aquatic Life:

This product may be harmful to aquatic plant or animal life, especially if released in large quantities.

Section 13: DISPOSAL CONSIDERATIONS**Preparing Wastes for Disposal:**

Waste disposal must be in accordance with appropriate U.S. federal, state, and local regulations, or appropriate Canadian standards. This product, if unaltered, may be disposed of by treatment at a permitted facility.

EPA Waste Number:

Not applicable to wastes consisting only of this product.

Section 14: TRANSPORTATION INFORMATION**THIS MATERIAL IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION****Proper Shipping Name:**

Not applicable

Hazardous Class Number and Description:

Not applicable

UN Identification Number:

Not applicable

Packing Group:

Not applicable

DOT Label(s) Required:

Not applicable

North American Emergency Response Number:

Not applicable

Marine Pollutant:

This product does not contain any components which are designated by the Department of Transportation (DOT) to be Marine Pollutants (per 49 CFR 172.101 Appendix B)

Transport Canada Transportation of Dangerous Goods Regulations:

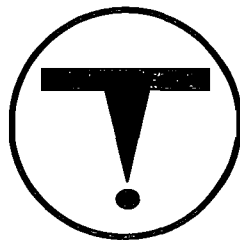
THIS MATERIAL IS NOT CONSIDERED AS DANGEROUS GOODS.

Section 15: REGULATORY INFORMATION

ADDITIONAL UNITED STATES REGULATIONS			
U.S. SARA Reporting Requirements:		The components of this product are subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act, and are listed below as follows:	
Chemical Name	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
OPACITROL™ -M (as Nitrate Compounds, Water Dissociable)	NO	NO	YES
U.S. SARA Threshold Planning Quantity:		Not applicable	
U.S. CERCLA Reportable Quantity (RQ):		Calcium Nitrate, Tetrahydrate is a hydrate of anhydrous Calcium Nitrate, which is on the TSCA inventory.	
U.S. TSCA Inventory Status:		Not applicable	
Other U.S. Federal Regulations:		Not applicable	
U.S. Regulatory Information:	The components of this product are covered under the following specific state regulations:		
Alaska – Designated Toxic and Hazardous Substance:	No		
California – Permissible Exposure Limits for Chemical Contaminates:	No		
Florida – Substance List:	No		
Illinois – Toxic Substance List:	No		
Kansas – Section 302/313 List:	No		
Massachusetts – Substance List:	No		
Michigan – Critical Materials Register:	No		
Minnesota – List of Hazardous Substances:	No		
Missouri – Employer Information/Toxic Substance List:	No		
New Jersey – Right to Know Hazardous Substance List:	Calcium Nitrate		
North Dakota – List of Hazardous Chemicals, Reportable Quantities:	No		
Pennsylvania – Hazardous Substance List:	No		
Rhode Island – Hazardous Substance List:	No		
Texas – Hazardous Substance List:	No		
West Virginia – Hazardous Substance List:	No		
Wisconsin – Toxic and Hazardous Substances:	No		
California Safe Drinking Water and Toxic Enforcement Act (Proposition 65):	No component of this product is on the California Proposition 65 lists		

Section 15: REGULATORY INFORMATION (Continued)

<p>ANSI Labeling (per Z129.1, provided to summarize occupational safety hazards):</p>	<p>WARNING! CAUSES SKIN OR EYE IRRITATION. MAY BE HARMFUL OR FATAL IF SWALLOWED. Keep away from flammable or combustible materials. Do not taste or swallow. Do not get on skin, in eyes, or on clothing. Avoid breathing vapors or mists. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Wear gloves, goggles, face-shield, and suitable body protection. FIRST AID: In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes while removing contaminated clothing or shoes. If inhaled, remove to fresh air. If ingested, do not induce vomiting. Get medical attention. IN CASE OF FIRE: Use water fog, dry chemical, CO₂, or "alcohol" foam. IN CASE OF SPILL: Absorb spill with inert material. Place residue in suitable container. Consult MSDS for additional information.</p>
<p>Current Labeling (Precautionary Statements):</p>	<p>WARNING! INGESTION: Temporary intestinal upset. SKIN CONTACT: Mild irritant. SKIN ABSORPTION: Mild irritant. EYE CONTACT: Mild irritant. FIRST-AID: INGESTION: Flush system with water. Take milk of magnesia. SKIN: Wash with plenty of soap and water. EYE: Flush with running water for a minimum of 15 minutes. INHALATION: Get patient to fresh air; blow nose to remove dust. IN CASE OF FIRE: Aqueous solution is non-flammable, but dry solids will support combustion of flammable materials. Anhydrous nitrates are powerful oxidizing agents. Exposure to heat or flame can emit toxic oxides of nitrogen. IN CASE OF SPILL: Clean up at once. Do not allow dried-out spill to remain near flammable material. See MSDS for further information.</p>
<p>ADDITIONAL CANADIAN REGULATIONS:</p>	
<p>Canadian DSL Inventory:</p>	<p>Calcium Nitrate, Tetrahydrate is a hydrate of anhydrous Calcium Nitrate, which is on the DSL/NDSL inventory.</p>
<p>Canadian WHMIS Symbols:</p>	<p>Class D2B: Materials Causing other Toxic Effects</p>



Section 16: OTHER INFORMATION

DEFINITIONS OF TERMS

A LARGE NUMBER OF ABBREVIATIONS AND ACRONYMS APPEAR ON AN MSDS. SOME OF THESE WHICH ARE COMMONLY USED INCLUDE THE FOLLOWING:

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent. It is used for computer related searching.

EXPOSURE LIMITS IN AIR:

ACGIH – American Conference of Governmental Industrial Hygienists, a professional association that establishes exposure limits. **TLV** – Threshold Limit Value; an airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (TWA), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (c). Skin absorption effects must also be considered. **OSHA** – U.S. Occupational Safety and Health Administration. **PEL** – Permissible Exposure Limit. This exposure value means exactly the same thing as a TLV, except that it is forcible by OSHA. The OSHA Permissible Exposure Limits are based in the 1969 PELs and the June, 1993 Air Contaminates Rule (Federal Register: 58:35338-35351 and 58:40191). Both the current PELs and the vacated PELs are indicated. The phrase, “Vacated 1989 PEL” is placed next to the PEL THAT was vacated by Court Order. **IDLH** – Immediately Dangerous to Life and Health. This level represents a concentration from which one can escape within 30 minutes without suffering, preventing escape or permanent injury. The **DFG-MAK** is the Republic of Germany’s Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the national institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Association (OSHA). NIOSH issues exposure guidelines called Recommended Exposure Levels (RELs) when no exposure guidelines are established, an entry of NE is made for reference.

HAZARD RATINGS:

HAZARD MATERIALS IDENTIFICATION SYSTEM:

Health Hazard: 0 (minimal acute or chronic exposure hazard); 1 (slight acute or chronic exposure hazard); 2 (moderate acute or significant chronic exposure hazard); 3 (severe acute exposure hazard; one-time overexposure can result in permanent injury and may be fatal); 4 (extreme acute exposure hazard; one-time overexposure can be fatal)

Flammability Hazard: 0 (minimal hazard); 1 (materials that require substantial pre-heating before burning); 2 (combustible liquid or solids; liquids with a flash point of 38-93 °C [100-200 °F]); 3 (Class 1B and 1C flammable liquids with flash points below 23 °C [73 °F] and boiling points below 38 °C (100 °F)

Reactivity Hazard: 0 (normally stable); 1 (material that can become unstable at elevated temperatures or which can react slightly with water); 2 (materials that are unstable but do not detonate or which can react violently with water); 3 (materials that can detonate when initiated or which can react explosively with water); 4 (materials that can detonate at normal temperatures or pressures)

Section 16: OTHER INFORMATION (continued)

NATIONAL FIRE PROTECTION ASSOCIATION:

Health Hazard: 0 (material that, on exposure under fire conditions, would offer no hazard beyond that of ordinary combustible materials); 1 (materials that on exposure under fire conditions could cause irritation or minor residual injury); 2 (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); 3 (materials that can, on short exposure, cause serious, temporary, or residual injury); 4 (materials that under very short exposure causes death or major residual injury)

Flammability Hazards and Reactivity Hazard:

Refer to definitions for "Hazardous Materials Identification System"

FLAMMABILITY LIMITS ON AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA).

Flash Point: minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. **Autoignition Temperatures:** the minimum temperature required to initiate combustion in air with no other source of ignition. **LEL:** the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. **UEI:** the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids and liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** - concentration expressed in weight of substance per volume of air; **mg/m³** - concentration expressed in weight of substance per volume of air; **mg/kg** - quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program; **RTECS** - the Registry of Toxic Effects of Chemical Substances; **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1-4. Subrankings (2A, 2B, etc) are also used. Other measures of toxicity include **TDLO**, the lowest dose to cause a symptom; **TDO**, **LDLO**, and **LDO**, or **TC**, **TCO**, **LCLO**, and **LCO**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the level of determinants, which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the **TLV**. **EC** - Ecological Information is the effect concentration in water.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the DOT; the Comprehensive Environmental Response, Compensation and Liability Act (**CERCLA** or **SUPERFUND**); and various state regulations.