AP-42/4.12/ Background

3.4.4 Tire Carcass Grinding

Tire carcass grinding is used for gross rubber removal (tread section) and for preparation of the resulting tire carcass for retreading. This operation consists of two phases, a coarse grind module and a fine grind module. The tire is first ground to a predetermined depth with a coarse grind hasp to prepare it for the fine grind operation. The fine grind operation completely removes the old tread and prepares the carcass surface to receive the new tread. The tire carcass to be ground is placed on a shaft and rotated at a predetermined speed. The carcass is then placed against a rotating fine-toothed hasp at a desired pressure. The hasp moves across the surface of the carcass in a predetermined pattern.

The fine grinding operation was selected for the study because the grinding period is longer, the pressure of the hasp on the wheel is greater than the coarse grind, and the temperature of the carcass surface is higher than for the coarse grinding operation. The grinding time for the coarse grind operation is one to two minutes, while the grinding time for the fine grind operation is four minutes. Approximately 10 to 12 tires are ground per hour.

The fine grind module consists of the rotating shaft on which the carcass is placed and a rotating fine-tooth hasp which is covered by a hood. At the facility tested, a flexible exhaust duct connects the hood to an elevated horizontal duct which leads to a cyclone. The exhaust from the cyclone passes through a horizontal centrifugal fan to an outlet stack on the roof. The entire module was enclosed with Tedlar sheeting to enhance the capture of volatiles, semivolatiles, and particulate matter by the hasp hood. Sampling was conducted in the 10-inch horizontal cyclone inlet duct and in the 16-inch outlet stack. Emissions are presented as pounds emitted per pound of rubber removed, measured by the quantity of rubber dust and rubber particles collected in the cyclone hopper.

3.5 Engineered Products Grinding - Drive Belts

The belt grinding operation selected for this study was located at an engineered rubber products manufacturing facility. The selected process line was deemed to be representative of surface grinding operations. This particular line was used for V-belt grinding and consists of eight grinders. Each grinder is enclosed within a close-fitting hood. An exhaust duct exited from each hood and entered an overhead exhaust manifold. The combined exhaust streams entered the 16-inch diameter central cyclone inlet duct which led to a cyclone. An 18-inch duct exited from the top of the cyclone and enters a dual three-stage electrostatic precipitator (ESP). The effluent streams exiting the ESP were combined into a single 14-inch duct which exited the roof through an I.D. fan. During the grinding operation the belts were cooled with a localized water spray located within each grinder hood. Sampling was conducted in the cyclone inlet duct, cyclone exit duct, and ESP exit duct. Emissions are presented as pounds per hour and as pounds emitted per pound of rubber removed, as measured by initial and final weights of the belt batches for each test run.

REFERENCES FOR SECTION 3

1. *Development of Emission Factors for the Rubber Manufacturing Industry, Volume 1: Emission Factor Program Results. Final Report*, prepared for the Rubber Manufacturers Association (RMA) by TRC Environmental Corporation, Lowell, MA, May 1995.

GRINDING OPERATIONS
HAP EMISSION FACTOR SUMMARY

10/27/2010

AP-42 / 4.12

Analyte Name	CAS #	Belt 30800151 lb/lb rubber removed	Carcass 30800152 lb/lb rubber removed	Retread 30800153 lb/lb rubber processed	Sidewall / Whitewall 30800154 lb/lb rubber removed
Total VOC		1.78E-03	5.21E-04	2.43E-04	1.59E-02
Total Speciated Organics		2.66E-03	2.53E-03	6.36E-04	1.10E-02
Total Organic HAPs		2.15E-03	1.27E-04	1.33E-05	1.12E-03
Total Metal HAPs		1.34E-05	6.35E-06	6.44E-08	3.72E-05
Total HAPs		2.17E-03	1.27E-04	1.33E-05	1.16E-03
Total Particulate Matter		2.26E-04	5.45E-01	9.09E-07	1.96E-04
1,1,1-Trichloroethane	71-55-6		3.58E-07	2.19E-08	
1,3-Butadiene	106-99-0	2.41E-05	2.65E-05	4.39E-08	2.40E-05
1,4-Dichlorobenzene	106-46-7			6.77E-09	
2-Butanone	78-93-3	6.22E-06	5.13E-07	1.51E-08	2.97E-05
2-Chloro-1,3-Butadiene	126-99-8	8.16E-05			
2-Methylphenol	95-48-7			3.91E-09	
4-Methyl-2-pentanone	108-10-1		1.92E-05	8.44E-07	
4-Nitrobiphenyl	92-93-3	3.80E-07			
Acetaldehyde	75-07-0	1.53E-05			
Acetophenone	98-86-2	1.77E-05	7.13E-07	1.89E-08	3.37E-06
Acrolein	107-02-8	6.44E-06	1.68E-06	4.70E-07	
Aniline	62-53-3		1.97E-05	6.66E-08	4.05E-04
Benzene	71-43-2		4.13E-06	9.96E-06	1.33E-05
Biphenyl	92-52-4			6.63E-09	
bis(2-Ethylhexyl)phthalate	117-81-7	5.30E-05	7.94E-06	1.99E-08	2.76E-05
Cadmium (Cd) Compounds		1.40E-07	8.58E-07		7.38E-07
Carbon Disulfide	75-15-0	3.03E-04	2.58E-06	6.77E-07	1.90E-05
Carbonyl Sulfide	463-58-1	7.14E-06	8.70E-06		
Chloromethane	74-87-3			7.12E-09	
Chromium (Cr) Compounds		2.58E-06	1.44E-06	3.79E-08	1.34E-05
Cobalt (Co) Compounds				8.74E-09	
Cumene	98-82-8				1.13E-06
Di-n-butylphthalate	84-74-2	3.31E-06	2.24E-06	3.87E-08	2.54E-06
Dibenzofuran	132-64-9		1.59E-07		
Ethylbenzene	100-41-4				5.70E-05
Hexane	110-54-3	4.18E-05	1.60E-05		1.24E-04
Isooctane	540-84-1	0.00E+00	1.09E-05		1.15E-04
Isophorone	78-59-1			6.46E-09	
Lead (Pb) Compounds		1.59E-06	2.02E-06		1.55E-05
m-Xylene + p-Xylene		8.51E-06	2.23E-06	5.36E-08	3.18E-05
Methylene Chloride	75-09-2	4.98E-05	2.50E-07	1.67E-07	2.76E-05
Naphthalene	91-20-3	4.02E-06	5.81E-07	2.11E-08	3.81E-06
Nickel (Ni) Compounds		9.13E-06	2.03E-06	1.78E-08	7.51E-06
o-Toluidine	95-53-4		2.55E-06		
o-Xylene	95-47-6	5.40E-06		4.17E-08	1.86E-05
Phenol	108-95-2	8.88E-06	1.66E-06	3.04E-07	1.57E-05
Propylene Oxide	75-56-9	3.06E-05			
Styrene	100-42-5			9.86E-08	1.69E-05
Tetrachloroethene	127-18-4	1.39E-04		7.58E-09	
Toluene	108-88-3	6.30E-06	6.30E-06	3.82E-07	1.86E-04
Trichloroethene	79-01-6		1.95E-06		

GRINDING OPERATIONS
HAP EMISSION FACTOR SUMMARY

Analyte Name	CAS #	Belt 30800151 lb/lb rubber removed	Carcass 30800152 lb/lb rubber removed	Retread 30800153 lb/lb rubber processed	Sidewall / Whitewall 30800154 lb/lb rubber removed

NOTES:

Sidewall, carcass, and belt grinding are reported in pounds emitted per pound of rubber removed or ground-off.

Retread buffing is reported in pounds emitted per pound of rubber processed.

All factors represent uncontrolled emissions. Below are the control efficiencies for the equipment used in testing:

Particulate Matter Control:

- Sidewall by cyclone - 91.9%
- Carcass by cyclone - 97.8%
- Belt by cyclone and ESP - 99.97%
- Retread by cyclone and baghouse - 97.9%

Toluene and methylene chloride factors on this table for carcass grinding were updated from the original by testing performed by Michelin North America in 1/99. The updated factors were submitted to EPA for inclusion in the AP-42.

Source Test: Stationary Source Sampling Report Michelin North America, Inc Tire Carcass Grinder Exhaust, Duncan, SC Performed by Trigon Engineering - January 1999

The revisions for toluene and methylene cloride are also reflected in the factors for Total HAPs, Total Organic HAPs and Total Speciated Organics.

All emissions factors are E rated

Extruder
HAP Emission Factor Summary

Analyte Name	CAS #	Cmpd #4 lb/lb rubber	Cmpd #6 lb/lb rubber	Cmpd #9 lb/lb rubber	Cmpd #22 lb/lb rubber
Total VOC		5.67E-06	1.23E-05	1.24E-05	8.30E-06
Total Speciated Organics		2.11E-05	9.04E-05	3.51E-05	1.81E-05
Total Particulate Matter		3.11E-08	7.77E-09	1.51E-08	2.34E-08
Total Organic HAPs		9.87E-06	3.51E-05	1.87E-05	8.54E-06
Total Metal HAPs		4.67E-07	1.05E-07	1.95E-07	7.55E-07
Total HAPs		1.03E-05	3.52E-05	1.89E-05	9.30E-06
1,1,1-Trichloroethane	71-55-6	8.47E-08	9.37E-08	6.58E-08	3.48E-08
1,1-Dichloroethene	75-35-4			7.04E-08	
1,3-Butadiene	106-99-0	8.92E-08	5.06E-07	6.01E-08	7.83E-08
1,4-Dichlorobenzene	106-46-7	8.36E-09			1.97E-09
1,4-Dioxane	123-91-1			1.67E-07	
2-Butanone	78-93-3	1.34E-07	1.17E-07	1.15E-07	9.28E-08
2-Chloroacetophenone	532-27-4	6.48E-09	1.68E-09	3.83E-09	5.35E-09
2-Methylphenol	95-48-7			9.28E-09	
4-Methyl-2-Pentanone	108-10-1	5.54E-06	2.66E-06	2.85E-07	1.63E-06
Acetonitrile	75-05-8	1.09E-07	2.19E-07		
Acetophenone	98-86-2	3.65E-08	3.32E-06	8.18E-06	1.65E-08
Acrolein	107-02-8	2.03E-07	3.10E-07	9.10E-08	1.04E-07
Aniline	62-53-3	5.08E-07	2.19E-07	5.52E-09	2.23E-07
Benzene	71-43-2	4.46E-08	2.69E-07	7.51E-08	1.28E-07
Benzidine	92-87-5			1.26E-08	
Biphenyl	92-52-4	4.65E-09	1.68E-08	3.27E-09	4.42E-09
bis(2-Ethylhexyl)phthalate	117-81-7	1.94E-07	1.13E-07	6.70E-08	1.55E-07
Carbon Disulfide	75-15-0	1.09E-07	2.66E-07	9.06E-08	1.16E-07
Chloroethane	75-00-3				5.36E-08
Chloroform	67-66-3				3.81E-08
Chloromethane	74-87-3	7.06E-08	6.64E-08	5.16E-08	1.88E-07
Chromium (Cr) Compounds		2.45E-07	2.25E-08	7.82E-08	2.54E-07
Cobalt (Co) Compounds		1.90E-08	9.92E-09	1.51E-08	1.02E-08
Cumene	98-82-8	3.66E-08	1.36E-07	1.82E-06	1.24E-07
Di-n-butylphthalate	84-74-2	1.87E-07	1.98E-07	3.65E-07	5.01E-08
Dibenzofuran	132-64-9	3.52E-09	3.24E-09	2.51E-09	2.67E-09
Dimethylphthalate	131-11-3		4.27E-09	3.32E-09	
Ethylbenzene	100-41-4	3.30E-08	8.10E-08	3.03E-08	3.57E-07
Hexachlorobutadiene	87-68-3			1.72E-07	
Hexane	110-54-3	1.02E-07	3.94E-07	8.38E-07	2.49E-06
Isooctane	540-84-1	3.81E-08	4.51E-08	2.36E-08	3.71E-09
Isophorone	78-59-1	3.50E-08		4.65E-09	6.45E-08
m-Xylene + p-Xylene		7.01E-08	3.32E-07	1.53E-07	5.22E-07
Methylene Chloride	75-09-2	1.60E-06	1.32E-05	2.69E-06	8.18E-08
N,N-Dimethylaniline	121-69-7	5.45E-09			
Naphthalene	91-20-3	1.08E-07	1.98E-07	1.96E-06	6.30E-08
Nickel (Ni) Compounds		1.99E-07	7.24E-08	1.02E-07	4.91E-07
o-Toluidine	95-53-4		1.50E-07		
o-Xylene	95-47-6	3.49E-08	2.58E-07	7.55E-08	4.77E-07
Phenol	108-95-2	3.11E-07	1.84E-07	1.73E-07	5.07E-08
Propylene Oxide	75-56-9		1.75E-06		4.42E-07
Styrene	100-42-5	9.61E-09	7.25E-07	2.38E-08	3.93E-08
Tetrachloroethene	127-18-4	5.32E-08	4.44E-08	7.39E-08	1.71E-07
Toluene	108-88-3	1.07E-07	9.26E-06	8.95E-07	3.67E-07
Trichloroethene	79-01-6				3.30E-07
Vinyl Chloride	75-01-4				3.26E-08

NOTES:

All emissions factors are E rated

Tire Cure
HAPS Emission Factor Summary

updated 1/11/99 by rjd

Analyte Name	CAS #	OEM 205/70 lb/lb rubber	High Performance 205/70 lb/lb rubber	OEM 195/75 lb/lb rubber	Replacement 195/75 lb/lb rubber
Total VOC		1.80E-04	2.11E-04	3.10E-04	1.94E-04
Total Speciated Organics		2.04E-04	2.13E-04	1.46E-04	1.35E-04
Total Organic HAPs		8.59E-05	1.06E-04	8.53E-05	5.43E-05
Total HAPs		8.59E-05	1.06E-04	8.53E-05	5.43E-05
1,1,1-Trichloroethane	71-55-6	1.19E-07	2.41E-07	3.96E-08	9.27E-08
1,1,2,2-Tetrachloroethane	79-34-5			1.03E-07	
1,1-Dichloroethane	75-34-3	7.96E-08			
1,1-Dichloroethene	75-35-4	5.85E-07			
1,2,4-Trichlorobenzene	120-82-1				2.59E-09
1,2-Dibromo-3-Chloropropane	96-12-8			2.06E-07	
1,4-Dichlorobenzene	106-46-7	6.79E-07	1.89E-09	2.49E-09	6.80E-09
2-Butanone	78-93-3	1.55E-06	1.10E-06	6.35E-07	5.37E-07
2-Chloroacetophenone	532-27-4		1.28E-09		
2-Methylphenol	95-48-7		9.00E-09	5.42E-09	6.63E-09
4-Methyl-2-Pentanone	108-10-1	9.60E-06	1.29E-05	1.32E-05	1.26E-05
Acetophenone	98-86-2	1.08E-07	1.07E-07	1.04E-07	1.20E-07
Acrolein	107-02-8				1.28E-07
Aniline	62-53-3	4.36E-06	5.29E-07	3.73E-06	3.57E-06
Benzene	71-43-2	3.51E-07	4.78E-07	2.01E-07	2.41E-07
Benzyl Chloride	100-44-7	4.42E-08			
Biphenyl	92-52-4		5.41E-08	6.78E-08	3.97E-08
bis(2-Ethylhexyl)phthalate	117-81-7		7.00E-09	6.89E-08	5.92E-07
Bromomethane	74-83-9			9.15E-08	
Carbon Disulfide	75-15-0	4.92E-07	6.86E-06	1.32E-05	4.60E-06
Carbonyl Sulfide	463-58-1			5.44E-07	
Chloroform	67-66-3		2.17E-08		
Chloromethane	74-87-3	4.92E-08	6.49E-08	9.25E-08	4.70E-08
Cumene	98-82-8		4.75E-07	2.28E-07	1.36E-07
Di-n-butylphthalate	84-74-2	9.49E-07	2.88E-07	1.97E-07	4.52E-07
Dibenzofuran	132-64-9		5.84E-09	9.11E-09	9.81E-09
Dimethylphthalate	131-11-3	4.06E-09	9.60E-08	7.36E-09	2.09E-08
Ethylbenzene	100-41-4	1.03E-05	1.35E-05	8.55E-06	3.70E-06
Hexane	110-54-3	3.04E-06	5.97E-06	6.62E-07	1.58E-06
Isophorone	78-59-1	4.37E-09	2.06E-08	4.54E-09	7.62E-09
m-Xylene + p-Xylene		2.34E-05	3.36E-05	2.27E-05	1.26E-05
Methylene Chloride	75-09-2	5.62E-06	2.87E-06	4.21E-06	2.18E-06
Naphthalene	91-20-3		2.01E-07	1.76E-07	1.24E-07
o-Toluidine	95-53-4	7.21E-09	5.45E-08	9.12E-08	1.01E-07
o-Xylene	95-47-6	7.73E-06	8.74E-06	6.09E-06	3.06E-06
Phenol	108-95-2	1.30E-07	4.64E-07	3.89E-08	3.87E-07
Styrene	100-42-5	3.98E-06	6.83E-07	3.39E-07	4.71E-07
t-Butyl Methyl Ether	1634-04-4	3.04E-07			
Tetrachloroethene	127-18-4	2.13E-07	9.56E-08	3.83E-08	
Toluene	108-88-3	1.22E-05	1.65E-05	9.47E-06	6.88E-06
Trichloroethene	79-01-6				3.68E-08

NOTES:

1,1,1-Trichloroethane for Tire OEM 205/70 is average from the other tires tested due to suspected mold release presence not normally used.

All emissions factors are E rated