Stack Emissions With Asphalt Rubber

A Synthesis of Studies

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ABSTRACT: *The emissions resulting from the production of asphalt rubber concrete have been subject to much analysis. The studies often have compared the stack emissions from the production of conventional asphalt concrete and asphalt rubber concrete. This document combines the work of three comparative studies from Michigan, Texas and California within the USA. In all cases, the emissions from AR materials were within the allowable limits and similar to the emissions from the production of conventional asphalt concrete.*

KEY WORDS: *Stack Emissions, Asphalt Rubber, Butadiene, Benzene, Toluene, Ethylene, Xylene.*

1. Introduction

Asphalt Rubber is combination granulated rubber derived from scrap tires and liquid asphalt cement. The material is defined by the American Society for Testing and Materials (ASTM) as: "a blend of asphalt cement, reclaimed tire rubber, and certain additives in which the rubber component is at least 15 % by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles." Common practice and specifications for the material call for 20% +/- 2% rubber content. Granulated tire rubber used in asphalt is referred to as crumb rubber modifier (CRM). Because tire rubber is often associated with burning tire piles in the minds of permitting authorities, regulatory agencies have been concerned that the crumb rubber component in asphalt rubber may contribute additional pollutants or toxics to the typical emission stream from an asphalt concrete manufacturing facility.

This document examines three separate and independent studies which explored the stack emissions created by the addition of granulated tire rubber to hot asphalt cement and compared the data to emissions derived from the manufacture of non-modified asphalt concrete. The comparable emission studies which included crumb rubber are listed below with the testing firm listed first, then the sponsoring agency and the date.

- Wildwood Environmental Engineering Consultants, Inc./Michigan DOT 1994
- Southwestern Laboratories, Inc Texas/Texas DOT 1992 & Texas Transportation Institute, 1995
- American Environmental Testing Company, Inc./Bay Area Air Quality Management District, California 2001

Although several other tests have been done, these three were selected because they compare the emissions between rubber and non rubber conditions. The Texas testing was subjected to a statistical analysis by the Texas Transportation Institute and compared to similar tests for a recycling operation. The reports will be referred to as the Michigan, Texas and Bay Area tests respectively.

2. Michigan Comparative Emission Testing

The Michigan DOT determined that seven mixes would be tested. Three of the mixes were considered control mixes and four were considered rubber mixes. Six of the mixes were manufactured with the same asphalt cement, a softer asphalt cement, which is commonly used with CRM. In this case, the asphalt cement was 200-250 penetration grading or roughly equivalent to an AC-2.5 asphalt cement. The same asphalt cement was used to eliminate the potential variable of asphalt cements in the testing program. The seventh mix, Control 1, contained a typical asphalt cement, an 85-100 penetration, roughly equivalent to an AC-10 but also contained 30% reclaimed asphalt pavement (RAP). Four of the mixes included RAP as the emissions from RAP content mixtures was also of interest to the Michigan DOT. The quantified emissions from the following seven mixtures in the Michigan study are described briefly as follows:

1. Control 1 – 85/100 Pen AC 30% RAP
2. Control 2 – No Rubber, No RAP
3. Control 3 – No Rubber, 20% RAP
4. RBR 1 – Wet Process, No RAP
5. RBR 2 – No Rubber, 20% RBR RAP
6. RBR 3 – Wet Process, 20% RBR RAP
7. RBR 4 – Dry Process, No RAP

Of the seven conditions tested, two were comparable to the Texas and Bay Area testing program and will be examined in this synthesis: Control 2 – No Rubber, No RAP and RBR 1 – Wet Process, No RAP. The rubber content was 10%. The comparative operating conditions are listed in Table 1.

Operating Data/Conditions/ Measurements	**Control 2**	**RBR 1**
HMA Production Rate (tons per hour)	351	357
Dry Aggregate Rate (TPH)	330	333
Asphalt Cement Added	5.75%	6.84%
Materials moisture content	4.17%	5.21%
Fuel Consumption (gal/hr)	655	690
Exhaust Gas Temperature (F)	311	324
Mix Temperature (F)	296	316
Sample Volume (SCF)	46.501	42.823
Sample Volume (cu.m)	1.317	1.213
Exhaust Gas Moisture (%)	27.0%	29.3%
Stack Temperature (F)	260	271
Actual Exhaust Gas Flow (ACFM)	89,540	95,450
Dry Exhaust Gas Flow (DSCFM)	47,076	47,836
Dry Exhaust Gas Flow (DSCMM)	1,333	1,355

Table 1. Comparative Operating Data of the Michigan Test

The operating conditions were similar and well controlled and documented. The operating data provided is an average of the operating for the two or three days over which all stack sampling was conducted for a given mix. The testing procedures used in the Michigan testing program followed the methods established by the United States Environmental Protection Agency (USEPA), Michigan Department of Natural Resources (MiDNR) and agreed upon by the National Asphalt Paving Association (NAPA). Units are reported in Parts Per Million (PPM), mg/m^3, and pounds per hour (lb/hr) within the report, however, for space lbs/hr will be used in this report for ease in comparison to the other two analysis. Additionally, lbs/hr is the common unit used in the permitting process of hot mix facilities in the U.S. Some additional compounds inherent in rubber and tire manufacturing were recommended for analysis. Among them: 1,3 – Butadiene, n-Nitrosodipropylamine, n-Nitrosodiphenylamine, Zinc, Styrene, Chlorobenzene, and methyl-isobutylKetone. Blank fields indicate no results or difficulties with analytical procedures. The results from the testing are listed in Tables 2, 3, 4, 5 and 6.

Continuous Emissions Measurements and Method 18 Results	**Control 2**	**RBR 1**
CO_2, %, Orsat Result	5.79%	6.02%
O_2, %, Orsat Result	12.75%	12.10%
N_2, %, Orsat Result	81.46%	81.88%
Carbon Dioxide (CO_2)	6.00%	6.48%
Oxygen (O_2)	12.87%	12.18%
Carbon Monoxide (CO) PPM	430.5	259.5
Nitrogen Oxides (NO_x) PPM	139.3	124.4
Sulfur Dioxide (SO_2) PPM	74.4	76.7
Non Methane Total Hydrocarbons (NMTHC) as Carbon PPM	225.5	183.0
Methane (CH_4) as measured PPM	27.7	10.6
Methane as Carbon PPM	20.7	7.9
Total Hydrocarbons (THC) as Carbon PPM	245.1	191.3
NMTHC as Carbon PPM	225.5	183.0
1,3 –Butadiene PPM	5.0	

Table 2. Continuous Emission Measurements and Method 18 Results.

PAH Emissions Measurements (lbs/hr)	**Control 2**	**RBR 1**
Acenaphthene	0.0018	0.0021
Acenaphthylene	0.0022	0.0026
Anthracene	0.0003	ND
Benzo Anthracene	0.0002	ND
Chrysene	0.0003	ND
Fluoranthene	0.0030	0.0024
Fluorene	0.0051	0.0055
Naphthalene	0.0502	0.0622
Naphthalene, 2-Methyl-	0.0578	0.0788
Phenanthrene	0.0120	0.0141
Pyrene	0.0030	0.0022
Cumene	0.0056	0.0069
o-Cresol (2-Methylphenol)	0.0029	0.0011
m-/p-Cresol (3-/4-Methylphenol)	0.0052	0.0058

Table 3. Polynuclear Aromatic Hydrocarbons in pounds /hour.

8270 Scan Average PAH Results (lbs/hr)	Control 2	RBR 1
2, 4-Dichlorophenol	.0009	.0013
2,4,5-Trichlorophenol	.0010	.0015
2,4,6-Trichlorophenol	.0011	.0015
Pentachlorophenol	.0015	.0023
1,2-Dichlorobenzene	.0007	.0016
1,3-Dichlorobenzene	.0006	.0010
1,4-Dichlorobenzene	.0006	.0010
1,2,4-Trichlorobenzene	.0025	.0012
Hexachlorobenzene	.0010	.0014
N-Nitrosodiphenylamine	.0005	.0012
N-Nitroso-di-n-propylamine	.0014	.0024
Benzoic Acid [4]	.0654	.0571
Benzyl Alcolhol	.0039	.0033
Bis(2-Ethylexyl)phthalate [4]	.0002	.0006
Di-n-Butylphthalate	.0023	.0010
Dibenzofuran	.0039	.0044
Phenol	.0347	.0398

Table 4. 8270 Scan of PAH as Recommended by NAPA in pounds /hour.

VOC Results (lbs/hr) **ND set equal to zero**	**Control 2**	**RBR 1**
Benzene	.316	.223
Toluene	.286	.142
Ethylbenzene	.034	.023
m-/p-Xylene	.123	.155
0-Xylene	.044	.025
Styrene	.067	.032
4-Methyl-2-pentanone (MIBK)		.179
Chlorobenzene		

Table 5. Volatile Organic Measurements Results for BTEX, Styrene, MIBK, and Chlorobenzene.

Metals Results (lbs/hr)	Control 2	RBR 1
Arsenic	.00000	.00000
Barium	.00481	.00105
Cadmium	.00017	.00009
Chromium	.00080	.00042
Lead	.00026	.00020
Mercury	.00119	.00053
Nickel	.00056	.00041
Selenium	.00013	.00015
Silver	.00008	.00008
Zinc	.00308	.00208

Table 6. Heavy Metals Measurements Results (lbs/hr).

2.1 Michigan Conclusions

Greater detail of the analysis is available in the report, however, the following general conclusions are made:

- Rubber does not contribute significantly to any increase in undesirable compounds.
- The base asphalt and burner fuels will cause greater changes in emissions than rubber.
- Soft asphalt cement appears to result in increased emissions of BTEX.

3. Texas Comparative Emission Testing

The methodology followed by the Southwest Laboratories for the Texas DOT compared three mixes, two with 18% crumb rubber in the binder and one without. Emissions sampling of the asphalt plant baghouse stack located at the San Antonio, Texas facility of Redland Stone Products Company was performed by personnel of Southwestern Laboratories, Inc. (SwL) Environmental Analytical Services (EAS) Division. The unit was sampled during the period of July 23-25 and 27-30, 1992.

Testing consisted of the determination of concentration and emission rate of particulate matter (PM), formaldehyde, benzene, styrene, 1,3 butadiene, benzo[a]pyrene, total polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOC) and opacity.

Testing of the source was performed for each of the above listed parameters at each of three (3) unit operating conditions. These conditions were as follows:

Condition No. 1: high mix temperature (~325°F) with crumb rubber additive
Condition No. 2: low mix temperature (~300°F) with crumb rubber additive

Condition No. 3: high mix temperature (~325°F) with conventional asphalt mix.

The asphalt plant operated at a production rate between 375 to 400 tons per hour. The conventional mix contained 5.0% binder content and the rubber conditions contained an average 7.6% binder content.

3. 1 Southwest Laboratories Conclusions

Although some sampling problems occurred with a limited set of samples available for analysis, the following conclusions were made.

- Higher visible emissions during the high temperature, crumb rubber condition.
- Increase in total VOCs with the crumb rubber additive, with a larger increase at high temperature.
- Slightly lower benzene emissions with the crumb rubber (at both temperatures) than with the conventional asphalt.
- Higher styrene emissions at the high temperature crumb rubber, with slightly lower styrene emissions at the low temperature crumb rubber as compared with conventional asphalt.
- Nondetectable 1,3 butadiene emissions at both crumb rubber operating conditions, with a detectable amount during the conventional asphalt test.
- Slightly higher total polycyclical aromatic hydrocarbons at the high temperature crumb rubber condition, with slightly lower emissions at the low temperature crumb rubber condition as compared to the conventional asphalt.
- Also, consistency in the compounds present was demonstrated (naphthalene and 2-methyl napthalene was present at all 3 conditions, with phenanthrene present at the high temperature conditions with and without crumb rubber).
- Overall higher total speciated organic emissions at the high temperature crumb rubber condition, while lower total speciated organic emissions at the low temperature crumb rubber condition as compared to the conventional asphalt mix condition.

3.2 Southwest Laboratories Reporting Issues

Conditions during the testing varied widely and were not well documented, the most notable variable was a change in asphalt supply during the course of the testing. However, the Texas Transportation Institute evaluated the data from Southwest Laboratories's testing as part of a recycling study of crumb rubber modified asphalt and reported the following results based upon a statistical analysis method. The report title is Recycling Crumb Rubber Modified Asphalt Pavements Texas Transportation Institute May 1995. It should be noted that the recycling project was a result of the failure of the rubber modified dense graded mixture which was placed during the Southwest Laboratories testing. The project proved to Texas

DOT that AR binders must be designed into an aggregate gradation with lower percentage of fines, which excluded the traditional dense graded mix. The results of the Texas Transportation Institute's statistical analysis in presented on Table 7.

	Conventional PPM	Modified HMA 18% CRM PPM
VOC	83.5	105.0
Benzene	3.0	1.3
Styrene	0.5	0.4
Naphthalene	0.3	0.2
2-Methylnaphthalene	ND	0.13
Phenanthrene	ND	0.03
Butadiene	3.6	2.6
Particulates	35.8	7.3

Table 7. Texas Transportation Institute Statistical Analysis of Air Emission Data.

A statistical analysis of testing results between two plants operated under similar conditions showed that overall, there is very little difference in emissions from plants manufacturing CRM asphalt and conventional HMA. The statistical analysis conducted by TTI is shown in Table 8.

Factor	VOC	Benzene	Sty-rene	Naph-thalene	2-Methyl Naph-thalene	Phenan-threne	Butadiene	Particu-lates	Opacity
Plant	N	S	N	N	S	S	S	N	N
Temp	N	S	N	N	N	S	N	N	N
%CRM	N	N	N	N	N	S	N	N	N

N= Not statistically different, S= Statistically different

Table 8. Texas Transportation Institute Statistical Analysis of Air Emission Data at Two Texas Hot Plants During Asphalt-Rubber Production.

3.3 TTI Conclusions

Besides the mix design procedures developed for recycling asphalt rubber concrete, the TTI provided the following conclusions based on the statistical analysis.

- The only case in which 18% rubber resulted in higher emission than no rubber for a specific compound was for phenanthrene.

- In some cases, measurements showed a higher concentration of a compound at the low temperature condition than at the high temperature condition. It is highly unlikely that this is valid.
- A discrepancy of this sort (concentration vs temperature) may well be the result of some variation in the hot mix plant operation itself.
- It should be noted that Hot Mix Asphalt production is, by nature, a highly variable process.
- In light of this high variability, it can be argued that for most chemicals, the effect of CRM on emissions may relatively small compared to the effects of other variables.

4.0 California Comparative Emission Testing

Another comparative emission testing program was developed in California as a result of an excessive smoking problem in a short drum hot mix facility in Petaluma, California directly adjacent to Highway 101 during the production of asphalt rubber hot mix. Although the facility had experienced similar problems with other asphalt products, the smoking in this case was thought to be unique to the rubber component in the material. It is noted that the operating temperature of the aggregate had been elevated to the allowable upper extreme of the specification of 163 degrees C to compensate for low ambient air temperatures and binder at the maximum 218 degrees C as allowed by specifications. It is likely that elevated mixing temperatures were pushed beyond the specified limits to compensate for the cool air temperatures and long haul distance. The plant was cited for an opacity violation. During the investigation of the violation on the part of the Bay Area Air Quality Management District (BA AQMD) the crumb rubber component was thought to contribute unique emissions beyond what is normally found in asphalt.

In order to explore the issue further, a partnership developed between the Bay Area Air Quality Management District, The California Department of Transportation, Northern California Asphalt Paving Association, Northern California Rubberized Asphalt Concrete Technology Center and the Rubber Pavements Association to set up a testing protocol and to examine asphalt and rubber materials unique to the area, not used in similar tests from other states.

The BA AQMD established a testing program which included the following:

- CARB Method 429 - Polycyclic Aromatic Hydrocarbons (PAH)
- Modified Method 5 – For Condensable Particulate of Benzene, Toluene, Ethyl Benzene, Xylene (BTEX) and 1,3 Butadiene
- Test during production of Conventional AC and RAC in triplicate at two hot plants during normal production runs

Other notable items discussed by the partnership were:

- A-R has been produced in the Bay Area since 1976 with no previous problems.

- A-R Hot mix typically uses 30-60% more binder
- A-R Hot mix is produced at a higher temperature
- A-R Hot mix is typically placed at reduced thickness
- Conventional AC production rates are 23 TPH higher (approximately 10 %)
- Tire Material has a flash point between 550 - 650 degrees F, not common hot mix temperatures, tire rubber should not be volatile.
- Permits are not currently required to be modified to account for the use of asphalt rubber binders.

4.1 California Comparative Emission Testing Results

Two facilities were selected to participate in the testing program. One facility used an aggregate heating drum with a pug mill coater and the other used a counter flow drum. The first facility will be referred to as “Dutra” and the second shall be referred to as Mission Valley Rock (MVR). The sampling point for the tests was at the stack, however, the Dutra facility included experimental hoods and duct work which attempted to capture emissions from the load out area (drop zone below the silo) and conveyor system. Because of the experimental equipment use, the emission factors established by the US EPA could not be used to accurately compare the emissions from the Dutra facility. However, a comparison was made for illustrative purposes. Three samples were collected for each condition at each plant, a total of twelve samples in all. The operational information during testing and particulate count is provided in Table 9.

	Avg. Prod Rate Tons/Hour	Temperature F°/C°	Particulates Pounds/Ton*
Dutra Conventional Mix	206	318/159	.0013
Dutra Rubber Mix	185	335/168	.0015
MVR Conventional Mix	336	311/155	.0025
MVR Rubber Mix	307	318/159	.0030

*AP 42 Particulate Estimate .033 pounds/ton

Table 9. Operating conditions and particulate emissions.

The EPA AP-42 estimates that total particulate emissions from a baghouse filter controlling a drum mix asphalt production operation is 0.033 pound per ton. Measured particulate emissions at the Dutra facility cannot be compared to AP-42 because AP-42 only provides particulate data from the main plant stack (which exhausts emissions from the aggregate dryer).

The reported units of measure for emissions are pounds emitted per US ton of Asphaltic Concrete. Hot Plants are permitted in product tons per year. The EPA’s Compilation of Air Pollutant Emission Factors (AP-42) provides relevant stack emission factors from asphalt plants in units of “pounds per ton”. Samples with non detects were set at zero.   The Toxic Potency Index was calculated and compared to the local regulation 2-1-316 which is displayed in Table 10.

	Reg 2-1-316 Threshold (lb/year)	Toxic Potency Index			
		Dutra		MVR	
		Conv.	AR	Conv.	AR
Benzene	6.7	1.90E-07	5.12E-06	6.32E-06	5.40E-06
Toluene	39,000	5.77E-11	1.99E-09	5.20E-10	4.64E-10
Xylene	58,000	0	1.42E-08	3.40E-10	8.93E-10
1,3-Butadiene	1.1	0	0	5.00E-06	6.20E-06
Naphthalene	270	4.89E-08	5.35E-08	1.16E-08	2.17E-08
Benz(a)anthracene	0.044	2.73E-08	0	0	0
Total Toxic Potency Index		2.66E-07	5.19E-06	1.13E-05	1.16E-05

Table 10. Toxic Potency Index compared to BAAQMD Regulation 2-1-316.

In order to compare the toxic emissions during the production of conventional asphalt concrete with those from asphalt rubber concrete, the measured emissions of each contaminant were interpreted with respect to the potency of each of the various contaminants. The annual emission thresholds (in units of pounds per year) that are listed in Bay Area Air Quality Management District (BAAQMD) Regulation 2-1-316 were used as the index of potency, compared with regulatory limits for toxic emissions:

- The Toxic Potency Index for each contaminant was calculated by dividing the measured Emission Factor (pounds per ton) by the Annual Emission Threshold (pounds per year).
- The sum of the various Toxic Potency Index values is the Toxic Potency Index of those emissions.

The data in Table 10 indicates that at the MVR facility, the total toxic Potency Index is approximately the same during production of conventional asphalt concrete and asphalt rubber concrete.

At the Dutra facility, the Total Toxic Potency Index was twenty-fold greater during the production of asphalt rubber concrete compared to the Index calculated from conventional asphalt concrete. The greater Index was due, primarily, to the greater measured emissions of benzene during the production of asphalt rubber concrete. The most likely source of the benzene is from tailpipe exhaust, which was captured (along with asphalt production emissions) in the truck load-out shed. The source of the additional benzene emission is not likely from the crumb rubber in the asphalt rubber concrete. The only other added component in the asphalt rubber concrete is an extender oil. Benzene is not a component that is listed on the Material Safety Data Sheet (MSDS) for the extender oils. The industry has tested the extender oil that has been used in the asphalt rubber binder on a number of projects and the analysis indicates that it does not contribute to the emissions of benzene.

The toxic emissions were compared to AP-42 emission factors for both types of facilities, a batch mix plant and a drum mix plant. The measured emission factors of toxic compounds and other chemical species during the production of both conventional asphalt concrete and asphalt rubber concrete at Dutra were generally lower than the AP-42 emission factors for a batch-mix asphalt plant. The emission factors for the batch mix plant are listed in Table 11.

	Emission Factor (pounds per ton)		
	Conventional Asphalt Concrete	Asphalt Rubber Concrete	AP-42 (Batch Mix)
Benzene	1.27E-06	3.43E-05	2.80E-04
Toluene	2.25E-06	7.75E-05	1.00E-03
Ethyl Benzene	0	7.37E-06	2.20E-03
Xylene	0	8.26E-04	2.70E-03
1,3-Butadiene	0	0	Not Avail.
Naphthalene	1.32E-05	1.45E-05	3.60E-05
2-Methylnaphthalene	1.12E-05	2.15E-05	7.10E-05
Acenaphthylene	3.43E-07	3.99E-07	5.80E-07
Acenaphthene	1.05E-06	1.63E-06	9.00E-07
Fluroene	6.61E-07	1.37E-06	1.60E-06
Phenanthrene	1.28E-06	1.83E-06	2.60E-06
Anthacene	4.09E-07	5.04E-07	2.10E-07
Fluoranthene	6.15E-08	4.00E-08	1.60E-07
Pyrene	2.78E-07	1.64E-07	Not Avail.
Benz(a)anthracene	1.20E-09	0	4.60E-09
Chrysene	7.55E-09	2.55E-09	3.80E-09

Benzo(b)fluoranthene	0	0	9.40E-09
Benzo(k)fluoranthene	0	0	1.30E-08
Benzo(e)pyrene	5.56E-09	2.82E-09	Not Avail.
Benzo(a)pyrene	0	0	3.10E-10
Perylene	1.51E-09	0	Not Avail.
Indeno(1,2,3-c,d)pyrene	0	0	3.00E-10
Dibenz(a,h)anthracene	0	0	9.50E-11
Benzo(g,h,l)perylene	0	0	Not Avail.

Table 11. Emission Factors (ponds per ton) for Batch Mix Facility

Similarly, the measured emission factors of toxic compounds and other chemical species during the production of both conventional asphalt concrete and asphalt rubber concrete at MVR were consistently lower than the AP-42 emission factors for a drum-mix asphalt concrete plant. The comparison is made in Table 12.

	Emission Factor (pounds per ton)		
	Conventional Asphalt Concrete	Asphalt Rubber Concrete	AP-42 (Drum Mix)
Benzene	4.23E-05	3.62E-05	3.90E-04
Toluene	2.03E-05	1.81E-05	1.50E-04
Ethyl Benzene	0	3.20E-06	2.40E-04
Xylene	1.97E-05	5.18E-05	2.00E-04
1,3-Butadiene	5.50E-06	6.82E-06	Not Avail.
Naphthalene	3.12E-06	5.87E-06	9.00E-05
2-Methylnaphthalene	7.78E-07	1.60E-06	7.40E-05
Acenaphthylene	1.71E-07	1.01E-07	8.60E-06
Acenaphthene	1.66E-08	1.86E-09	1.40E-06
Fluroene	5.27E-08	3.68E-08	3.80E-06
Phenanthrene	1.09E-07	8.02E-08	7.60E-06
Anthacene	1.19E-07	4.79E-09	2.20E-07
Fluoranthene	8.28E-09	4.04E-09	6.10E-07
Pyrene	1.16E-09	3.52E-09	Not Avail.
Benz(a)anthracene	0	0	2.10E-07

Chrysene	0	0	1.80E-07
Benzo(b)fluoranthene	0	0	1.00E-07
Benzo(k)fluoranthene	0	0	4.10E-08
Benzo(e)pyrene	0	0	1.10E-07
Benzo(a)pyrene	0	0	9.80E-09
Perylene	0	0	8.80E-09
Indeno(1,2,3-c,d)pyrene	0	0	7.00E-09
Dibenz(a,h)anthracene	0	0	Not Avail.
Benzo(g,h,l)perylene	0	0	4.00E-08

Table 12. Emission Factors (ponds per ton) for Drum Mix Facility

5.0 Summary

Measured emissions of particulate and specified toxic compounds during production of Asphalt Rubber were not significantly greater, if greater at all, than the emissions during production of Conventional Asphalt in these tests. Emission increases with Asphalt Rubber can be attributed to increased asphalt content and increased mixing temperature. Also, measured emission rates of particulate and toxic compounds were consistently lower than the emission factors indicated in EPA's AP-42 emission factors for asphalt plants.

6.0 Conclusion

These data indicate that emissions from the production of Asphalt Rubber are not significantly different than those from the production on Conventional Asphalt. A-R is one of many types of “asphalt”; and emissions from its production are not dissimilar to the emissions from the production of conventional asphalt. The rubber particles in A-R are not digested, but remain, for the most part, un-dissolved and do not become volatilised, and do not contribute to toxic emissions. Therefore, existing production plants that are permitted to produce asphalt, should be permitted to produce rubberized asphalt.

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