



Petroleum Hydrocarbon Solutions

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PAHs in Parking Lot Sealcoats Performance Study

PAHs in Parking Lot Sealcoats Page 1 of 5

There is growing concern over the use of sealcoating products used on driveways, roads and parking lots. In the United States and elsewhere, most sealcoats are made from coal tar which are high in PAH content and can be toxic to aquatic life and threaten public water supplies from rain and runoff. Exposure to fumes when applied can be a dangerous health hazard. Indoor air from dust is also a problem, especially with kids playing on these surfaces and tracking it into their homes. As the dangers to the environment and to humans from coal tar are better understood, cities and states are beginning to ban the use of coal tar in their jurisdictions. A number of states presently have pending legislation banning the use of coal tar.

An evaluation study was conducted by Sitelab Corporation comparing coal tar based sealcoats and asphalt based sealcoats. GuardTop, LLC manufactures asphalt based sealcoats and provided samples of their product and a popular brand of a coal tar product from another manufacturer.

Samples were split and analyzed by two reputable, certified laboratories in Massachusetts for polycyclic aromatic hydrocarbons. The PAHs of concern includes a group of 17 priority pollutant compounds regulated by federal and state agencies. The laboratories tested their samples using two different test methods for comparison. Samples were also tested using Sitelab's portable analyzers to help develop a field method for screening samples on-site.



CoalTarFreeAmerica.BlogSpot.Com

Promotes the ban of coal tar sealants and has lots of good information about the dangers and scale of this billion dollar industry.



GuardTop contains a liquid blend of asphalt emulsion oil, water and binder.



Coal Tar Sealcoat



Asphalt Based Sealcoat

Samples were dried in the sun for several days on aluminum foil at GuardTop's facility in Rockmart, Georgia and then sent to Sitelab for analysis. Although they look and function very similar, coal tar has a very strong, creosote like odor, especially in it's liquid form. PAHs like Naphthalene, Phenanthrene and other semi-volatile hydrocarbons contribute to it's smell. GuardTop's sealcoat has almost no odor.



Sealcoat 'Scrapings'

Samples were smashed into tiny fragments using a hammer, ranging in size from fine dust to particles no bigger than 5 mm. Large pieces were avoided as they have less surface area for the solvent to contact. Samples were then split and filled into 40 mL glass VOA vials and sent to two laboratories for analysis.



Coal Tar Sealcoat



Asphalt Based Sealcoat

For Sitelab's UVF analysis, 1 gram from each sample was placed into a glass vial and filled with 20 mL of the methanol solvent. Extracts were shaken and tested at different time intervals to monitor solvent extraction efficiency. The scrapings are hard, almost like rock and take time to dissolve in the solvent. Liquid sealcoats were also tested by UVF and dissolved very quickly in the solvent. Liquid sealcoat analysis was not performed by the laboratories.

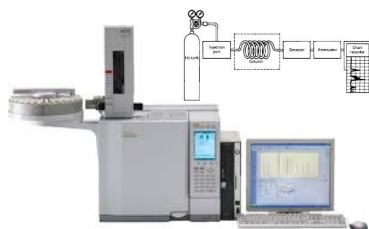


Laboratory Results for Coal Tar Sealcoat

Both laboratories tested PAHs using (1) U.S. EPA Method 8270 by GC/MS and (2) MADEP EPH method by GC/FID for extractable petroleum hydrocarbons. Both methods use gas chromatography to detect and report target compounds. The range in results exhibited between the labs and methods demonstrates the challenges of getting repeatable results when testing this type of contaminant.

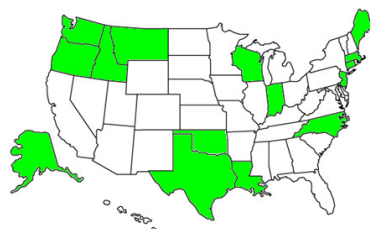
Lab 1 extracted samples in methylene chloride using soxlet extraction, where the sample circulates in solvent for 16 hours. Lab 2 used a 80/20 mixture of methylene chloride and acetone and micro waved the samples in solvent for 20 minutes. Both techniques are common.

The EPH test requires an additional step using silica gel cartridges and hexane solvent used to separate the aliphatic and aromatic fractions. The silica gel acts as a filter and contributes to the lower PAH concentrations exhibited by both labs compared to the 8270 results. Despite this limitation, the EPH test was chosen in order to quantify the other PAHs in the sample. In this case, about half of the C11-C22 aromatics consisted of other PAHs (cousin compounds) that are detected but not reported. The EPH method is more of a TPH test intended for fuel oils and crude oils in soil or water and not coal tars so high in aromatic content. Sitalab's fluorescence-based technology is sensitive to aromatic hydrocarbons and historically, Sitalab's analyzers correlate well to these two methods.



EPA 8270 Method

Uses GC/MS instrumentation and is a popular test for PAHs. The list typically includes 16 to 18 compounds reported.



MADEP EPH Method

State method for Extractable Petroleum Hydrocarbons using GC-FID. Detects aliphatic and aromatic fractions plus the same group of PAHs as 8270 method.

Coal Tar Sample Results in ppm (mg/Kg)	EPA 8270 Method			MADEP EPH Method	
	Lab 1	Lab 2	Lab 2*	Lab 1	Lab 2
Naphthalene	3,500	2,400	2,100	2,290	1,200
2-Methylnaphthalene	920	680	580	626	350
Acenaphthylene	ND <160	ND <16	ND <17	ND <356	ND <2.3
Acenaphthene	3,500	2,700	2,200	2,410	1,300
Fluorene	4,400	3,500	3,000	2,710	1,500
Phenanthrene	18,000	15,000	13,000	9,850	5,500
Anthracene	5,200	3,700	3,300	1,450	1,400
Fluoranthene	15,000	12,000	9,300	7,120	3,600
Pyrene	10,000	8,200	7,600	4,870	2,900
Benzo[a]Anthracene	5,000	4,400	3,300	1,880	930
Chrysene	4,700	3,800	2,800	980	710
Benzo[b]Fluoranthene	5,700	4,300	3,500	1,320	690
Benzo[k]Fluoranthene	1,800	1,700	1,100	1,140	230
Benzo[a]Pyrene	4,300	3,800	2,600	1,290	470
Indeno[1,2,3]Pyrene	2,800	2,000	1,500	762	240
Dibenzo[ah]Anthracene	680	530	330	ND <356	61
Benzo[ghi]Perylene	2,300	1,800	1,200	544	170
Sum of PAH Compounds:	87,800	70,510	57,410	39,242	21,251

ND = Non Detect

EPH C11-C22 Aromatics: 81,300 39,000

*Retest performed to check accuracy

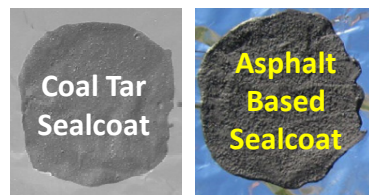
EPH C9-C18 Aliphatics: ND <7,120 330

EPH C18-36 Aliphatics: ND <7,120 1,800

Concentrations vary, but the proportions of PAH compounds are similar:

	8270 Method			EPH Method	
	Lab 1	Lab 2	Lab 2*	Lab 1	Lab 2
Naphthalene	4%	3%	4%	6%	6%
2-Methylnaphthalene	1%	1%	1%	2%	2%
Acenaphthylene	0%	0%	0%	0%	0%
Acenaphthene	4%	4%	4%	6%	6%
Fluorene	5%	5%	5%	7%	7%
Phenanthrene	21%	21%	23%	25%	26%
Anthracene	6%	5%	6%	4%	7%
Fluoranthene	17%	17%	16%	18%	17%
Pyrene	11%	12%	13%	12%	14%
Benzo[a]Anthracene	6%	6%	6%	5%	4%
Chrysene	5%	5%	5%	2%	3%
Benzo[b]Fluoranthene	6%	6%	6%	3%	3%
Benzo[k]Fluoranthene	2%	2%	2%	3%	1%
Benzo[a]Pyrene	5%	5%	5%	3%	2%
Indeno[1,2,3]Pyrene	3%	3%	3%	2%	1%
Dibenzo[ah]Anthracene	15	1%	1%	0%	0%
Benzo[ghi]Perylene	3%	3%	2%	1%	1%

Phenanthrene, fluoranthene and pyrene are abundant in coal tars and contribute to it's strong smell and high toxicity.



Laboratory Results for Asphalt Based Sealcoat

GuardTop's sealcoat was analyzed and no/very low PAHs were detected. Results for both methods show this product contains none of the regulated compounds of concern. Is it PAH free? Yes, but not exactly. The EPH aromatics ranged from 1,800 to 2,790 ppm, so it does contain PAHs, just not the worst ones. In contrast, EPH aromatics in the coal tar sealcoat ranged from 39,000 to 81,300 ppm, about 20 to 30 times higher. This is substantial. The asphalt emulsion oil GuardTop uses in its product is a safer, cleaner alternative.

The presence of aliphatics in this sample vs. no/little aliphatics in the coal tar sample, further demonstrates this product is very different in composition. Aliphatic compounds are straight chain hydrocarbons, which do not fluoresce using Sitelab's instruments. Unlike aromatic compounds, aliphatics are less carcinogenic and have higher regulatory limits.



Photo showing sample extracts performed by Sitelab's laboratory for UVF analysis. 1 gram of sealcoat was extracted in 20 mL of methanol solvent. The difference in yellow color is proportionate to hydrocarbon concentration.

GuardTop Sample Results in ppm (mg/Kg)	EPA 8270 Method			MADEP EPH Method	
	Lab 1	Lab 2	Lab 2*	Lab 1	Lab 2
Naphthalene	ND <15	ND <17	ND <17	ND <2.8	ND <4.7
2-Methylnaphthalene	ND <18	ND <17	ND <17	ND <2.8	ND <4.7
Acenaphthylene	ND <12	ND <17	ND <17	ND <2.8	ND <4.7
Acenaphthene	ND <12	ND <17	ND <17	ND <2.8	ND <4.7
Fluorene	ND <15	19	ND <17	ND <2.8	ND <4.7
Phenanthrene	ND <9.2	88	ND <17	3.7	ND <4.7
Anthracene	ND <9.2	22	ND <17	ND <2.8	ND <4.7
Fluoranthene	ND <9.2	68	ND <17	ND <2.8	ND <4.7
Pyrene	ND <9.2	53	ND <17	3.7	ND <4.7
Benzo[a]Anthracene	ND <9.2	25	ND <17	ND <2.8	ND <4.7
Chrysene	ND <9.2	22	ND <17	ND <2.8	ND <4.7
Benzo[b]Fluoranthene	ND <9.2	28	ND <17	ND <2.8	ND <4.7
Benzo[k]Fluoranthene	ND <9.2	ND <17	ND <17	ND <2.8	ND <4.7
Benzo[a]Pyrene	ND <12	22	ND <17	ND <2.8	ND <4.7
Indeno[1,2,3]Pyrene	ND <12	ND <17	ND <17	ND <2.8	ND <4.7
Dibenzo[ah]Anthracene	ND <9.2	ND <17	ND <17	ND <2.8	ND <4.7
Benzo[ghi]Perylene	ND <12	ND <17	ND <17	ND <2.8	ND <4.7
Sum of PAH Compounds:	No PAHs	347 Void	No PAHs	7.4	No PAHs

ND = Non Detect

EPA C11-C22 Aromatics: 2,790 1,800

*Sample retested due to carry over suspected in GC from coal EPH C9-C18 Aliphatics: 288 510

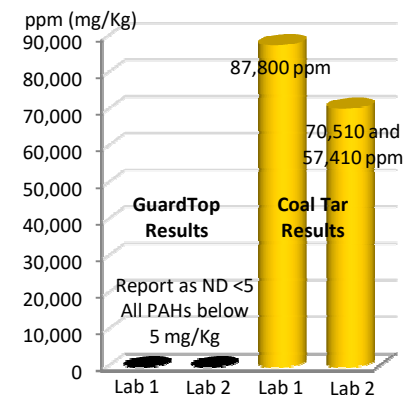
tar sample analyzed before it. EPH C18-36 Aliphatics: 4,210 3,200

347 ppm is a false positive result.

Why Two Labs are Better Than One

This material can be difficult to test. The extraction procedures are labor intensive and gas chromatography is prone to cross contamination, as Lab 2 experienced. Using multiple labs for this study was expensive, but necessary to confirm accuracy and limitations using the different test methods. For example, Lab 1 detected phenanthrene and pyrene in the EPH test. These are 'iffy' as they hover just above the detection limit of 2.8 ppm and could not be confirmed in the 8270 test, nor by the other laboratory.

Concentrations of PAHs by EPA Method 8270



Performance Testing Sealcoats using Fluorescence

Sitelab tested the samples multiple times to develop this field screening method. Samples were extracted in methanol solvent and measured for PAHs using the UVF-3100D and TD-500D analyzers at different time intervals. The fluorometers are fitted with different optical filters and light sources. Sensitivity varies depending on what type of PAHs are in the sample. The analyzers produce 'total' concentrations only. They cannot detect one compound from another. The UVF-3100D can perform Total PAH, Target PAH and GRO (BTEX).

Accuracy varies depending on extraction time and contaminant. Results illustrated here are compared to the Lab Range for each test performed, since the results of one lab were not favored over the other. The Total PAH test was the most accurate. The Target PAH and Heavy PAH concentrations were fairly close to each other. Both contaminants respond about the same using either instrument. The coal tar results correlated, the GuardTop did not.



UVF-3100D

Total PAHs (EPH Aromatics)
Target PAHs



TD-500D

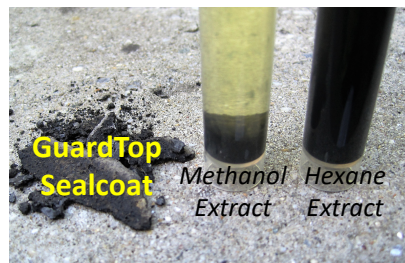
Heavy PAHs



PAH Calibration Kit

Standard contains mixture of PAH compounds and is used to calibrate both analyzers.

What About Other Solvents?



Methanol is a polar solvent and is more accurate when comparing Sitelab to laboratory methods. Samples extracted in hexane, a non-polar solvent, produced lower concentrations in the coal tar sample and higher concentrations in the asphalt based sample. Dark extract color in photo indicates high PAHs.

UVF-3100D Correlation Testing C11-C22 Aromatic Hydrocarbons

Coal Tar Sealcoat (ppm)

Solvent	UVF-3100D	vs. Lab Range
Extraction	Total	EPH C11-C22
Time:	PAHs:	Aromatics:
2-3 Minutes	43,000	39,000 to
10 Minutes	80,000	81,300
1 Hour	142,000	GOOD, VERY QUICK
24 Hours	450,000	

GuardTop Sealcoat (ppm)

Solvent	UVF-3100D	vs. Lab Range
Extraction	Total	EPH C11-C22
Time:	PAHs:	Aromatics:
2-3 Minutes	2,000	1,800 to
10 Minutes	4,000	2,790
1 Hour	7,900	GOOD, VERY QUICK
24 Hours	16,000	

Extracting samples for ten minutes or less produced results similar to the labs for both contaminants. Good accuracy can be expected if using EPH methods for confirmation.

UVF-3100D and TD-500D Correlation Testing 17 PAH Compounds

Coal Tar Sealcoat (ppm)

Solvent	UVF-3100D	TD-500D	vs. Lab Range	vs. Lab Range
Extraction	Target	Heavy	EPH Method	8270 Method
Time:	PAHs:	PAHs:	PAHs:	PAHs:
2-3 Minutes	11,000	10,600	21,251 to 39,242	57,410 to 88,300
10 Minutes	22,000	19,000		
1 Hour	37,000	28,000	GOOD, BUT TAKES TIME	
24 Hours	100,000	62,000		

Extracting samples for ten minutes or less produces low PAHs on both analyzers. Depending on which lab method is used, samples containing coal tar sealcoats should extract for at least 1 hour for the EPH method and up to 24 hours for the 8270 method.

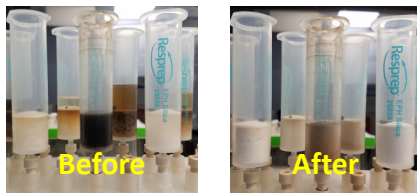
GuardTop Sealcoat (ppm)

Solvent	UVF-3100D	TD-500D	vs. Lab Range	vs. Lab Range
Extraction	Target	Heavy	EPH Method	8270 Method
Time:	PAHs:	PAHs:	PAHs:	PAHs:
2-3 Minutes	400	360	ND to 7.4	ND
10 Minutes	820	720		
1 Hour	1,600	1,280	FALSE POSITIVE, OTHER PAHs ARE DETECTED	
24 Hours	3,200	2,460		

Sitelab's analyzers are detecting other PAHs in the sealcoat which are not reported by the two methods, producing false positive results.



PAHs in Parking Lot Sealcoats Page 5 of 5



Labs use silica gel to extract and separate aliphatic from aromatic hydrocarbons. Color shows residual PAHs trapped in filter.

Summary and Conclusions

Sitelab Corporation conducted a very thorough, independent study to evaluate the accuracy using its portable TD-500D and UVF-3100D analyzers testing polycyclic aromatic hydrocarbons in parking lot sealcoats. Samples provided by GuardTop, LLC included their asphalt-based product and a competitor's coal tar brand. Samples were tested by two laboratories using EPA Method 8270 by GC/MS and the Massachusetts DEP EPH method using GC/FID.

It was expected the two lab methods would produce similar concentrations. This was not the case with the coal tar sample. PAHs detected by the 8270 method by both labs were twice as high as the PAHs detected by the EPH method. The 8270 results were even higher than the EPH C11-C22 aromatics. The use of silica gel to separate the aliphatic and aromatic fractions is the likely cause. As such, the 8270 results are more accurate. Although it underquantifies PAHs, the EPH analysis was useful for determining the content of the other aromatics in the samples.

Sitelab's accuracy for the 3 PAH tests performed wasn't as good compared to more traditional petroleum contaminants. Normally, when testing soil or water, samples only need to be extracted for several minutes. Hydrocarbons in gasoline, diesel and crude oils dissolve instantly in the solvent. With sealcoat scrapings, keeping track of extraction time is important. Coal tars, for example, must extract for 24 hours in order to achieve similar PAH results as the labs.

Some regulatory agencies like the European Union and U.S. FAA limit PAHs to 1,000 ppm for roads and runways. Some prohibit the use of coal tar sealcoats altogether. For these applications, accuracy using these field screening tools may not be that important. False positives detected in cleaner sealcoats are unavoidable, but for "pass/fail" situations, these analyzers can be used to determine if PAHs are above or below 1,000 ppm with a high level of certainty.



GuardTop® Asphalt Based Sealcoat Product Specification

For more information:
Call 877-948-2738
www.GuardTop.com



The parking lot at this supermarket in Georgia was treated with GuardTop's asphalt based sealcoat. Laboratory analysis performed in this study confirms this product is low in aromatic content with no regulatory PAHs of concern.

Quick, Ten Minute "Pass/Fail" Test for 1,000 ppm Action Limit

GuardTop Sealcoat	Two Other Asphalt Based Sealcoat Brands Tested by Sitelab	Coal Tar Sealcoat
Target PAHs = 820 ppm	= 1,300 ppm	= 1,800 ppm
Heavy PAHs = 720 ppm	= 930 ppm	= 1,400 ppm
False Positive! PAHs <5 ppm		PAHs High as 87,800 ppm

Use as a semi-quantitative tool for pass/fail decision making. Sealcoats with readings that stay well below 10,000 ppm after a 10 minute extraction (above), do not contain coal tars and will not exceed the 1,000 ppm action limit. Coal tars produce PAH results greater than 10,000 ppm within minutes when tested on either instrument.