ASPHALT INSTITUTE
Executive Offices and Research Center
Research Park Drive
P.O. Box 14052
Lexington, KY 40512-4052
USA
Telephone 859-288-4960
FAX No. 859-288-4999

LEACHABILITY OF ASPHALT AND CONCRETE PAVEMENTS

Anthony J. Kriech (Heritage Research Group, 7901 W. Morris St., Indianapolis, Indiana 46231, U.S.A.; e-mail tony.kriech@heritage-enviro.com)

CONTENTS

0. INTRODUCTION

The IAPA (Illinois Asphalt Pavement Association) contracted with Heritage Research Group to study the leachability of both Portland Cement Concrete (PCC) and Hot Mix Asphalt Pavements (HMA). Granular materials, including soil from the edge of each pavement type, were also tested to determine leachability. The design of this experiment was through the joint cooperation of the Illinois Environmental Protection Agency, Illinois Department of Transportation and IAPA. The purpose of the study was to determine the suitability of using concrete, asphalt, or soils from the surrounding roadway for use as clean fill. The concern is that the incidental spills onto the road from cars and trucks could contaminate the pavement and surrounding road side, and make these road materials unsuitable for use in clean fill situations below the water table. Specifically, unsubstituted Polynuclear Aromatic Hydrocarbons (PAH's) and heavy metals were studied. These were chosen because volatile and semi-volatile compounds, which may be spilled on the road, evaporate quickly. Previous studies by Heritage Research Group[1,2] have not found these compounds present. Only the metals and high molecular weight organic compounds tend to remain.

1.0 SITE LOCATIONS

The Illinois Department of Transportation located a section of pavement on Route #4 south of Springfield. The unique feature of the pavement section was that it contained Portland Cement Concrete, which was built in 1976 and a Hot Mix Asphalt pavement, which abuts this section and was also built at the same time. Because these sections are contiguous, the traffic on each are identical. Three sites were randomly selected in each pavement type, as to longitudinal location. Coring occurred on December 17, 1991 by IDOT District personnel. Once a site was selected, three four inch specimens were taken across the pavement. The first is between the wheel paths, the second was in the outer wheel path, and the third was taken outside the outer wheel path. A sample of soil and granular material was also taken from the shoulder of the road. The sample identification and locations are listed in Figure A. The "W"

proceeding the numbers indicates white (PCC) pavements and "B" indicates black (HMA) pavements.

Heritage Research also received some laboratory prepared samples from IDOT laboratories. Sample W-0 is a Portland Cement Concrete laboratory cylinder and is considered typical of Portland Cement Concrete by IDOT. Sample B-0 is a Hot Mix Asphalt sample prepared by IDOT and the compositional mix design is also considered typical by IDOT. These samples were used as controls and are free of any potential contamination, which the road samples may have received since they were placed in 1976.

2.0 SAMPLE PREPARATION

To prepare the sample for Toxic Characteristics Leachability Procedure (TCLP) in accordance with EPA guidelines, the samples were crushed to pass the 9.5 mm. sieve size. An impact crusher was used to reduce the samples to below this size.

Representative materials from each sample location were combined with other samples sites to test various hypothesis about pavement contamination. The first was that contamination may be greater between the wheel path, because this is where crankcase drippings tend to fall. To test this theory, all samples from between the wheel path were combined for each pavement type to make one sample. A second hypothesis was that the samples taken from the wheel path would be cleaner, because the tires are constantly wearing this pavement away. This idea was tested by combining all samples in the wheel path for each pavement. Samples outside the wheel path were also combined to make a sample to determine if there was a similar trend in the data. The soil samples from the shoulder were also combined to determine if the soil was higher or lower than the pavement in leachability. Finally, one transverse sample was taken from one location of each pavement type and compared to longitudinal samples to test for site specific contamination. All of these combined samples were compared to the laboratory samples of each pavement type, which had been prepared in the laboratory as a control. Table A lists the combination of sites used to make each sample for TCLP testing.

3.0 METHODS

After the combined samples were prepared by Heritage Research, they were submitted to EMS Heritage Laboratories for TCLP testing. EMS Heritage is an EPA certified laboratory. The test methods used are listed below.

Contents

Test	**Method/Procedure**
TCLP Procedure	SW-846-1311
PAH's	SW-846-8310
Metals	
Barium	SW-846-7080
Cadmium	SW-846-7130
Chromium	SE-846-7190
Lead	SW-846-7420
Silver Arsenic	SW-846-7760
Selenium	SW-846-7740
Mercury	SW-846-7470

4.0 SAMPLE ANALYSES

A summary of the test results from the TCLP are listed in Table B for the Portland Cement Concrete Pavement and soil located next to this pavement type. Table C lists the leachability of Hot Mix Asphalt samples and soil corresponding to this pavement.

Please note that PAH's are measured in ?g/L, which is parts per billion. The metal leachability is in mg/L or parts per million. The detection limit of the barium analyses varied with the sample. Because of high calcium in the leachate of some samples, the detection levels varied from 0.2 to 2.0. Matrix effects do impact on the detection level achievable in these samples.

5.0 COMMENTS

5.1 Both the PCC and HMA laboratory prepared samples from IDOT had measurable amounts of metals leaching, but no measurable PAH's. The PCC sample indicated a small amount of leachable chrome. The HMA had measurable barium in the leachate.

5.2 Samples taken in the PCC section, whether taken longitudinally or transversely, showed trace amounts of naphthalene and phenanthrene in two samples. Both samples contained material from site W-3, so it could be the same contaminant. Four samples contained a small amount of Naphthalene. These values were, in all cases, less than one part per billion. One sample from the wheel path had measurable barium on the leachate.

5.3 The soil samples taken from the PCC shoulder produced no leachable PAH's. However, a measurable (3.5 ppm.) level of barium was found.

Contents

5.4 The HMA pavement appeared quite similar to the PCC pavement in leachate results. Only naphthalene and phenanthrene were found in the pavement leachate. In all cases, the level was under one part per billion. Metal leachate was confined to barium, which was present in both the laboratory and field samples. This would indicate that barium is not coming from contamination, but rather is most likely coming from the aggregate in the mixture. These values would probably be lower if the sample was not crushed, which exposes the uncoated aggregate surfaces and increasing the exposed surface area greatly.

5.5 The soil from the HMA shoulder also contained a measurable level (0.76 parts per billion) of naphthalene. Since the laboratory samples did not have measurable levels, it is possible that this came from surface contamination. Used crankcase oils and tire composition contains measurable quantities of both naphthalene and phenanthrene, and could be potential sources for these very low, but measurable values.

5.6 The hypothesis that contamination would be greater between the wheel paths than at other location was not supported by these results. Overall, the level of leachable PAH materials was too low to determine trends in the data.

6.0 CONCLUSIONS

This study found that both PCC and HMA pavements each have very low levels of leachable metals and PAH materials. The relative low levels of leachable materials from both pavement types are quite similar. Soils from the shoulder of the road are quite similar in characteristics to the PCC and HMA pavements.

7.0 REFERENCES

1. Kriech, Anthony J. *Evaluation of Hot Mix Asphalt for Leachability.* HRG #3959AOM3. October 15, 1990.
2. Kriech, Anthony J. *Evaluation of RAP for Use as a Clean Fill.* HRG #4122EM02. January 30, 1991.

TABLE A
Sample Identification

Sample #	Sample Identification	Description
1	W-0	PCC Uncontaminated, Laboratory Specimen
2	W-1, 2, 3	PCC Transverse Across the Pavement
3	W-1, 5, 9	PCC Between Wheel Path, Longitudinal Sample
4	W-2, 6, 10	PCC In Wheel Path, Longitudinal Sample
5	W-3, 7, 11	PCC Outside Wheel Path, Longitudinal Sample
6	W-4, 8, 12	PCC Soil from Shoulder, Longitudinal Sample
7	B-0	HMA Uncontaminated, Laboratory Specimen
8	B-1, 2, 3	HMA Transverse Across the Pavement
9	B-1, 5, 9	HMA Between Wheel Path, Longitudinal Sample
10	B-2, 6, 10	HMA In Wheel Path, Longitudinal Sample
11	B-3, 7, 11	HMA Outside Wheel Path, Longitudinal Sample
12	B-4, 8, 12	HMA Soil from Shoulder, Longitudinal Sample

Contents

TABLE B

Illinois TCLP Test Results for Portland Cement Concrete Cores

Sample Number	**1 (Control)**	**2**	**3**	**4**	**5**	**6 (Soil)**	**--**
Site Number	**W-0**	**W-1,2,3**	**W-1,3,9**	**W-2,6,10**	**W-3,7,11**	**W-4,8.12**	**Heritage Det. Limit**
PAH's, µ/L							
Naphthalene	BDL	0.44	0.21	0.23	0.26	BDL	0.16
Acenaphthylene	BDL	BDL	BDL	BDL	BDL	BDL	0.25
Acenaphthene	BDL	BDL	BDL	BDL	BDL	BDL	0.16
Fluorene	BDL	BDL	BDL	BDL	BDL	BDL	0.019
Phenanthrene	BDL	0.44	BDL	BDL	0.26	BDL	0.16
Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.021
Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	0.021
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.075
Benzo(A)Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.013
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	0.041
Benzo(B)Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	0.029
Benzo(K)Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	0.013
Benzo(A)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.023
Dibenzo(A,H)Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.085
Benzo(G,H,I)Perylene	BDL	BDL	BDL	BDL	BDL	BDL	0.14
Indeno(1,2,3-cd)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.028
Metals, mg/L							
Barium	BDL	BDL	BDL	1.2*	BDL	3.5	2.000
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	0.020
Chromium	0.072	BDL	BDL	BDL	BDL	BDL	0.050
Lead	BDL	BDL	BDL	BDL	BDL	BDL	0.200
Silver	BDL	BDL	BDL	BDL	BDL	BDL	0.040
Arsenic	BDL	BDL	BDL	BDL	BDL	BDL	0.005
Selenium	BDL	BDL	BDL	BDL	BDL	BDL	0.010
Mercury	BDL	BDL	BDL	BDL	BDL	BDL	0.005

- This sample had a detection limit for barium of 0.2.

Contents

TABLE C

Illinois TCLP Test Results for Portland Cement Concrete Cores

Sample Number	**7 (Control)**	**8**	**9**	**10**	**11**	**12 (Soil)**	**--**
Site Number	**B-0**	**B-1,2,3**	**B-1,3,9**	**B-2,6,10**	**B-3,7,11**	**B-4,8.12**	**Heritage Det. Limit**
PAH's, µ/L							
Naphthalene	BDL	0.26	0.26	0.31	0.28	0.76	0.16
Acenaphthylene	BDL	BDL	BDL	BDL	BDL	BDL	0.25
Acenaphthene	BDL	BDL	BDL	BDL	BDL	BDL	0.16
Fluorene	BDL	BDL	BDL	BDL	BDL	BDL	0.019
Phenanthrene	BDL	BDL	BDL	0.30	BDL	BDL	0.16
Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.021
Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	0.021
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.075
Benzo(A) nthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.013
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	0.041
Benzo(B) Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	0.029
Benzo(K) Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	0.013
Benzo(A)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.023
Dibenzo(A,H) Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.085
Benzo(G,H,I)Peryle	BDL	BDL	BDL	BDL	BDL	BDL	0.14
Indeno(1,2,3-cd) Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.028
Metals, mg/L							
Barium	2.9	3.7	BDL	3.1	2.6	3.5	2.000
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	0.020
Chromium	BDL	BDL	BDL	BDL	BDL	BDL	0.050
Lead	BDL	BDL	BDL	BDL	BDL	BDL	0.200
Silver	BDL	BDL	BDL	BDL	BDL	BDL	0.040
Arsenic	BDL	BDL	BDL	BDL	BDL	BDL	0.005
Selenium	BDL	BDL	BDL	BDL	BDL	BDL	0.010
Mercury	BDL	BDL	BDL	BDL	BDL	BDL	0.005

Contents