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EVALUATION OF RAP FOR USE AS A CLEAN FILL

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0. BACKGROUND

The IAPA (Illinois Asphalt Pavement Association) has asked Heritage Research Group to evaluate six RAP (Reclaimed Asphalt Pavements) for their potential use as a clean fill. In certain situations the RAP, which is produced by milling an old pavement is unsuitable for recycling and could be used on site for clean fill. The goal of this testing program is to determine if the RAP contains materials which may make it environmentally unsuitable for clean fill.

1.0 SITE LOCATIONS

Six RAP samples were selected based on achieving a wide geographical cross section of the state of Illinois. This would ensure that different aggregates, as well as asphalt sources, were included in the study. The sample location can be found in Table A with a sample description and code.

2.0 SAMPLE LOG-IN AND PREPARATION

Samples were received directly from IDOT (Illinois Department of Transportation) personnel via UPS, along with a Sample Identification Form. This information includes date sampled, location, project, type of material, how it was removed and person obtaining the sample. This information is summarized in the sample identification Table A. The 50 lb. samples were split using a Gilson splitter to obtain smaller representative samples for further testing.

3.0 SAMPLE ANALYSIS

The sample analysis was performed in two parts. The first was physical testing of the RAP for typical properties. This includes asphalt content, gradation (aggregate sizing) and Abson Recovery to look at the physical properties of the recovered asphalt cement, which is removed from the aggregate. These tests were performed by Heritage Research personnel using appropriate ASTM (American Society for Testing and Materials) and AASHTO (American Association of State Highway and Transportation Officials) procedures. Heritage Research is inspected by AMRL (AASHTO Materials Reference Laboratories), a division of the National

Bureau of Standards for procedures and laboratory equipment for these tests. Heritage Research also participates in a round robin of laboratories conducted by AMRL for these procedures on a regular basis. The results of the physical tests are enclosed in Table B.

The environmental testing involved testing for PCB's (Polychlorinated Biphenyls) on the samples before leachate testing Identical samples were also prepared for TCLP (Toxic Characteristic Leachability Procedure) for each RAP source. Samples were crushed to correspond to the size requirements of the test. Samples were hand carried to Heritage Environmental Services - Commercial Laboratories by Heritage Research personnel. Following the TCLP test the leachate was tested for semivolatile organics, Polynuclear Aromatic Hydrocarbons (PAH's) by HPLC and metals by Atomic Absorption.

Test procedures were in accordance with EPA procedures and are as follows.

	Method/Procedure
PCB Extraction Procedure	SW846-3550
PCB Analysis	SW846-8080
TCLP Procedure	SW846-1311
Semivolatiles GC/MS	SW846-3510
PAH's	SW846-8310
Metals	SW846-3010

A summary report of the results is listed in Table C.

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4.0 COMMENTS

4.1 Physical testing indicates that these RAP samples are typical in gradation, asphalt content and asphalt residue properties to other RAP materials tested by Heritage Research Group.

4.2 PCB's were tested on the RAP samples, not on the leachate after TCLP. The results were then measured on a weight basis in mg/Kg. or parts per million. There is not a currently known method for testing on leachate. From these results it appears that no PCB's were found at the detection limits listed in any sample.

4.3 TCLP leachate did not contain any of the standard semivolatile compounds normally tested for by the EPA at the detection limits listed. It should be noted that semivolatiles are listed in 1 g/liter, which is parts per billion.

4.4 The polynuclear aromatic hydrocarbon show up in only trace levels. Naphthalene, the most volatile PAH is still under a half a part per billion, which is well within any guidelines tested for this material. Benzo(A)pyrene, a known carcinogen which is often used as a marker compound for PAH's, was not found in any sample at the detection limits reported.

4.5 Metals were also tested and found to have measurable values in three samples. Barium is present in all three samples, but 200-300 times below maximum concentration of contaminants for TCLP under RCRA (Resource Conservation Recovery Act) for hazardous materials by characteristics (see Table D for guidelines). Barium was also below national drinking water standards for this metal. For metals it is one hundred fold below Table D guidelines. Chrome and lead are also below the Table D guidelines for hazardous by characteristic. The leachate on Site #2 would, however, not meet drinking water standards. It is important to point out that Site #1 meets all guidelines, whereas Site #2 had low, but measurable levels of lead, chrome, and barium. Both of these were taken from the same project, but at different locations. This could indicate that contamination of the surface was a possible cause for having a low, but measurable level. Barium could be from a lube additive and be from crankcase drippings. The same is true for chrome, a wear metal. Lead could also be from crankcase oil and leaded gasoline.

Background samples from soils along the roadside have been studied in the literature. It is not unusual to find much higher levels of lead than encountered in this sample due to the use of leaded fuel in the past.

5.0 CONCLUSIONS

After a thorough investigation of these samples it can be ascertained that all of these samples meet current guidelines for TCLP maximum concentration for the contaminants by characteristic. Due to asphalt non-volatile viscoelastic properties this is not surprising. The migration of metals and organics are impaired greatly by the matrix of asphalt and aggregate. It is contaminants which may be spread on the road surface later through spills or accidents, which could change these characteristics. The results on this representative group of RAP samples would suggest that RAP should not be a concern for clean fill.

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TABLE A

Site No.	Date Sampled	County	Route/Sta. No.	Project	Material Type	How Removed	IDOT Personnel Taking Samples
#1	10/08/90	Vermilion	Route #1 1100+06	C-95-143-89	Surface/Binder	Milled	Alex Kedas
#2	10/08/90	Vermilion	Route #1 112+50	C-95-143-89	Surface/Binder	Milled	Alex Kedas
#3	10/11/90	Peoria	IL 88 36+88	FA 646/88171	Surface	Milled	Leroy Williams
#4	10/15/90	Cook	First Avenue	#80451	Surface	Milled	Eddie Pizarro
#5	09/26/90	St. Clair	IL 159 200+00	#96198 FA600	Surface/Binder	Roadtec RX50 Roto-Milled	Allan Guttmann
#6	09/13/90	Jackson	IL 3 IL 151	#98071 FA14	Surface	Cold Milling	Larry Miloshewski

TABLE B

Site Number	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**
County Located	Vermilion	Vermilion	Peoria	Cook	St. Clair	Jackson
Asphalt Content, %	5.2	4.9	4.4	4.4	5.2	3.9
Abson						
Penetration @77°F	33	23	26	42	48	35
Viscosity @140°F	15614	27040	19225	9121	9017	8335
Gradation						
Passing 2"	100.0	100.0	100.0	100.0	100.0	100.0
Passing 1-1/2"	100.0	100.0	100.0	100.0	100.0	100.0
Passing 1"	100.0	100.0	100.0	100.0	100.0	100.0
Passing 3/4"	100.0	100.0	99.0	98.6	99.8	100.0
Passing 1/2"	98.8	100.0	96.2	92.4	98.7	97.9
Passing 3/8"	95.1	99.3	90.6	85.6	95.2	92.8
Passing #4	76.5	73.5	64.9	56.2	69.5	59.3
Passing #8	60.0	47.5	45.4	37.9	51.4	39.3
Passing #16	47.8	35.3	36.2	30.2	41.9	30.3
Passing #30	37.7	27.6	29.2	25.3	30.8	23.1
Passing #50	24.4	16.6	19.0	18.7	19.7	15.0
Passing #100	12.0	9.2	11.6	7.8	11.6	8.3
Passing #200	6.6	6.4	7.5	7.7	7.4	5.4

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TABLE C
State of Illinois TCLP Test Results

Site Number	#1	#2	#3	#4	#5	#6	Det. Limit
PAH's, μ g/L							
Naphthalene	0.49	BDL	BDL	0.30	BDL	BDL	0.13
Acenaphthylene	BDL	BDL	BDL	BDL	BDL	BDL	0.20
Acenaphthene	0.14	BDL	BDL	BDL	BDL	BDL	0.13
Fluorene	BDL	BDL	BDL	BDL	BDL	BDL	0.015
Phenanthrene	BDL	BDL	BDL	BDL	BDL	BDL	0.13
Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.017
Fluorathene	BDL	BDL	BDL	BDL	BDL	BDL	0.017
Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.060
Benzo(A)Anthracene	BDL	BDL	BDL	BDL	0.017	BDL	0.017
Chrysene	BDL	BDL	BDL	BDL	BDL	BDL	0.033
Benzo(B)Fluoranthene	BDL	BDL	BDL	BDL	BDL	BDL	0.023
Benzo(K)Fluoranthene	BDL	BDL	BDL	BDL	0.050	BDL	0.017
Benzo(A)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.240
Dibenzo(A,H)Anthracene	BDL	BDL	BDL	BDL	BDL	BDL	0.068
Benzo(G,H,I)Perylene	BDL	BDL	BDL	BDL	BDL	BDL	0.110
Indeno(1,2,3-cd)Pyrene	BDL	BDL	BDL	BDL	BDL	BDL	0.022
Metals, mg/L							
Barium	BDL	0.40	0.36	0.33	BDL	BDL	0.200
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	0.200
Chromium	BDL	0.52	BDL	BDL	BDL	BDL	0.050
Lead	BDL	1.80	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	0.025
Mercury	BDL	BDL	BDL	BDL	BDL	BDL	0.005
Semi-Volatiles, μ g/L							
1,4 Dichlorobenzene	BDL	BDL	BDL	BDL	BDL	BDL	50
2,4 Dinitrotoluene	BDL	BDL	BDL	BDL	BDL	BDL	50

Hexachlorobenzene	BDL	BDL	BDL	BDL	BDL	BDL	50
Hexachlorobutadiene	BDL	BDL	BDL	BDL	BDL	BDL	50
Hexachloroethane	BDL	BDL	BDL	BDL	BDL	BDL	50
Nitrobenzene	BDL	BDL	BDL	BDL	BDL	BDL	250
Pyridine	BDL	BDL	BDL	BDL	BDL	BDL	120
Cresylic Acid	BDL	BDL	BDL	BDL	BDL	BDL	50
2 Methyl Phenol	BDL	BDL	BDL	BDL	BDL	BDL	50
3 Methyl Phenol	BDL	BDL	BDL	BDL	BDL	BDL	50
4 Methyl Phenol	BDL	BDL	BDL	BDL	BDL	BDL	250
Pentachlorophenol	BDL	BDL	BDL	BDL	BDL	BDL	250
2,4,5-Trichlorophenol	BDL	BDL	BDL	BDL	BDL	BDL	50
2,4,6-Trichlorophenol	BDL	BDL	BDL	BDL	BDL	BDL	---
PCB's, mg/Kg							
PCB Arochlor 1016	BDL	BDL	BDL	BDL	BDL	BDL	1.0
PCB Arochlor 1221	BDL	BDL	BDL	BDL	BDL	BDL	5.0
PCB Arochlor 1232	BDL	BDL	BDL	BDL	BDL	BDL	1.0
PCB Arochlor 1242	BDL	BDL	BDL	BDL	BDL	BDL	1.0
PCB Arochlor 1248	BDL	BDL	BDL	BDL	BDL	BDL	1.0
PCB Arochlor 1254	BDL	BDL	BDL	BDL	BDL	BDL	1.0
PCB Arochlor 1260	BDL	BDL	BDL	BDL	BDL	BDL	1.0
PCB Arochlor 1262	BDL	BDL	BDL	BDL	BDL	BDL	1.0

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TABLE D

Maximum Concentration of Contaminants for the Toxicity Characteristic (TCLP)

EPA HW NUMBER	CONTAMINANT	CHARACTERISTIC LEVEL (mg/L)
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon Tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	0-Cresol	200.0
D024	m-Cresol	200.0
D025	p-Cresol	200.0
D026	Cresol	200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its	0.008
D032	hydroxide)	0.13
D033	Hexachlorobenzene	0.5
D034	Hexachlorobutadiene	3.0
D008	Hexachloroethane	5.0
D013	Lead	0.4
D009	Lindane	0.2
D014	Mercury	10.0
D035	Methyoxychlor	200.0
D036	Methyl ethyl ketone	2.0

D037	Nitrobenzene	100.0
D038	Pentachlorophenol	5.0
D010	Pyridine	1.0
D011	Selenium	5.0
D039	Silver	0.7
D015	Tetrachloroethylene	0.5
D040	Toxaphene	0.5
D041	Trichloroethylene	400.0
D042	2,4,5-Trichlorophenol	2.0
D017	2,4,6-Trichlorophenol	1.0
D043	2,4,5-TP (Silvex) Vinyl chloride	0.2

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