Heritage Research Group

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7901 W. Morris Street • Indianapolis, IN 46231 U.S.A.
317-243-0811 • 486-5095 (FAX)

LEACHABILITY

OF

COLD MIX ASPHALTS

by Anthony J. Kriech

HRG #4937AIR1.926
November 9, 1992

Introduction

Heritage Research has recently completed a study of the leachability of cold mix asphalt (CMA). CMA is a mixture of aggregate and asphalt mixed at ambient temperatures. The asphalt used in the study includes:

ASPHALT	MEETS SPECIFICATION
HFMS-2s (Asphalt Emulsion)	ASTM* D977
MC-3000 (Cutback Asphalt)	ASTM D2027
CM-150 (Gelled Asphalt)	Local Specification

All three of these asphalts are used in the United States for making CMA.

Recently there has been a concern about whether CMA could be leaching materials into the ground water from stockpile storage or roadway after placement. Previous studies of Hot Mix Asphalt[1,2,3] have found the leachability of asphalt aggregate mixtures to be extremely low. However, cold mix asphalts had not been studied by the author.

Sampling and Analytical

The CMA mixture was prepared using standard mixes prepared for low volume roads. The aggregate was an Indiana limestone meeting the ASTM D448 #8 stone. The gradation is listed in Table A. The HFMS-2s asphalt emulsion and CM-150 were taken from production from Asphalt Materials Inc. in Indianapolis. The MC-3000 was obtained from Laketon Refining in Laketon, Indiana and was taken from production storage. The physical properties of these three asphalts are listed in Table B and comply with national (ASTM) and local specifications for these products.

Each asphalt was mixed with a representative amount of aggregate to produce a 4.2% residual asphalt content. The mixture was allowed to set undisturbed for 24 hours before testing was initiated. This represents a minimum normal amount of reaction time between asphalt and aggregate before use. All sample mixtures were checked to ensure they complied with the 9.5 mm maximum particle size.

Each mixture was submitted to Heritage Laboratories Inc., an EPA certified laboratory. The test methods are listed below:

TEST	METHOD/PROCEDURE
TCLP Procedure	SW 846-1311
Volatiles	SW 846-8240
Semi Volatiles GC/MS	SW 846-3510
Polynuclear Aromatic Hydrocarbons	SW 846-8310
Metals	SW 846-3010

* American Society for Testing and Materials

Results

The leachable metals are found in Table C and are given in parts per million. The test results for volatiles are listed in Table D. The semivolatiles can be found in Table E. Polynuclear Aromatic Hydrocarbons (PAH's) are given in Table F. The volatiles, semivolatiles and PAH's are all given in parts per billion.

Comments

1. No metals leached from any of the mixtures above detection level. Testing on limestone aggregate, similar to the one used in the study, found that barium, naturally present in limestone, typically leaches up to 5 ppm. However, coated with asphalt the leachability of the aggregate is reduced to below the listed detection limits.

2. The volatiles and semivolatiles tested for in the study were not found in any of the samples above detection levels.

3. The PAH compounds, which have been found in previous studies on asphalt in trace quantities, were also tested and found to be present in very low levels in cold mix asphalt. The top four compounds listed are non-carcinogenic and appear on the list as indicators for coal tar material, not asphalt. Secondly, the method used by Heritage Laboratories Inc. is extremely sensitive, allowing measurements below 1 part per billion. The levels reported in the study are well below in known regulatory standard for these compounds.

Conclusions

1. Based on this study, cold mix Asphalt has very low leachable PAH's. These levels are very similar to HMA pavements, concrete pavements and soils from the shoulder of roads[2,3]. Recently, the Illinois EPA determined that HMA asphalt could be considered a clean fill material, based on very similar levels as reported in those studies.

Based on the evidence there does not appear an environmental leachate problem associated with cold mix asphalt materials. This study does not preclude the need to use good engineering practice in using cold mix asphalt. Asphalt storage tanks and CMA's stockpile should not be located next to bodies of water, because liquid asphalt (which is used in mixing) can foul water supplies if spilled before it reacts and mixes with the aggregate. Proper use of cold mix provides an environmentally safe material for roads.

TABLE A

ASTM #8 STONE

AGGREGATE GRADATION

SIEVE SIZE	% by wgt.
% Passing 1/2 inch	100.0
% Passing 3/8 inch	80.6
% Passing #4	16.9
% Passing #8	4.7
% Passing #16	2.3
% Passing #30	2.0
% Passing #50	1.6
% Passing #100	1.2
% Passing #200	0.9

TABLE B

ASPHALT TEST RESULTS

HFMS-2s	
TEST	**RESULT**
Furol Vis of 25°C, sec.	185
Residue from Distillation %	68.9
Oil Portion of Distillate %	1.1
Stone Coating	pass
Sieve Test %	0.0
Float on Residue 60°C	1200+
Penetration 25°C, 50g, 5 sec.	180

CM-150	
TEST	**RESULT**
Viscosity @ 25°C, 1 sec^{-1}P.	2750
Flash Point °C	105
Distillation	
To 225°C	0
To 260°C	0
To 316°C	61
Residue %	90
Pen of Residue	155
Float 60°C, sec.	1200+
Solubility %	99.0
Water %	0.0

MC-3000	
TEST	**RESULT**
Flash Point °C	80
Kinematic Vis @ 60°C, es.	3500
Distillation	
To 225°C	0
To 260°C	0
To 316°C	32
Residue %	88
Pen of Residue	230
Ductility @ 25°C cm.	100+
Solubility %	99.95

TABLE C

TCLP FOR METALS FOR COLD MIXES (mg/l)

Description	HFMS-2s	MC-3000	CM-300	Det. Limit
BARIUM ppm	BDL	BDL	BDL	2
CADMIUM ppm	BDL	BDL	BDL	0.02
CHROMIUM ppm	BDL	BDL	BDL	0.01
LEAD ppm	BDL	BDL	BDL	0.20
SILVER ppm	BDL	BDL	BDL	0.04
ARSENIC ppm	BDL	BDL	BDL	0.005
SELENIUM ppm	BDL	BDL	BDL	0.005
MERCURY ppm	BDL	BDL	BDL	0.005

TABLE D

VOLATILE ORGANICS FOR COLD MIXES (ug/L)

Description	HFMS-2s	MC-3000	CM-300	Det. Limit
BENZENE	BDL	BDL	BDL	50
CARBON TETRACHLORIDE	BDL	BDL	BDL	50
CHLOROBENZENE	BDL	BDL	BDL	50
CHLOROFORM	BDL	BDL	BDL	50
1,2-DICHLOROETHANE	BDL	BDL	BDL	50
1,1-DICHLOROETHYLENE	BDL	BDL	BDL	50
METHYL ETHYL KETONE	BDL	BDL	BDL	100
TETRACHLOROETHYLENE	BDL	BDL	BDL	50
TRICHLOROETHYLENE	BDL	BDL	BDL	50
VINYL CHLORIDE	BDL	BDL	BDL	100

TABLE E

TCLP SEMIVOLATILES ORGANICS FOR COLD MIXES (ug/l)

DESCRIPTION	HFMS-2s	MC-3000	CM-300	Det. Limit
1,4-DICHLOROBENZENE	BDL	BDL	BDL	50
2,4-DINITROTOLUENE	BDL	BDL	BDL	50
HEXACHLOROBENZENE	BDL	BDL	BDL	50
HEXACHLOROBUTADIENE	BDL	BDL	BDL	50
HEXACHLOROETHANE	BDL	BDL	BDL	50
NITROBENZENE	BDL	BDL	BDL	50
PYRIDINE	BDL	BDL	BDL	250
2-METHYL PHENOL	BDL	BDL	BDL	50
3-METHYL PHENOL	BDL	BDL	BDL	50
4-METHYL PHENOL	BDL	BDL	BDL	50
PENTACHLOROPHENOL	BDL	BDL	BDL	250
2,4,5-TRICHLOROPHENOL	BDL	BDL	BDL	50
2,4,6-TRICHLOROPHENOL	BDL	BDL	BDL	50

TABLE F

POLYNUCLEAR AROMATIC HYROCARBONS BY HPLC FOR COLD MIXES (ug/L)

Description	HFMS-2s	MC-3000	CM-300	Det. Limit
NAPHTHALENE	4.4	8.0	14	0.16
ACENAPHTHYLENE	BDL	BDL	BDL	0.25
ACENAPHTHENE	0.41	BDL	2.7	0.16
FLUORENE	1.8	0.34	1.0	0.019
PHENANTHRENE	1.3	0.74	1.1	0.16
ANTHRACENE	0.14	BDL	0.090	0.021
FLUORANTHENE	BDL	BDL	0.19	0.021
PYRENE	BDL	BDL	0.10	0.075
BENZ (A) ANTHRACENE	BDL	BDL	BDL	0.13
CHRYSENE	BDL	BDL	BDL	0.041
BENZO (B) FLUORANTHENE	BDL	BDL	BDL	0.029
BENZO (K) FLUORANTHENE	BDL	BDL	BDL	0.013
BENZO (A) PYRENE	BDL	BDL	BDL	0.23
DIBENZO (A,H) ANTHRACENE	BDL	BDL	BDL	0.085
BENZO (G,H,I) PERYLENE	BDL	BDL	BDL	0.14
INDENO (1,2,3-CD)PYRENE	BDL	BDL	BDL	0.028

REFERENCES

[1] Kriech, Anthony J. *Evaluation of Hot Mix Asphalt for Leachability.* October 15, 1990.

[2] Kriech, Anthony J. *Evaluation of RAP for Use as a Clean Fill.* January 30, 1991.

[3] Kriech, Anthony J. *Leachability of Asphalt and Concrete Pavements.* March 5, 1992