

WATER QUALITY RESULTS FOR WHITTER FARM ROAD TIRE SHRED FIELD TRIAL

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INTRODUCTION

The Whitter Farm Road tire shred field trial was constructed in the Fall, 1996. The purpose of the field trial was to evaluate the insulation and drainage properties of tire shreds beneath a paved road. A secondary purpose was to obtain data on the effects of tire shreds on water quality. The field trial consists of six 12.2-m (40-ft) long paved sections. Three sections are underlain by 154 mm (6 in.) to 305 mm (12 in.) of tire shreds, two sections are underlain by 305 mm (12 in.) of a mixture of tire shreds and granular subbase aggregate (gravel), and one section is a control underlain by granular subbase aggregate. A typical cross section is shown in Figure 1. The tire shreds had a maximum size of 76 mm (3 in.) and were made from a mixture of steel and glass belted tires. There was a significant amount of steel belt and bead wire exposed at the cut edges of the shreds. Additional information on the design of the project is given in Lawrence, et al. (1998).

A drainage trench runs parallel to one side of the road. The trench width varies from 0.66 to 1.07 m (2.2 to 3.5 ft). It was filled with the same material as the adjacent test section, i.e., tire shreds, tire shred/gravel mixture, or gravel. About 76 m (250 ft) of 102-mm (4-in.) diameter perforated ADS pipe was embedded in the trench backfill at a

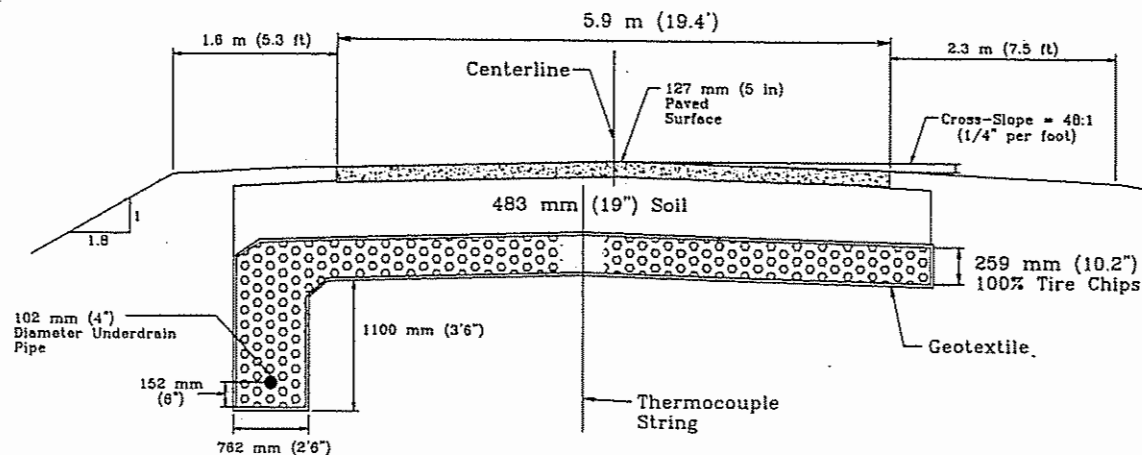


Figure 1. Typical cross section of Whitter Farm tire shred field trial.

depth of about 1.7 m (5.6 ft) below the road surface. Approximately 100 mm (4 in.) of backfill was placed under the pipe as bedding. The trench and perforated pipe intercepted groundwater flowing from higher ground adjacent to the project and surface infiltration. Thus, the water would come into direct contact with the tire shreds. It is likely that the tire shreds used as bedding beneath the pipe are saturated. The trench and perforated pipe conveyed the water to a 67-m (220-ft) length of solid 102-mm (4-in.) diameter ADS pipe. The solid pipe discharged in a field adjacent to the project. On June 27, 1997 water discharging from the pipe was collected for analysis.

WATER SAMPLING AND ANALYSIS PROCEDURES

Water sampling and analysis procedures were adapted from those described in Downs, et al. (1996) and Humphrey, et al. (1996). The sample containers used for collecting samples to be analyzed for volatile organics were clear 40 mL borosilicate glass vials with polypropylene closures and Teflon faced silicone septa. The samples were preserved by adding 4 drops of hydrochloric acid (HCl) to each vial before collecting the samples. Samples to be analyzed for semivolatile organics were collected in 1 L amber borosilicate glass bottles with polypropylene closures and Teflon liners. No sample preservation is required for semivolatile samples. Samples to be analyzed for metals and other compounds were collected in 1 L or 0.5 L high-density polyethylene (HDPE) bottles with HDPE closures. Samples to be analyzed for dissolved metals were filtered through Corning disposable sterile filters with 0.45 µm cellulose acetate filters. Filtered and unfiltered samples were preserved with 1.5 mL nitric acid (HNO₃) per liter of sample. All samples were stored at 4°C prior to analysis.

Samples for metals analysis except for lead were prepared in accordance with EPA Method 200.7 (Inductively Coupled Plasma - Atomic Emission Spectrometric Method for Trace Element Analysis) (EPA, 1991). The metals were then measured with a Thermo Jarrell Ash Model 975 Plasma Atomcomp Inductively Coupled Plasma Emission Spectrometer. Samples for lead were prepared in accordance with EPA Method 200.9 (Determination of Trace Elements by Stabilized Temperature Graphite Furnace Atomic Absorption Spectrometry) (EPA, 1991) and tested in accordance with EPA Method 7421 Lead (Atomic Absorption, Furnace Technique) (EPA, 1987). Chloride and sulfate were measured in accordance with EPA Method 300.0 (Determination of Inorganic Anions by Ion Chromatography) (EPA, 1983). Volatile organics were analyzed in accordance with EPA Method 8260 (Determination of Volatile Organics by Purge-and-Trap Capillary Column GC/MS). Semivolatile organics were analyzed in accordance with EPA method 8270 (Determination of Semivolatile Organics by Capillary Column GC/MS).

WATER QUALITY RESULTS

The results for metals and other inorganic compounds are summarized in Table 1. For metals with a primary drinking water standard, the dissolved and total concentrations were all below their corresponding regulatory limit. In fact, the concentrations were below the test method detection limit for cadmium (Cd), chromium (Cr), copper (Cu),

Table 1. Inorganic test results.

Compound	Test method detection limit (mg/L)	Drinking water standard type	Regulatory Limit (mg/L)	Concentration (mg/L)		
				Sample 1 (Dissolved)	Sample 2 (Total)	Sample 3 (Total)
Ba	0.005	Primary	2.0	0.017	0.021	0.020
Cd	0.0005	Primary	0.005	< 0.0005	< 0.0005	< 0.0005
Cr	0.006	Primary	0.1	< 0.006	< 0.006	< 0.006
Cu	0.009	Primary	1.3	< 0.009	< 0.009	< 0.009
Pb	0.002	Primary	0.015	< 0.002	< 0.002	< 0.002
Al	0.07	Secondary	0.05 - 0.2	< 0.07	< 0.07	< 0.07
Cl	0.4	Secondary	250	111	100	103
Fe	0.015	Secondary	0.3	0.158	22.3	19.1
Mn	0.002	Secondary	0.05	2.53	2.51	2.51
SO ₄	0.5	Secondary	500	3.51	5.19	4.79
Zn	0.0057	Secondary	5.0	0.082	0.144	0.142
Ca	0.5	None	N/A	33.0	32.3	32.4
Mg	0.1	None	N/A	12.7	12.4	12.4
Na	0.5	None	N/A	79.5	75.3	75.1

and lead (Pb). Moreover, the measured concentration of barium (Ba) was a factor of 100 less than its regulatory limit.

For metals and other compounds with a secondary drinking water standard, the dissolved concentrations of aluminum (Al), chloride (Cl), iron (Fe), sulfate (SO₄), and zinc (Zn) were below their corresponding regulatory limit. Although it is most appropriate to compare dissolved concentrations to drinking water standards, it is noteworthy that the total concentrations of aluminum (Al), chloride (Cl), sulfate (SO₄), and zinc (Zn) were also below the standard. The total concentration of iron was elevated due to the presence of relatively insoluble iron oxide in particulate form. The level of dissolved manganese (Mn) was above its secondary drinking water standard. The dissolved and total concentrations of manganese were essentially the same.

Tests were also conducted for calcium (Ca), magnesium (Mg), and sodium (Na). The results are shown in Table 1. These are commonly found in groundwater and do not have drinking water standards. The dissolved solids concentration in Sample 1 was 320 mg/L. The total solids concentration in Samples 2 and 3 were 660 mg/L and 559 mg/L, respectively.

The results for volatile and semivolatile organic compounds were all below the test method detection limit. The test results are included as Attachment A. The results indicate that there were no detectable levels of organic compounds.

DISCUSSION and CONCLUSIONS

In this sampling event, tire shreds did not cause the levels of metals to exceed their primary drinking water standard. Moreover, the levels of volatile and semivolatile

organic compounds were all below their test method detection limit. The same results were obtained at the North Yarmouth field trial where tire shreds were used as subgrade fill above the water table (Humphrey, et al., 1996). The level of manganese (Mn) was above its secondary drinking water standard. Steel belts are 2 to 3% manganese by weight so this is the likely source of the compound. Water in direct contact with tire shreds causes higher levels of particulate iron (Fe) due to oxidation of the exposed steel belts. Since manganese (Mn) and iron (Fe) have secondary (aesthetic based) drinking water standards these do not pose a health concern. The levels of aluminum (Al), chloride (Cl), sulfate (SO₄), and zinc (Zn) were all below their respective secondary drinking water standard. It is not possible to draw definitive conclusions from the single sampling event covered by this report. However, these results agree with the ongoing study in North Yarmouth, Maine (Humphrey, et al., 1996), namely, that tire shreds placed above the water table have a negligible impact on ground water quality.

REFERENCES

Downs, L.A., Humphrey, D.N., Katz, L.E., and Rock, C.A. (1996), "Water Quality Effects of Using Tire Chips Below the Groundwater Table," Technical Services Division, Maine Department of Transportation, Augusta, Maine, 323 pp.

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Humphrey, D.N., Katz, L.E., and Blumenthal, M. (1997), "Water Quality Effects of Tire Chip Fills Placed Above the Groundwater Table," Testing Soil Mixed with Waste or Recycled Materials, ASTM STP 1275, Mark A. Wasemiller and Keith B. Hoddinott, Eds., American Society for Testing and Materials, pp. 299-313.

Lawrence, B.K., Chen, L.H., and Humphrey, D.N. (1998), "Use of Tire Chip/Soil Mixtures to Limit Frost Heave and Pavement Damage of Paved Roads," report to the New England Transportation Consortium by Dept. of Civil and Environmental Engineering, University of Maine, Orono, Maine, 316 pp.

ATTACHMENT A (continued)



**NORTHEAST
LABORATORY**

TO:
University of Maine-Orono/Aaron Smart

ANALYSIS REPORT

P.O. Box 788
Waterville, Maine 04903-0788
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DATE SAMPLED: 06/27/97
DATE RECEIVED: 07/01/97
DATE EXTRACTED: 07/03/97
DATE ANALYZED: 07/10/97
DATE REPORTED: 07/14/97

LABORATORY NUMBER: 9733527
SAMPLE MATRIX: Water
ANALYST: VAM

SAMPLE DESCRIPTION: WF Road

SEMI-VOLATILE ORGANICS

Base/Neutral Extractables		PQL, ug/L	Result, ug/L	Acid Extractables		PQL, ug/L	Result, ug/L
N-Nitrosodimethylamine	10	ND	Phenol	10	ND		
Aniline	10	ND	2-Chlorophenol	10	ND		
Bis(2-chloroethyl) ether	10	ND	2-Methylphenol (o-cresol)	10	ND		
1,3-Dichlorobenzene	10	ND	3&4-Methylphenol (m&p-cresol)	10	ND		
1,4-Dichlorobenzene	10	ND	2-Nitrophenol	10	ND		
1,2-Dichlorobenzene	10	ND	2,4-Dimethylphenol	10	ND		
Benzyl alcohol	10	ND	Benzole acid	10	ND		
Bis(2-chloroisopropyl) ether	10	ND	2,4-Dichlorophenol	10	ND		
Hexachloroethane	10	ND	4-Chloro-3-methylphenol	20	ND		
Nitrobenzene	10	ND	2,4,5-Trichlorophenol	10	ND		
Isophorone	10	ND	2,4,6-Trichlorophenol	10	ND		
Bis(2-chloroethoxy)methane	10	ND	2,4-Dinitrophenol	50	ND		
N-Nitrosodi-n-propylamine	10	ND	4-Nitrophenol	50	ND		
1,2,4-Trichlorobenzene	10	ND	2-Methyl-4,6-dinitrophenol	50	ND		
4-Chloroaniline	10	ND	Pentachlorophenol	50	ND		
Hexachlorobutadiene	10	ND					
Hexachlorocyclopentadiene	10	ND					
2-Nitroaniline	10	ND					
Dimethyl phthalate	10	ND	<u>Polyaromatic Hydrocarbons</u>				
2,6-Dinitrotoluene	10	ND	Naphthalene	10	ND		
3-Nitroaniline	50	ND	2-Methylnaphthalene	10	ND		
Dibenzofuran	10	ND	2-Chloronaphthalene	10	ND		
2,4-Dinitrotoluene	10	ND	Acenaphthylene	10	ND		
Diethyl phthalate	10	ND	Acenaphthene	10	ND		
4-Chlorophenyl phenyl ether	10	ND	Fluorene	10	ND		
4-Nitroaniline	50	ND	Phenanthrene	10	ND		
N-Nitrosodiphenylamine	10	ND	Anthracene	10	ND		
Azobenzene	50	ND	Fluoranthene	10	ND		
4-Bromophenyl phenyl ether	10	ND	Pyrene	10	ND		
Hexachlorobenzene	10	ND	Benzo(a)anthracene	10	ND		
Di-n-butyl phthalate	10	ND	Chrysene	10	ND		
Benzidine	20	ND	Benzo(b)fluoranthene	10	ND		
Butyl benzyl phthalate	10	ND	Benzo(k)fluoranthene	10	ND		
3,3'-Dichlorobenzidine	20	ND	Benzo(a)pyrene	10	ND		
Bis(2-ethylhexyl) phthalate	10	ND	Indeno(1,2,3-cd)pyrene	10	ND		
Di-n-octyl phthalate	10	ND	Dibenzo(a,h)anthracene	10	ND		
			Benzo(g,h,i)perylene	10	ND		
<u>Surrogate</u>	<u>% Recovery</u>		<u>Surrogate</u>	<u>% Recovery</u>			
Nitrobenzene-d5	116*		2-Fluorophenol	7.1*			
2-Fluorobiphenyl	124*		Phenol-d5	26			
Terphenyl-d14	103		2,4,6-Tribromophenol	7.6*			

*Recoveries are outside the expected control limits for Nitrobenzene-d5 (35-114%), 2-Fluorobiphenyl (43-116%), 2-Fluorophenol (21-100%) and 2,4,6-Tribromophenol (10-123%) as expressed in EPA Method 8270. Analysis was conducted according to EPA Method 8270, "SW-846," 3rd Ed., 1986.

< = Less than PQL = Practical Quantitation Limit ND = None Detected

Reviewed by: James E. Curlett Date: 7-14-97
James E. Curlett, Laboratory Manager