MatCon® Technical Paper

Leaching Characteristics of Asphalt Road Waste

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Approximately 2.5 million miles of paved roads currently exist in the United States. Due to daily wear and tear, roadway expansion, and construction-related activities, these roadways sometimes need to be removed or repaired. During reconstruction or removal of a road surface, reclaimed asphalt pavement (RAP) is commonly obtained by milling or removing the existing pavement.

RAP is typically recycled back into new Hot Mix Asphalt, but in some instances all of it can not be re-used. A proposed alternative for the management of RAP is use as fill material.

One limitation to using RAP as fill material stems from a lack of knowledge regarding possible environmental impacts of RAP.

Two different types of environmental concerns relate to leaching of pollutants from RAP. The first is the leachate produced when rainfall infiltrates RAP stockpiles. These RAP stockpiles can range in size up to 2,000 yards.

Concerns have been expressed that the leachate produced could potentially be contaminated with trace amounts of hazardous chemicals, namely organic compounds or heavy metals. These chemicals could be the result of accidental spills onto the roadway from vehicles or possibly due to the virgin material used to make asphalt.

A second environmental concern is the use of RAP as fill material. RAP used as fill material could potentially leach off contaminants when rainfall infiltrates the waste (an unsaturated condition). In some instances the RAP may be proposed to be used as fill below the water table (a saturated condition). In both situations, the leachate produced could potentially br contaminated with trace amounts of hazardous chemicals, such as organic compounds and heavy metals.

Addressing concerns

This project was conducted to address some of the environmental concerns expressed by regulators and others related to the leaching of pollutants from asphalt road waste, primarily RAP. A series of leaching tests were performed at both batch-scale and in leaching columns.

The primary chemicals investigated were volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals.

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While it is generally recognized that RAP does not present a great risk to human health or the environment, a better characteristization of the amount and type of chemicals that leach in the environment helps provide a better means to correctly manage this material.

In light of the environmental concerns about RAP, a project involving a series of leaching tests was performed at the University of Florida Solid and Hazardous Waste Laboratory. The first step included collection of six RAP samples throughout the state of Florida.

After sample collection, the Florida DOT bituminous laboratory physically characterized the RAP samples. Then a series of leaching tests were performed on the RAP samples.

The batch tests performed consisted of the Toxicity Characteristic Leaching Procedure (TCLP), the Synthetic Precipitation Leaching Procedure (SPLP), and a deionized water test.

The column study utilized 16 stainless steel columns (lysimeters) assembled at the University of Florida Solid and Hazardous Waste Lab. The second test was a column leaching test performed to simulate a more realistic environmental condition.

Leachate samples obtained from the batch experiments and column experiments were analyzed for the same parameters. The primary chemicals investigated were volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals. The total concentrations of pollutants in the RAP were not measured.

Testing Samples
Batch tests were performed on all six RAP samples. In the leachate generated during the TCLP batch test, measurements of VOCs, PAHs, and heavy metals, all were below detection limit (BDL) and below any applicable TCLP limits.

The RAP samples evaluated were, therefore, not a hazardous waste. This result was expected, as the literature had demonstrated this.

Batch tests are also used by regulatory agencies to determine whether a waste presents a potential leaching threat to ground water. Concentrations of pollutants from batch tests are usually compared directly to groundwater limits or guidance concentrations. TCLP tests are sometimes used.

The literature did present some TCLP results that were above applicable groundwater limits for some heavy metals. The TCLP test is a somewhat aggressive test that represents the conditions inside an anaerobic landfill.

Less aggressive tests were, therefore, also conducted in this study (SPLP and deionized water). The SPLP is currently the method of choice for evaluating leaching from waste or contaminated soils in Florida when exposed to rainfall.

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In all of the batch tests, measurements of VOCS, PAHS, and selected heavy metals (Ba, Ca, Cr, Cu, Pb, Ni, and Zn) all were below detection limit (BDL) and were below applicable regulatory groundwater guidance concentrations.

This indicated that the RAP samples tested did not pose an undue risk (in regard to leaching of the pollutants tested) under current waste policy in Florida. No comparisons can be made regarding the effectiveness of each test to leach pollutants because no pollutants were measured.

Physical characterizations of the six RAP samples

Sample	Viscosity (poise)	% Asphalt Concentration	Penetration (.10mm)
Miami	118,942	6.23	16
Tampa	99,524	7.90	17
Lake City	145,293	5.14	14
I-10 (Summannee Cty.)	820,109	6.39	15
Indian Town Road	270,774	6.04	10

The Florida DOT physically characterized each sample. These results were useful in assessing the condition and age of the milled asphalt samples.

Using realistic conditions

Column (lysimeter) tests were then performed on the same six RAP samples. Column tests are not a prescribed test procedure by regulatory agencies. They were conducted in this case to investigate leachate production from RAP under more realistic environmental scenarios.

Approximately 60 pounds of RAP material filled a three-foot section of each column. Duplicate columns were subjected to saturated and unsaturated conditions. Column leachate samples were analyzed for the same parameters as the batch tests and continued for a total of 42 days.

The columns did leach large concentrations of ions such as calcium, sodium, sulfate, floride, and carbonate as a result of mineral leaching from the aggregate used in the asphalt pavement manufacture.

Looking for heavy metals

All VOC and PAH analytical results were similar to the batch test-no compounds were detected. Leachate concentrations for selected heavy metals (Ba, Ca, Cr, Cu, Ni, and Zn) were always below detection limits (BDL). An exception was lead (Pb), which was detected.

Only one unsaturated lysimeter resulted in a leachate with a lead concentration above the groundwater guidance concentration (15 parts per billion).

Leachate from the unsaturated lysimeter containing the Jacksonville sample had a lead concentration of approximately 24 ppb 12 days into the sampling period. The concentration of lead decreased over time, and then leveled off well below the regulatory guidance concentrations.

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In the saturated columns, all columns had detectable concentrations of lead ranging from 5 ppb to 38 ppb. Three out of the six lysimeters (two sites) were above the regulatory guideline.

The lysimeters decreased over time to lead concentrations below the guidance concentration (and the detection limit) except the Jacksonville sample. The Jacksonville sample concentration decreased slightly but was still above the guidance concentration at approximately 18 ppb.

The batch tests were more dilute than the column tests. This condition helps to explain why lead concentrations were observed in the column study but not in the batch test.

In a real-world situation, rainfall would ultimately dilute leachate produced from a stockpile before it reached the groundwater table or a nearby receiving body of water.

Factoring in dilution
This phenomenon is commonly referred to as dilution attenuation. Attenuation models, used to determine the concentration of a pollutant in the groundwater resulting from waste piles and landfills, commonly use a dilution factor of 20 in their models.

This dilution factor is accounted for in the batch test by the 20 to 1 liquid to solid ratio. In the column study, somewhat no dilution is involved. If the concentrations produced from the column studies were used as part of a groundwater dilution model, results would likely be below any regulatory guideline.

Lead was observed in the greatest concentrations in the oldest RAP samples. This indicated that the lead was not a result of the aggregate or asphalt cement, but rather a result of vehicle traffic and emissions.

Lead has been used for many years in leaded gasoline and in crankcase oil. Since vehicle accidents and accidental spills contribute to this contamination, there is a possibility that this contamination is site specific.

Previous studies regarding asphalt road waste also found trace amounts of lead in some circumstances. Since lead was encountered in greater concentrations in older samples, the source of lead was likely prolonged exposure to vehicle traffic and emissions.

Under most reuse circumstances, even if lead were encountered at levels of the highest concentration measured in this study, the concentrations in the environment would be below acceptable regulatory levels for drinking water. Possible exceptions would be older RAP placed below the water table in areas with little or no dilution.

Consistent finding
Most of the previous studies regarding RAP leaching were consistent with the results found in this study. Organic compounds do not leach from typical RAP under the conditions tested. Heavy metals are sometimes encountered. The literature indicated the presence of chromium. lead, and barium. Only lead was detected in this study and was ascribed to prolonged exposure to traffic and vehicle emissions.

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The literature often referred to chromium resulting from slag used as aggregate. It should be noted that the aggregate used in the asphalt samples collected for this study was assumed to be natural aggregate (e.g. limerock).

If other materials-especially waste materials such as slag, spent sandblast grit and ash-are used as aggregate, the results gathered here may not be applicable. It should also be noted that fresh asphalt was not tested, nor were extremes in temperatures evaluated.

The results of this research project indicated that reclaimed asphalt pavement of the nature examined in this study poses minimal risk to groundwater as a result of pollutant leaching under normal land disposal scenarios. The results of the leaching tests indicated that in most cases RAP would pose minimal environmental risk when used as fill in regard to the leaching of the pollutants. This study did not, however, address that implication of direct exposure.

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