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Hazardous Waste Engineering
Research Laboratory
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Research and Development

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Project Summary

Composition of Leachates from Actual Hazardous Waste Sites

J. Bramlett, C. Furman, A. Johnson, William D. Ellis, H. Nelson, and William H. Vick

Leachate from 13 hazardous waste sites in different parts of the country was analyzed for organic and inorganic chemical content to determine patterns and to assess the feasibility of formulating synthetic mixtures representative of actual leachates. Leachates were approximately 99% aqueous and 1% organic. Less than 5% of the total organic content (TOC) was accounted for in nearly all sites; consequently recommendations for synthetic mixtures were based on a number of assumptions and compromises. Organic acids and oxygenated/heteroatomic hydrocarbons comprised the bulk of the characterized TOC with halogenated hydrocarbons present in lesser but still significant quantities.

This Project Summary was developed by EPA's Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The Hazardous Waste Engineering Research Laboratory (HWERL) of the U.S. Environmental Protection Agency (USEPA), is interested in determining the feasibility of formulating a synthetic hazardous waste leachate, representative of actual leachates for the purpose of testing containment liners that are currently available for use in landfills treatment, and disposal facilities. To this end, the USEPA has undertaken a study to gather data on the composition of leachate from representative hazardous waste sites across the country.

Approach

The general approach to this study is summarized as follows:

Step 1; Site Selection - Thirteen sites were selected for study based on geographical location, mix of weather conditions, presence of leachate collection system, and relatively good management.

Step 2; Sampling and Analysis - Ten sites were sampled by the contractor and three were sampled by site personnel. Field tests included temperature, pH, redox potential and conductivity. Laboratory analysis included tests for volatile and semivolatile organics using gas chromatography-mass spectrometry, heavy metals, cyanide, chemical oxygen demand (COD) and total organic carbon (TOC).

Step 3; Data Evaluation and Assessment of Formulating Synthetic Leachate - Laboratory data were reviewed and leachate quality evaluated. Based on these data three synthetic mixtures have been suggested.

Step 4; Report Preparation - A final report, complete with titles, charts and figures showing data gathered and conclusions drawn was prepared.

Evaluation of Total Organic Carbon (TOC)

The TOC of leachates was used as an indicator of the level or organic loading. Subsequent identification and quantification of individual constituents of each leachate led to the calculation and assignment of a portion of the leachate TOC to each identified constituent.

Combined, the calculated TOC of identified constituents comprised a fraction of the TOC of the leachate - the larger the fraction, the higher the success of the analytical program in achieving maximum identification.

Results

The leachate samples were analyzed for 35 volatile, 68 semivolatile and 13 metal priority pollutants. In addition, 102 nonpriority pollutant compounds and families of compounds were identified. Specifically, the results are presented in six classes:

1) organic acids,
2) oxygenated/heteroatomic hydrocarbons,
3) halogenated hydrocarbons,
4) organic bases,
5) aromatic hydrocarbons,
6) aliphatic hydrocarbons.

Of these six classes, the organic acids and oxygenated/heteroatomic hydrocarbons constituted 75% of the characterized TOC. Halogenated hydrocarbons and aromatic hydrocarbons were found in lesser quantities in all sites.

Within a given class, compounds having higher water solubility accounted for the highest mole fraction percentages.

The leachates were analyzed for 13 heavy metals, 8 of which were found in all sites in varying concentrations. These included silver, cadmium, chromium, copper, nickel, lead, selenium and zinc. Arsenic in high concentration was found in 10 sites.

The percentage of analytical TOC which is accounted for in the identified organics was less that 10% for 11 of the 13 sites and less than 5% for 6 of the 13 sites. These low percentages reflect large quantities of nonvolatile compounds or nonextractable components. Overall, approximately 96% of the TOC remains unidentified.

Leachate Formulation

While it is recognized that a synthetic mixture based on a mere 4% of characterized components may not be representative of actual leachates, the information generated in this study is sufficiently comprehensive to allow suggestions of three possible formulas: one incorporates general classes of compounds in more fractions found to exist in actual leachates, and the other two formulas utilize specific chemicals focused commonly in more than five sites and at significant concentrations.

The 96% uncharacterized organic carbon may be represented by high molecular weight n-alkane or motor oil that forms a suspension at the 1% level. This is based on descriptions of materials disposed of at the waste sites as being "petroleum based materials" in nearly all sites.

Recommendation

The project demonstrated the complexity and the diversity of leachates. Characterization of leachate constituents is a difficult, time consuming and expensive task that requires a more concentrated effort than was possible under this task. More detailed analyses of fewer samples would perhaps provide a more realistic picture of leachate compositions. Emphasis should be placed on the nonvolatile and nonextractable components which comprise the bulk of leachate composition.

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J. Bramlett, C. Furman, A. Johnson, W. Ellis, H. Nelson, and W. Vick are with JRB Associates (SAIC), McLean, VA 22102..
***Charles I. Mashni** is the EPA Project Officer (see below).*
The complete report entitled "Composition of Leachates from Actual Hazardous Waste Sites," (Order No. PB 87-198743/AS; Cost: $18.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Hazardous Waste Engineering Research Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

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