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Project Summary

Tar Sands Leachate Study

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The research described in the full report was initiated at the USEPA's Test and Evaluation (T&E) Facility to assess the potential for release of contaminants to ground and surface waters from in-situ and above-ground processing of western tar sands. Initial laboratory tests indicate that leachates from spent tar sands may not contain significant amounts of toxic pollutants but may contain substantial amounts of sulfate and total organic carbon (TOC). Of the five priority pollutants tested (cyanide, mercury, nickel, arsenic and zinc), all exhibited low concentrations. However, concentrations of sulfate and TOC were sufficiently high to impact surface and groundwater quality.

This Project Summary was developed by EPA's Industrial Environmental 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

Preliminary studies assessing the environmental implications of in-situ extraction, as well as above-ground retorting, are scarce, yet there is heightened concern in states such as Utah about the environmental impact on local water supplies from tar sands mining and in-situ recovery operations. The purpose of this effort was, therefore, to provide information that would (1) assist regulatory offices in permitting the mining and processing operations, (2) establish a data base for developing and reviewing monitoring plans and (3) support efforts to establish guidelines for ultimate disposal of solid wastes generated from tar sands operations. Such information will assist the development of an environmentally acceptable tar sands industry.

Experiment

In order to determine the chemical composition of tar sands leachate, approximately 28 feet of 3-inch tar sand core were obtained from the TS-2C forward combustion in-situ experiment conducted at Asphalt Ridge by the Laramie Environmental Technical Center (LETC). Segments of the core were recognized as being either combusted or non-combusted. In addition, a fifty-five gallon drum of processed tar sands (spent sand) was obtained from an above-ground retort pilot plant in Salt Lake City. In all, three types of tar sands matrices were extracted and analyzed: combusted core (cc), uncombusted core (uc), and spent sand (ss).

Shake and extraction tests were conducted in an effort to assess the characteristics of tar sands leachate. The leachate was analyzed by the EPA analytical support group, IERL, Cincinnati, for parameters specified by the drinking water quality standards and criteria. Screening for toxic components thought to be present in the leachate was also performed. The Resource Conservation and Recovery Act's (RCRA) EP Toxicity Test (with and without acid addition) was used to simulate tar sands leachate generation. The ASTM shake extraction procedure was also performed on all tar sand matrices to generate a third set of data for evaluation.

Results

In all, twelve different water quality tests plus trace metal analysis were conducted on the leachate samples generated from the shake and extraction procedures.

Table 1 shows the averages of the trace metal concentration measurements for the three runs conducted. The combusted core showed significantly higher concentrations of trace metals. Calcium, magnesium, potassium, and sodium were present in the highest concentrations. Arsenic, barium, mercury, nickel and zinc were below the detection limit.

When the data for hazardous waste contaminants were examined, it was determined that only three (arsenic, barium and mercury) are listed in the Federal Drinking Water Quality Standards. These values are provided as a reference point rather than to imply that discharge should meet drinking water standards. Those contaminants included in the standards which were measured in this study are presented in Table 2.

After the results were examined, it became apparent that none of the hazardous constituents listed in Table 2 were in excess of the maximum allowable concentrations.

Of the other parameters analyzed in this study, only TOC and sulfate determinations exhibited concentrations high enough to cause any concern. Whether this level of concentration can be expected from the addition of acid for pH adjustment during the extraction procedure or whether organic constituents are released is a matter that deserves further consideration. A more thorough characterization of specific organics, especially phenols and compounds associated with the various functional groups prevalent in tar sands bitumen, may be necessary.

Recommendations

It is therefore recommended that further work be undertaken to characterize organics such as hydrocarbon combustion products and phenols. It has also been recommended that digestion tests be performed on the spent filter paper from the shake and extraction tests. Further work may involve some groundwater modeling of the more problematic constituents characterized by this study.

Table 1. Trace Metal Analysis (mg/l)

	EP Toxicity with Acid			EP Toxicity no Acid			ASTM			
	CC	UC	SS	CC	UC	SS	CC	UC	SS	%R
Al	.1	2.3	.3	8.3	.16	2.4	19.9	.15	.23	109
Ca	176	32	378	78	17	65	36	18	47.6	102
Fe	.5	3.0	.83	7	.5	1.5	2.9	.6	.57	100
Mg	61.6	3.4	12.9	31.4	2.7	5.0	13.5	2.9	2.5	98
K	9.0	1.4	1.9	9.4	1.3	1.7	8.7	1.6	4.0	105
Na	5.6	2.9	2.3	6.4	3.8	3.2	9.2	1.5	2.1	104
Zn	.04	.32	.08	.22	.03	.03	7.3	.04	.18	100
Ba	All less than 1.0									98
Hg*	All less than .001									--
Ni	All less than .2									100
As	All less than .02									108

**All tar sand samples were analyzed in duplicate for mercury (Hg), and seven of them were spiked with 1 ppb Hg. Recoveries could not be computed for the spikes because the concentration of the unspiked samples was above the blank but too low for meaningful detection.*

*Table 2. Water Quality Standards**

EPA Hazardous Waste Number	Contaminant	Maximum Concentration (mg/l)	Measured Concentration (mg/l)
D004	Arsenic	.05	< .02
D005	Barium	1.0	<1.0
D009	Mercury	.002	< .001

**Established by the National Interim Primary Drinking Water Regulations.*

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W. W. Liberick, Jr. is the EPA Project Officer (see below).
The complete report, entitled "Tar Sands Leachate Study," (Order No. PB 84-209 659; Cost: $8.50, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
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