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Demonstration Bulletin

Soil Recycling Treatment Train

The Toronto Harbour Commissioners

Introduction: The Toronto Harbour Commissioners (THC) have developed a soil treatment train designed to treat inorganic and organic contaminants in soils. THC has conducted a large-scale demonstration of these technologies in an attempt to establish that contaminated soils at the Toronto Port Industrial District can be treated to attain contaminant levels below the Modified Ontario Ministry of the Environment (MOE) Criteria Levels for Industrial Soils without utilizing incineration processes. This Superfund Innovative Technology Evaluation (SITE) of the on-going THC Demonstration was undertaken to provide a consistent basis for comparing these technologies to other technologies evaluated under the SITE program.

Technology Description: The THC's treatment train consists of three soil remediation technologies: a soil washing technology, a technology that removes inorganic contamination by chelation, and a technology that utilizes chemical and biological treatment to reduce organic contaminants.

The process utilizes an attrition soil wash plant to remove relatively uncontaminated coarse soil fractions using mineral processing equipment while concentrating the contaminants in a fine slurry which is routed to the appropriate process for further treatment. The wash process includes a trommel washer to remove clean gravel, hydrocylones to separate the contaminated fines, an attrition scrubber to free fines from sand particles, and a density separator to remove coal and peat from the sand fraction.

If only inorganic contaminants are present, the slurry can be treated in the inorganic chelator unit. This process uses an acid leach to free the inorganic contaminant from the fine slurry and them removes the metal utilizing solid chelating agent pellets in a patented countercurrent contactor. The metals are recovered by electrowinning from the chelating agent regenerating liquid.

Organic removal is accomplished by utilizing a chemical pretreatment of the slurry from the wash plant or the metal removal process and biological treatment in upflow slurry reactors utilizing the bacteria which have developed naturally in the soils being treated. The treatment soil is dewatered utilizing hydrocyclones and transported back to the site from which it was excavated.

A process flow diagram for these processes in a configuration which would be used for soils highly contaminated with organic and inorganic contaminants is shown in Figure 1.

Waste Applicability: The technology is designed to reduce organic and inorganic contaminants in soils found at industrial and commercial sites. The process train approach is most useful when sites have been contaminated as a result of multiple uses over a period of time. Typical sites where the process train might be used include refinery and petroleum storage facilities, sites with metal processing and metal recycling histories, and manufactured gas and coal/coke processing and storage sites. The process is less suited to soils with undesirable high inorganic constituents which result from the inherent mineralogy of the soils.

Demonstration Results: The THC SITE Demonstration of these technologies took place in the first half of 1992 at a temporary pilot facility constructed at a site within the Toronto Port Industrial District. The sampling associated with this SITE project took place in April and May of 1992 when the pilot unit was processing a soil from a site which has been used for metals finishing and refinery and petroleum storage. Field characterization of the soils indicated that organic and inorganic treatment would be required. When working quantities of the soil were excavated, it was determined that the metals contamination was very low and therefore no inorganic processing was required. The sampling and analysis centered on the soil washing and biological treatment process. The developer did operate the metals removal process during the sampling period in order to complete the processing of the soil from another site where high metals levels were encountered. A modified sampling program for the metals removal process was implemented in the field to provide an engineering assessment of this technology.

The project objective was to achieve the Modified MOE Criteria Levels for Clean Soil for Commercial/Industrial Sites. An abbreviated list of the criteria which proved important in this study is presented in Table 1.

Table 1. Abbreviated MOE Criteria for Commercial/Industrial Site Soils

Oil and Grease	*1%*
Naphthalene	*8.0 g/kg*
Benzo(a)pyrene	*2.4 mg/kg*

In addition, the objectives included an assessment of the removal efficiencies for the various undesirable constituents by the individual processes. Gaseous emissions from the biotreatment process were also sampled.

Composite samples were collected from all feed and product streams and from process streams where data were required to assess the performance of the processes. Process operating data were accumulated to define operating conditions during the Demonstration sampling. Laboratory activities conducted for the Demonstration included

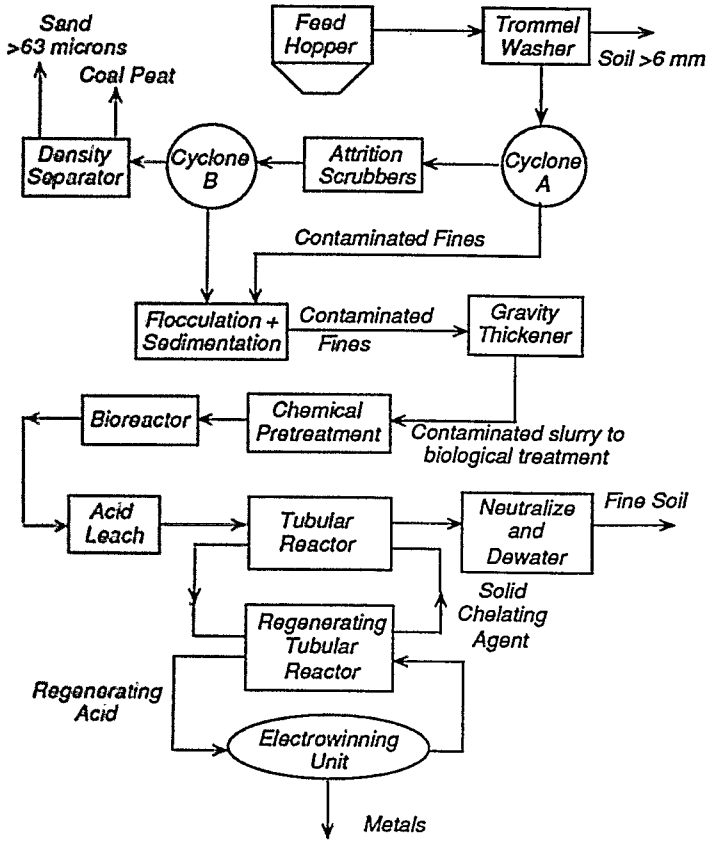

Figure 1. Simplified process flow diagram.

analysis of metals, semivolatile organic compounds, a number of conventional parameters, and soil physical characteristics.

The Demonstration showed that:

- Soil washing was effective in producing clean coarse soil fractions and concentrating the contaminants in the fine slurry.

	Feed	Clean Sand	Contaminicted FineSlurry
Oil & Grease	.8 mg/kg	.2 mg/kg	4 mg/kg
Naphthalene	11 mg/kg	2 mg/kg	52 mg/kg
Benzo (A) Pyrene	2 mg/kg	.5 mg/kg	10 mg/kg

- The chemical treatment process and biological slurry reactors, when operated on a batch basis with a nominal 35 day retention time, achieved at least a 90% reduction in simple PAH compounds such as Naphthalene, but fell just short of the approximately 75% reduction in Benzo(a)pyrene required to achieve the MOE criteria.

	Contaminated Fine Slurry	Treated Fine Slurry
Naphthalene	52 mg/kg	<5 mg/kg
Benzo (A) Pyrene	10 mg/kg	2.6 mg/kg

- The biological process discharge did not meet the MOE criteria for oil and grease and the process exhibited virtually no removal of this parameter. The developer believes that the high outlet oil and grease values are the result of the analytical extraction of the biomass developed during the process.
- The hydrocyclone dewatering device did not achieve significant dewatering. Final process slurries were returned to the excavation site in liquid form. The development of an acceptable dewatering process will require further evaluation of alternative technology.
- The metals removal process achieved a removal efficiency for toxic heavy metals such as copper, lead, mercury and nickel of approximately 70%.
- The metals removal process equipment and chelating agent were fouled by free oil and grease contamination; forcing the curtailment of sampling prematurely. This establishes a limitation for this technology since biological treatment or physical separation of oil and grease will be required to avoid such fouling.

An Application Analysis Report and a Technical Evaluation Report describing the complete Demonstration will be available in the Spring of 1993.

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