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Demonstration Bulletin

The Basic Extractive Sludge Treatment (B.E.S.T.®)

Resources Conservation Company (RCC)

Technology Description: The Basic Extractive Sludge Treatment (B.E.S.T.®) process is a solvent extraction system that separates organic contaminants from sludges, soils, and sediments. The primary distinguishing feature of the process is the extraction agent, triethylamine.

The key to the success of triethylamine extraction is the property of inverse miscibility. At temperatures below 60°F, triethylamine is miscible with water; above 60°F, triethylamine and water are only slightly miscible. Therefore, by utilizing solvent chilled below 60°F, solids can be dewatered while simultaneously extracting organic contaminants. This is referred to as a "cold extraction". Afterwards, the remaining organic contaminants can be removed at temperatures ranging from 70 to 160°F and higher. These are referred to as "warm" and "hot" extractions, respectively.

The B.E.S.T.® process operates as follows. Contaminated material screened to less than 1/2 inch diameter (1/8 inch for this demonstration) is added to a refrigerated premix tank with a predetermined volume of 50 percent sodium hydroxide. After the tank is sealed and purged with nitrogen, chilled solvent is added. The chilled mixture is agitated, and then allowed to settle. After this cold extraction is completed, the resulting solution of solvated oil, water, and solvent is decanted from the solids and centrifuged. The solvent and water are removed from the solvent/water/oil mixture by evaporation and condensation of the solvent and water.

Cold extractions are repeated as additional feed is added to the premix tank so that enough solids are accumulated to warrant subsequent extraction cycles. Solids with high moisture contents may require more than one cold extraction. For this demonstration, a sediment containing 41% moisture required two cold extractions.

Once a sufficient volume of moisture-free solids is accumulated, it is transferred to a steam jacketed extractor/dryer. Warm triethylamine is added to the solids. The mixture is heated, agitated, settled, and decanted. This process can also be repeated. These warm and hot extractions result in separation of the organics not removed during the initial cold extraction.

The B.E.S.T.® solvent extraction process is illustrated in Figure 1. As illustrated, high oil and/or water content material such as

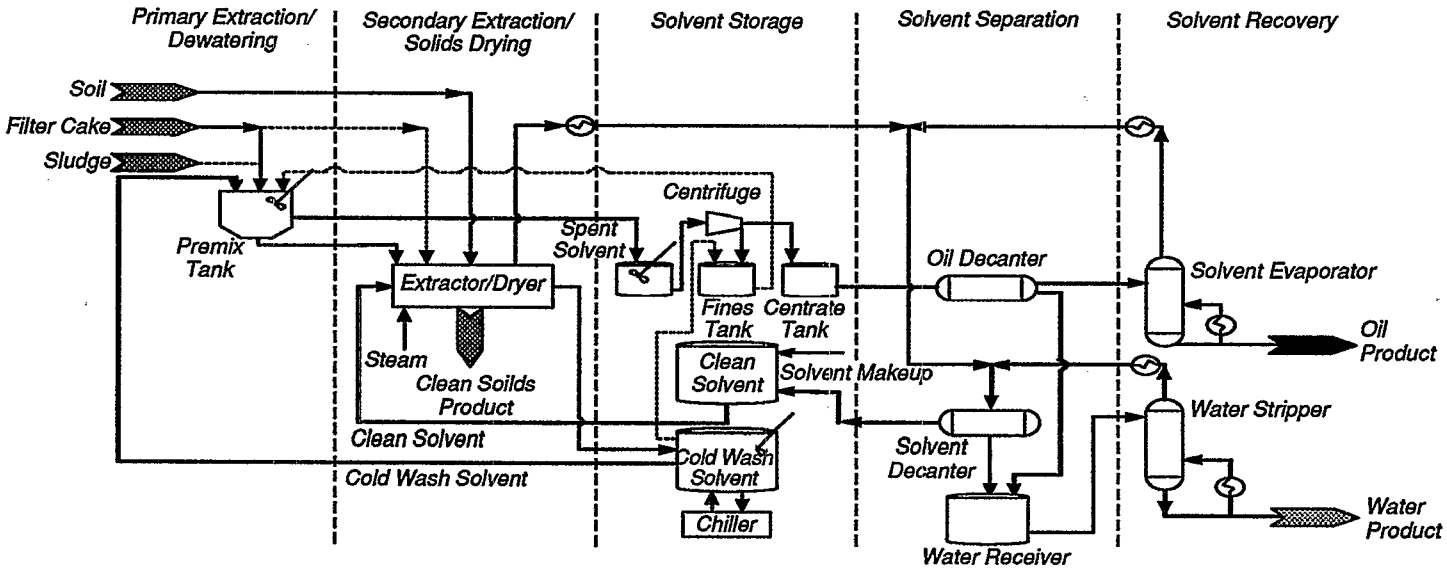

Figure 1. Simplified diagram of the RCC B.E.S.T. solvent extraction process.

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sludge is placed initially in a premix tank where cold extractions are performed. Although the total number of cold and hot extraction cycles required for a particular feedstock may vary, bench-scale tests aid in the determination of process requirements. The solids remaining in the extractor/dryer contain triethylamine following decanting. After a small amount of caustic is added for pH control, the solvent is volatilized by heating with the steam jacket. Steam is also injected into the solids near the end of the drying cycle to drive off residual solvent and to add moisture to reduce dust problems. The products from the fully run process are 1) product solids 2) product water and 3) concentrated oil containing the organic contaminants. The recovered oil fraction can be dechlorinated or incinerated to destroy the organics. The triethylamine is recovered and reused in further extractions.

Waste Applicability: This process is designed to treat sludges, soils, and sediments contaminated with organic compounds. Polynuclear aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) were the organics of interest during the demonstration.

Demonstration Results: The demonstration of RCC's B.E.S.T.® pilot plant was conducted in cooperation with the Great Lakes National Program Office and the U.S. Army Corps of Engineers. The testing took place between July 1 and July 22, 1992 at a location adjacent to the Grand Calumet River in Gary, IN. The material treated during the demonstration was river bottom sediment collected from two separate locations along the Grand Calumet River.

Figure 2 is a regional map showing the approximate sample locations. These core sample locations were chosen so that a variation in contaminant concentration (including oil percentage) could be evaluated in regard to treatment applicability.

The B.E.S.T.® demonstration consisted of two separate tests, one for each sediment type. Each test consisted of two phases; Phase I involved determination of optimum process variables from results of three runs and Phase II consisted of two additional runs at the determined optimum conditions (for a total of three optimum runs.)

Sediment A contained 41% moisture, 6,900 mg/kg oil and grease, 12 mg/kg PCBs and 550 mg/kg PAHs. The process removed greater than 98% of the oil and grease, 99% of the PCBs and greater than 96% of the PAHs. Sediment B contained 64% moisture, 127,000 mg/kg oil and grease, 430 mg/kg PCBs and 73,000 mg/kg PAHs. The process removed greater than 98% of the oil and grease and greater than 99% of the PCBs and PAHs. The residual solvent in the product solids, product water, and product oil (Sediment B) was 103 mg/kg, less than 1 mg/l, and 730 mg/kg, respectively.

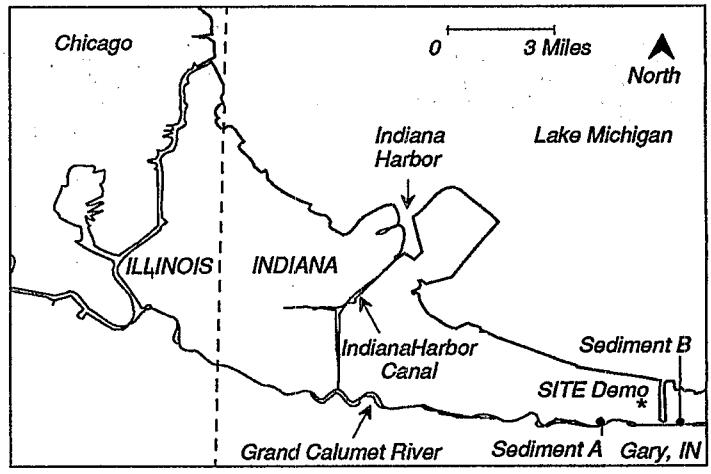

Figure 2. Regional location map.

A Technical Evaluation Report and an Applications Analysis Report describing the complete demonstration will be available in the summer of 1993.

For Further Information:

EPA Project Manager:
Mark Meckes
U.S. Environmental Protection Agency
Risk Reduction Engineering Laboratory
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7348

United States
Environmental Protection Agency
Center for Environmental Research Information
Cincinnati, OH 45268

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