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Biological Treatment of Hazardous Sludge Using a Modified Ex situ Biopile System and Beneficial Reuse of Residuals

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This presentation illustrates the development of a modified ex situ Biopile system used for the successful treatment of TPH-contaminated sludge. Over the course of 30-years, highly-impacted sludge accumulated in a sediment pond, which formed part of a petrochemical plant's storm and wastewater treatment process. Chemical analysis illustrated TPH content as high as 330,000 ppm and classified as a hazardous waste.

Laboratory work was conducted to ensure viable microflora to sustain biological treatment and develop a successful approach to provide the sludge with an appropriate structure for biodegradation using an ex situ Biopile process. Organic amendments were evaluated for their capacity to absorb excess fluid (hydrocarbon and water) and facilitate aeration. Different laboratory scale treatment conditions were studied in an engineered mesocosm system to simulate the full-scale process. This included fluid (hydrocarbon and water) content, type and quantity of nutrient sources, as well as the aeration rate for optimal treatment conditions. Physio-chemical and biological parameters were monitored during laboratory treatment. An optimized laboratory scale treatment process was able to decrease the average concentration of tested material from 190,000 ppm to 17,000 ppm within a 23-week treatment period, representing degradation efficiency of 91%. The microbial count during treatment reached concentrations as high as 109 CFU/g and the temperature increased up to 46°C. During this bench-scale phase, re-engineering of the biopile process was conducted to accommodate modifications and constraints that had been created.

Based on laboratory results, Biogenie proposed a guaranteed remedial solution using a modified biopile process. Approximately 7,800m^3 of contaminated material, ranging from liquid to solid waste, were solidified and treated. Waste was placed in biopiles and treatment objectives were met in 6-months (occurring during parts of the Canadian winter season). During treatment, gaseous effluent was treated in a biofilter and physio-chemical and biological parameters were monitored, illustrating consistency which was observed during the laboratory study. Total microflora reached up to 23% TPH degraders and the average temperature during treatment was 43°C. All other physio-chemical parameters were maintained at the appropriate range for biological treatment. Using this modified biopile system, the TPH content of this hazardous material was successfully reduced below a target criterion.

Utilizing Biogenie's ex situ Biopile process resulted in the ability to beneficially reuse all by-products that would have otherwise been disposed and is summarized as follows:

Organic amendment is used to solidify sludge; this equalled ~80% of the initial volume creating a significantly increased solidified volume. The active biopile resulted in ~40% (solidified volume) reduction of organic material as a result of composting during treatment.

The modified biopile (composting) process promoted fluid recovery during treatment; this equalled ~30% of the initial volume in the form of hydrocarbon and water. Fluids were collected and processed at the petrochemical plant for hydrocarbon recovery.

Reduction of the TPH content of the sludge below 20,000 ppm allowed for beneficial reuse of residual solids as Alternative Daily Cover at Municipal Solid Waste landfills.

The successful implementation of this project demonstrates the capability of biological treatment to cost-effectively promote beneficial reuse vs. waste disposal of hazardous sludge. A disposal alternative would have resulted in waste sludge (hydrocarbon, water, and sediment) and organic amendment being disposed of.

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Mr. Dirks holds a diploma in Environmental Sciences from the Northern Alberta Institute of Technology. Upon completion of his studies, he began working in the field of hazardous waste management and contaminated site remediation. In 2007, he joined Biogenie and is currently the General Manager for the Western Canadian operations. Mr. Dirks has managed projects that included environmental site assessments, facility decommissioning, abatement, demolition, and remediation. This experience has enabled him to implement large-scale environmental and capital projects throughout Canada, ensuring a link between the various parties involved such as vendors, municipalities, governing bodies, other human resources of the firm, and client representatives.