Enhancement of Oily Sludge Biodegradation in Historic Refinery Wastewater Lagoons

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Background. The presence of untreated historic oily sludge in refinery wastewater ponds represents a long-term liability at older petroleum refineries. In many cases, this waste will be classified as a listed hazardous waste if it is removed from the pond as part of pond maintenance, process alteration or pond unit closure. The oil component of this sludge is typically difficult to biodegrade because it consists of long-chain or polyaromatic hydrocarbons. Most efforts to remediate this type of waste center on removal, dewatering, and potentially solidification or stabilization for final disposal. However, this approach is equipment intensive, costly, and typically disturbs normal site operations. For a refinery that is still in operation, in situ treatment approaches that rely on biodegradation of the waste material can offer a more economical solution to this liability.

Approach. The purpose of this research effort is to evaluate different approaches to bioremediate or treat sludge-containing wastewaters impounded in lagoons from historic refinery wastewater treatment operations. The primary approach for enhancing the desired biodegradation treatment is by dispersion of the oily material to increase oil/water interfacial area and addition of microbial consortia optimized for crude oil or heavy hydrocarbon biodegradation. Laboratory experiments are conducted for each of these enhancement steps, as well as the two steps combined. Modeling of the dispersion and biodegradation process is also conducted for comparison with the laboratory results. The goal is to attain nearly complete oily sludge biodegradation in an aqueous environment within a period of a couple of years. This result would be an acceptable treatment goal for an operating refinery where the wastewater lagoon is still part of current operations.

Results. The laboratory results completed to date for dispersing oil material indicate differences in amount of material dispersed into the water column due to amount of dispersant loading, type of vendor-supplied dispersant, and type and energy of mixing. The modeling results obtained to date indicate very significant differences in the time required for 95 percent of material to be biodegraded, depending on the particle size of the dispersed sludge. These results indicate that the critical elements in this process are control of the particle size obtained in dispersion, and the energy used for mixing.