

CRUDE OIL SLUDGE ASSIMILATION STUDIES

Environmental Remediation Consultants, Inc. (ERC) is pleased to present the following report on the degradation of a highly paraffinic petroleum sludge using Bio-Integration[®] protocols and amendments. This report summarizes the constituents of the treatability study, the technical approach taken, the results obtained, and the physical problems encountered. Due to the fact that another sludge was liberated from the reactant matrix, a second study was initiated, albeit short lived, to further assess its relevance and eventual fate. At the onset, the underlying premise of this endeavor was to demonstrate the efficacy of using an alternative, water-based, non-hazardous technology for the in-situ cleaning of crude oil storage tanks that limits liabilities and reduces manpower, costing, and turnaround times, while rendering the contents compatible with POTW disposal methods. The results of both studies are contained herein.

SCOPE OF WORK

The following is a thirty-one (31) day (run time), batch, suspended culture, biodegradation study (ies) utilizing biotic and abiotic co-treatment amendments, as provided by ERC, and a highly paraffinic crude oil sludge purchased from a major oil refinery. ERC personnel oversaw the daily operation of the test, measured pH and temperature, provided make-up water, and, at various intervals, harvested subsamples for analytical analyses; said analyses were performed by ENVIROCHEM and TEST AMERICA.

PROCEDURE

A 110 gallon, open top, poly tank was skid mounted, with its 2 inch center drain coupled to a centrifugal AMT 369D-95 cast iron circulation pump connected to a single phase, 2 horse power, 3600 RPM, TEFC motor, wired for 110/220V; the inlet to the pump is 1 ½ inches, with a 1 inch outlet. This downsizing caused most of our heating problems, forcing periodic down times to allow for reactant cooling.

The initial **sludge** had a **pH** of **5.8**, a **water content** of **0.4%**, and a **COD** of **810,000 ppm**. Approximately 4 ½ gallons of this material was slowly added to a circulating reagent mixture to prevent clogging and pump damage.

This reagent mixture was a combination of water and Bio-Integration[®] amendments (Terradyne, electron acceptors, bacteria, etc.). Approximately 20 gallons were used to fully entrain the sludge; this level gave us optimal mixing capabilities, without causing pump cavitation. Again, physical limitations dictate test protocols.

TECHNICAL APPROACH

Study I

As previously stated, the initial sludge was slowly added to the tank reagents, resulting in a homogeneous liquid reactant being **circulated at 65 GPM (2.6 volume exchanges per minute)**. Aliquots were removed daily for observation and pH/temperature were monitored; circulation was stopped when the mixture reached **110° F**, resulting in increased run times. Metabolic heat, ambient temperature, and a reduction from 220V to 110V caused this temperature elevation; moving the tank to three different locations also contributed to an increased timeframe. Five COD samples were submitted for laboratory analyses and are graphed in **Figure 1**.

Study II

During the breakdown of the initial sludge, balls of paraffin appeared floating on the surface. These were harvested and were observed to have no odor and left no residue upon handling. Laboratory analysis showed this **paraffinic sludge** to have a **flash point greater than 215° F**, making it suitable for reuse/resale or non-hazardous disposal. ERC dissolved this new component in mineral spirits and reintroduced it to the circulating tank; within 36 hours, no volatiles were detected and the balls had reformed.

ANALYTICAL METHODS

The following parameters were measured using the instruments/methodologies as indicated:

pH	Test Strips
Temperature	Hand Held Digital Infrared Thermometer
COD	SM5220D
Flash Point	EPA 1010

RESULTS

Study I

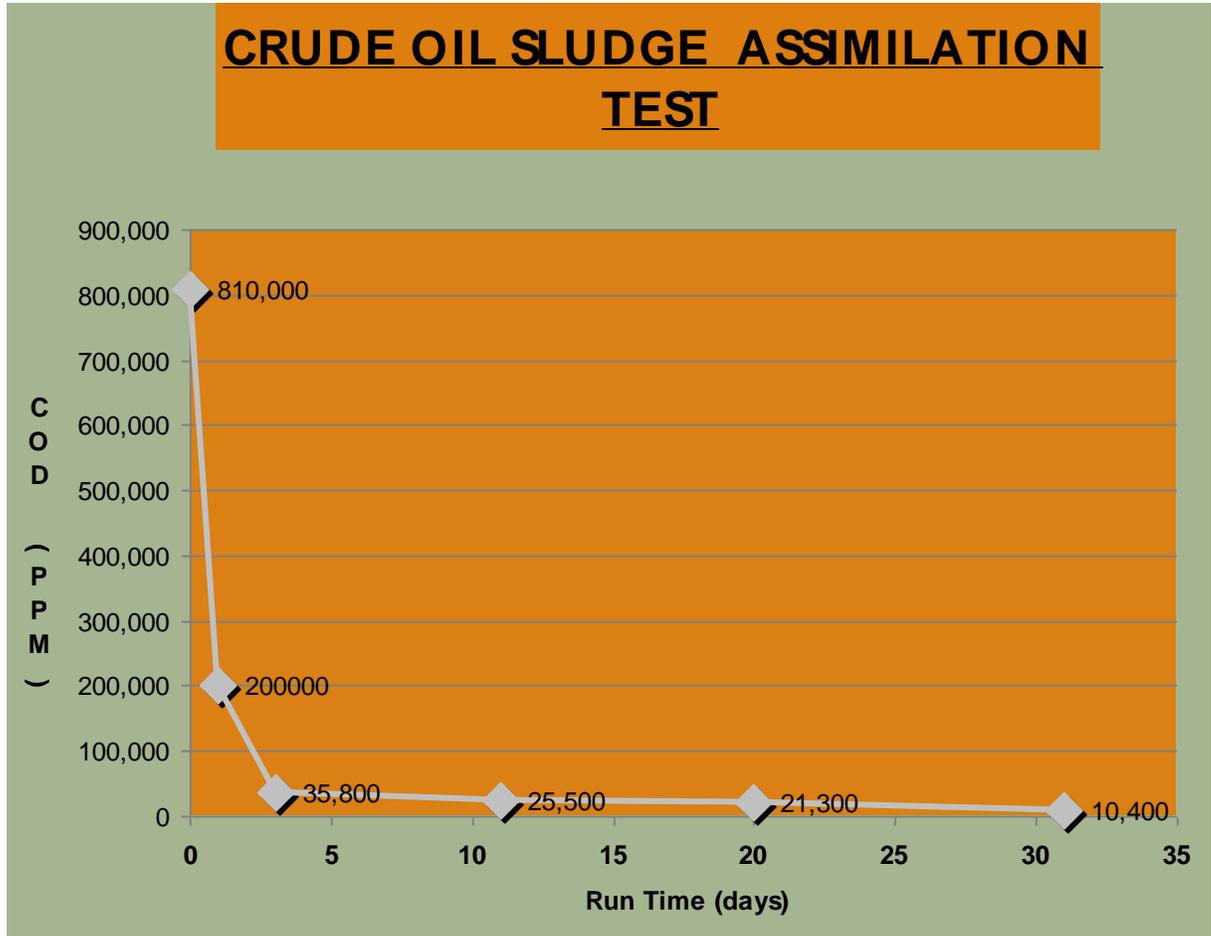


Figure 1.

Degradation Rates Per;

Day 1	Reduction Caused By Reagent Dilution
Day 3	82.1%
Day 11	29.0%
Day 21	16.4% (added additional bacteria)
Day 31	51.2%

Overall removal rate of 98.7% in 31 days

Study II

Paraffinic Sludge Flash Point > 215° F

DISCUSSION

These two small scale studies represent a significant advancement in the understanding and predictability of Bio-Integration[®], as it pertains to tank cleaning processes. Despite the compromisingly imposed physical limitations, our original premise held and was validated by the results obtained. Our pragmatic approach provides a viable, economical, and timely alternative for the in-situ cleaning of petroleum storage tanks that requires no solvent based cutter stock, no confined space entry under air, no transportation, no burning, no land filling.....a truly eco-friendly, lean, green initiative.