PEMEX REFINERY DECOMMISSIONING CASE STUDY

THE PROBLEM

The decision by PEMEX to close their "La Nogalera" petroleum storage facility in Guadalajara, Mexico, involved the demolition of the facility's large storage tanks. Before demolition, the tanks had to be cleaned and all traces of petroleum had to be removed from the tanks. All tanks were pressure washed prior to demolition creating a large volume (9,035 m^3) of contaminated wash water that could not be disposed of. Storage of this wash water in the two remaining tanks on site was preventing the final closure of the facility, creating both an environmental liability and an operating cost for PEMEX.

OUR APPROACH

Upon reviewing the problem, it was clear that a two phased approach would be required to meet the discharge limits (less than 5 ppm) dictated to PEMEX by environmental authorities and do so in as short a period of time as possible to facilitate the final closure of the facility. The first phase of the treatment was an active treatment of the contaminated wash water as it was pumped from the storage tanks into a Nordevco designed bioreactor. The second phase involved reinjecting water treated in the bioreactor back into the storage tank. This water carried BactiDomus® Technology product from the bioreactor into the tank where they began a passive treatment of both the sludge and wash water. In addition, urea and phosphate were added to ensure a C/N/P balance. No water was discharged until the entire contents of the tank met regulatory/contract requirements

THE TECHNOLOGY

Nordevco's BactiDomus® Technology was developed by a diversified group of research scientists working together at Universities in Belgium and France. Their goal was to create a mechanism with the flexibility to delivery biological solutions to a range of environmental issues more effectively and efficiently

The foundation for the success of the BactiDomus® Technology was the development team's clear understands that for any carrier material to be successful it had to meet specific underlying needs of the organisms:

- Regardless of the organisms used, they would be cultured in a sterile laboratory and would require time to acclimate to the environment they were activated in.
- Microorganisms, like humans, do not exist or thrive in isolation of each other but rather rely on others for stimulation and competition;
- Organisms prefer to grow and live in colonies or flocs and prefer to attach to something to anchor these colonies;

- Individual species of microorganisms do not work in isolation to break down organic compounds. To successfully break down any organic completely to CO2 and H20, a variety of different organisms are required;

The result of that work is the BactiDomus® Technology which is based on the use of an inorganic limestone-like porous carrier material. The porosity of the material allows it to be bathed in a nutrient broth, absorbing key micro-nutrients that act as an initial food source when the product is activated. It is then impregnated with a range of different naturally occurring and non-pathogenic organisms, selected for their ability to breakdown specific organic contaminants.

The organisms selected for inclusion are selected based on the understanding that each contaminated environment can be aerobic, anaerobic or facultative anaerobic. Therefore, aerobic, anoxic and anaerobic organisms are selected and used in each product to ensure that they can function successfully in a broad range of environments.

The carrier material's large surface area to size ratio provides the organisms with both internal and external floc points where they grow and create large effective colonies of biodegraders working together to break down the organic contaminant into carbon dioxide and water.
The carrier material's hydrophilic nature allows it to absorb both the water and contamination. This provides a steady strong contact between the imbedded organisms and organic contaminant. This ensures that the organisms have a continuous food source as they grow and create flocs within the protective confines of the capillary network of the carrier material.

THE RESULTS

A total of 9,035,000 litres of contaminated wash water was treated in four batches over a four month period (September 2 – December 20, 1993). The level of treatment in all the wash water exceeded the requirements of the contract.

Treatment was initiated on Sept. 2, 1993 with an initial batch of 3, 668,000 liters of wash water contaminated to 187 ppm (total hydrocarbons). Testing on Sept. 9 revealed that levels of contamination had been reduced to 3 ppm, at which point an additional 804,000 liters of contaminated wash water was added to the initial batch raising levels of contamination to 36 ppm. By September 23 the levels of contamination in the 4,472,000 liters of wash water had been reduced to 4.6 ppm and by October 12 to <1 ppm.

On Oct. 12 the 4,472,000 liters of treated wash water was discharged and a new batch of 2,963,000 liters contaminated water was pumped into the storage tank used for treatment. On Oct. 13 an addition 1,600,000 liters of wash water was added to the tank. During this second loading process an undetermined amount of diesel fuel and oil sludge were also transferred to the storage tank. PEMEX determined that levels of contamination in the 4,563,000 liters of wash water was 125 ppm, exclusive of the layer of diesel fuel/sludge floating on the surface of the wash water. PEMEX sampling on Nov. 4 estimated that levels of contamination had increased to 943 ppm. This increase was the result of the secondary passive treatment breaking down the diesel/sludge layer making it more likely to be drawn into the sampling vessel. By Dec. 1 the level of contamination in the wash water exiting the bioreactor (and prior to re-injection into the storage tank) was 19.8 ppm. On Dec. 20 the level of contamination in the storage tank was 3.6 ppm and the treatment was considered complete, including the biodegradation of sludge/diesel fuel that had been accidentally transferred to the tank.

TREATMENT SUMMARY

Start Date	Completion Date	Volume of wash water Treated	Initial Hydrocarbon Concentration	Final Hydrocarbon Concentration
Sept. 2	Sept. 9	3,668,000 liters	187 ppm	3 ppm
Sept. 12	Oct. 12	4,472,000 liters	36 ppm	4.6 ppm
Oct. 13	Dec. 20	4,563,000 liters	943 ppm	3.6 ppm

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