

Evaluation of bio-surfactants enhancement on bioremediation process efficiency for crude oil contaminated soil at oilfield: Strategic study

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Abstract One of the most critical environmental impact of extraction and production of oil industry is the spillage of crude oil that causes severe soil contamination. A polluted soil by crude oil at the bank of produced water pit at a studied oilfield has been chosen as a case study area. A typical soil sample has been prepared from a mixing of twenty four contaminated soil samples that have been gathered from the top soil at the bank of produced water disposal pit. Total Petroleum Hydrocarbon (TPH) has been determined for the typical soil sample. Bioremediation study has been conducted, where the typical sample was divided into five controlled soil cells. Four cells have treated by biosurfactant in a certain concentration (0.05%, 0.5%), and volume (2.5, 10 cm³/Kg soil). One cell has been used as a reference.

An evaluation of the ability of aqueous biosurfactant solutions (rhamnolipid), for possible applications in crude oil contaminated soil bioremediation was carried out. The results showed that the biosurfactants were able to remove significant amount of crude oil from the contaminated soil at different solution concentrations and volumes comparing with untreated cell.

Computational fluid dynamics (CFD) model has been developed and employed to simulate the transport of TPH in the soil around the pit and then simulate the bioremediation process for completely studied area at the mentioned controlled parameters. CFD modeling provides insights into the environmental problems that would be too costly or simply prohibitive by experimental techniques alone. The added insight and understanding gained from environment modeling gives confidence in the design proposals, avoiding the added costs of over-sizing and over-specification, while reducing risk. The model chosen to represent the transport and bioremediation process provided satisfactory results. The values calculated by the model were consistent with the experimental results. The model results were based to build up an effective plan of the bioremediation of contaminated soil by crude oil. This technique is applicable for many contaminated site cleanup programs.

Keywords: soil, bioremediation, biosurfactants, CFD models, Oil & Gas Industry.