

TREATABILITY AND CHARACTERIZATION OF A CONTAMINATED SOIL FROM AN EXPLORATION ZONE: EFFECT OF THE PARTICLE SIZE OVER THE WASHING RATE

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Oil exploration and production zones are very frequently contaminated. In Mexico, the most important exploration and production zones are located at Veracruz and Tabasco states. There are several remediation techniques, which have proven to be an excellent option for remediation purposes. One of them is surfactant enhanced soil washing. Our research group has been studying for years this remediation technique at laboratory, pilot plant and full-scale levels, for decontamination of soil containing diesel, gasolines, crude oil and other petroleum fractions. First step in developing a washing technique is to characterize the soil, and the specific contaminants present, and then, to carry out treatability tests, i.e., determining the best surfactants or surfactant+salts mixtures, and the ideal doses to perform the soil washing process.

A crude-contaminated soil, arising from an oil exploration and production zone in Tabasco, Mexico was received and stored at room temperature. A sample of about 40 kg was dried and screened through mesh 10-100 (1,700 to 150 μm). At this point, TPHs and 6 metals (Cd, Cu, Cr, Ni, V and Zn) were determined to the different portions. Particles higher than mesh 10 were separated. Six non-ionic, three anionic and one zwitterionic surfactant solutions were employed to wash the soil (all the soil and the portion correspondent to mesh 10). The concentration of all surfactants was 0.5%. Process was as follows: six grams of soil were washed in a 40 ml amber vial, with 20 ml of water or surfactant solution, using gentle agitation during 23 hours, at room temperature. Finally, soil was allowed to settle for 1 hour and solutions were discharged. Clean soils were dried and TPHs were measured using a gravimetric technique. Washing removals were calculated taking into account the water content of samples and the initial TPH concentrations. After that, two anionic surfactants (SDS and SDBS) were used together with NaCl, Na-silicate or seawater in order to wash the same soil. At the end, every one of the soil portions (i.e. mesh 4, 6, 10, 20, 40, 60, 80 and 100) were washed with SDBS at 0.5%.

Results indicated that TPHs and metals had particular distributions in the soil meshes, which has important implications for the full-scale process. TPH values were in the range of 51,550 to 192,130 mg/kg. Cd was not found in any of the soils portions, and the rest of the metals were found at different concentrations, for every soil mesh. Treatability tests applied to the soils indicated that it is possible to get removals between 9.1% (seawater alone) to 20.5% (SDS 0.5%) when washing soils with 0.5% solutions. For the special case of a SDS 1% solution, TPH removal was as high as 35.4%. Combinations of SDS and salts, gave removal rates up to 49.5%. These figures are considerable, since the initial TPH concentrations for the whole soil were about 150,600 mg/kg. Finally, the particle size had an important effect in the TPH removal rates. The higher the particle size, the lower the washing removal rate.

