Beneficial Reuse of Petroleum – Contaminated Soil in Concrete Mixture

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Abstract

Petroleum-contaminated soils (PCS) result from leaking underground tanks, from oil spills on clean soils, or as a result of soils surrounding petroleum refineries and crude oil wells. Some disposal and treatment techniques generally include: landfilling; bioremediation; and low temperature desorption. In Oman, Petroleum Development Oman (PDO) generates approximately 53,000 tons/year of PCS. The main objective of this project is to investigate the use of untreated and treated PCS as a sand replacement in concrete. For each PCS type, one group of cement mortar mixes was prepared by replacing the sand fraction using different percentages of PCS (0, 25, 50, 75 and 100%). In addition, two groups of concrete mixes were prepared and five blends were tested by replacing sand with PCS. Groups One and Two included mixtures of PCS/sand ratios of 0, 25, 50, 75 and 100% and 5, 10, 15, 20, 25% (by weight), respectively. The results obtained for the Group One mixes showed that a concrete mix containing a higher untreated PCS/sand ratio developed lower compressive strength for that mix. The mixes that contained treated PCS generally behaved similarly to the mixes prepared using untreated PCS. The data also showed that untreated PCS mixes yielded a higher compressive strength than treated PCS mixes. The results obtained from the flexural strength test yielded the same trend as that of the compressive strength test. A target 28-day compressive strength of 30 MPa can be achieved using 25% untreated or treated PCS. The results obtained for Group Two mixes showed that concrete containing higher untreated and treated PCS/sand ratios developed lower compressive strength for all curing periods. Tensile strength test results indicated that treated PCS concrete mixes have higher 7-day strength than untreated PCS. The Initial Surface Absorption Test results show that with an increase in PCS content in the concrete mixes, there is an increase in the flow rate with no specific pattern. For the modulus of elasticity test, the values are a function of compressive strength. When the compressive strength increases, there is an increase in the modulus of elasticity. Recommendations for additional work include: (a) investigate the effect of PCS addition on steel corrosion; (b) examine fatigue and creep properties; and (c) evaluate leachability of toxic heavy metals and organics.