Use of Petroleum – Contaminated Soils in Road Bases and Sub bases

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Abstract

Petroleum-contaminated soils (PCS) result from leaking underground storage tanks, oil spills on clean soils, or soils surrounding petroleum refineries and crude oil wells. Contaminated soils typically consist of sand, silt and may have clay soil with the petroleum product. PCS disposal techniques include: landfilling; bioremediation; low temperature desorption; and possible use as construction materials. Landfill disposal is not considered a real disposal option as the process continues to carry a liability of a contaminated soil generator. The thermal process is suspected to cause air pollution. The use of PCS in construction applications appears to be the most efficient technique. Still engineering and environmental aspects need to be investigated. In Oman, Petroleum Development of Oman (PDO) generates approximately 53,000 tons/year of untreated petroleum-contaminated soils. PDO faces a real challenge to dispose of huge amounts of PCS. This research investigated the potential use of PCS in road bases and subbases. Raw materials used in the research study include: untreated PCS; treated PCS; virgin subbase aggregates and virgin base aggregates. Research tasks included: (1) literature review; (2) materials characterization; (3) mechanical-based testing of optimum blends of PCS and virgin aggregates; and (4) leachate-based testing of selected mixtures using the Toxicity Characteristic Leaching Procedure. Results indicated that: (1) both treated and untreated PCS don't meet gradation requirements for road bases and subbases set forth in Oman's specifications; (2) optimum blends of PCS with virgin subbase aggregates include: (a) 25% treated PCS with 75% virgin aggregates; (b) 25% untreated PCS with 75% virgin aggregates; and (c) 5% treated PCS + 20% untreated PCS + 75% virgin aggregates; (3) optimum blends of PCS with virgin base aggregates include: (a) 15% treated PCS with 85% virgin aggregates; (b) 20% treated PCS with 80% virgin aggregates; (c) 15% untreated PCS with 85% virgin aggregates; and (d) 5% treated PCS + 15% untreated PCS + 80% virgin aggregates; (4) raw untreated or treated PCS would meet Oman's specifications of a California Bearing Ratio (CBR) requirement of 30% for road subbases; (5) all mixtures of virgin subbase or base aggregates with PCS would meet Oman's specifications for a Class B road subbase CBR requirement of 30%; (6) however, only one blend of 15% untreated PCS with 85% virgin base aggregates would meet Oman's specifications for a Class Broad base CBR requirement of 100%; (7) because of the high CBR requirement (100%) for road base, it is not recommended to use PCS in the base layer; (8) however, it would be feasible to use combinations of treated and untreated PCS (up to 25%) with virgin subbase aggregates in the road subbase structure and (9) the toxicity characteristic leaching procedure (TCLP) test results indicate that the concentrations of heavy metals and toxic organics in treated PCS; untreated PCS; and mixtures of untreated or treated PCS with virgin base aggregates and virgin subbase aggregates are well below the United States Environmental Protection Agency
Recommendations for further work include the construction and evaluation field test sections incorporating mixtures of untreated and treated PCS in the road subbase structure. This evaluation should include both mechanical and environmental assessment of the field test sections.