

In Situ Deposited Non-Aqueous Phase (IDN) Sediments: A Conceptual Model for NAPL Emplacement

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Background/Objectives. In situ deposited non-aqueous phase (IDN) sediments are the result of the deposition of oil-particle aggregates (OPAs). These in situ deposited sediments develop at locations where a continual or nearly continual discharge of non-aqueous phase liquids (NAPLs) have occurred or are occurring through time. These conditions have historically occurred in association with wastewater discharge outlets from manufactured gas plants (MGPs), refineries, terminals, and other related facilities. Given the number of these facilities throughout the world, the distribution of IDN sediments could be widespread throughout many waterways.

Approach/Activities. This paper describes the characterization of IDN sediments collected at two locations through numerous physical property measurements. These include bulk density, grain size, moisture content, total porosity, hydraulic conductivity, and capillary properties. The results of the measurements were compared to ascertain similarities and differences in IDN formation.

Results/Lessons Learned. Results from these studies document that IDN sediments have unique physical characteristics that inherently contain NAPL within pore structure of the sediment. Porosity, water content, and dry bulk density measurements indicate the solid particles within the sediment compose between 30 and 50 percent of the total sediment volume. Therefore, dry bulk density values below 1.0 g/cm^3 may result. Although the pore structure is very open, the pore openings are relatively small, which inhibits fluid movement. Capillary pressure analyses indicate that oil is retained within the smallest pores and is encapsulated within a network of larger pores filled with water. Although total petroleum hydrocarbon (TPH) concentrations can exceed 100,000 milligrams per kilogram, NAPL within the pore network is contained and is immobile under ambient conditions.