

Delineation of Residual Free-Phase Product Using OIP Tool

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Background/Objectives. The study area is located in the Southern Region of Brazil, in a site that covers 40 hectares, in a coastal cove where natural soils are predominately sandy to clayey-sandy, associated with deposits of Quaternary coastal sediments. The primary activity carried out onsite consists of the refining of crude petroleum for the manufacture of petroleum products. Environmental studies detected a hot spot in the former area of acid sludge basins and surroundings. Sludge was formerly disposed in this area, directly on the soil. This area also had a sludge disposal basin that overflowed and a former underground line for the conveyance of oily wastewater (currently non-operational), where an accidental release was recorded. Oily sludge wastes are therefore found in this area in the soil matrix, as well as light non-aqueous phase liquid (LNAPL) that consists generally of a mix of several hydrocarbons. This area was deactivated in the middle of 1998, but it was not until 2017 that the sludge disposal basin was emptied (2.2 tonnes of liquid-phase and 3.5 tonnes of pasty products) and the area was backfilled with soil. Occurrences of LNAPL were observed primarily near the water channel (area of discharge of the local aquifer) that runs close to this area, where waste removal operations may have been less effective. The use of a high-resolution tool was selected for the vertical screening of these occurrences.

Approach/Activities. The screening tool used was an Optical Image Profiler (OIP). This probe has an onboard camera that records at 15 mm drilling intervals soil images produced in response to 2 different light sources in UV and in visible ranges. Software filters are applied to the images to generate semi-quantitative data (% of pixels that responded to fluorescence) of LNAPL occurrence. Thirty-three (33) boreholes were advanced to delineate the LNAPL occurrence in the subject area.

Results/Lessons Learned. It was initially expected that vertical delineation would occur in the zone of oscillation of the water level surface, between 1.0 m bgs and 1.5 m bgs; however, when boring started, fluorescence signs were observed between 1.80 m bgs and 8.15 m bgs, with peaks going from 30% up to more than 90% of fluorescence. The fluorescence peaks covered both the upper horizon near the water level and the deeper layers of the subsoil. The fluorescence observed in the deeper layers is believed to be linked to the base level of the former sludge disposal basin, since it is known that the terrain elevation has significantly changed through backfilling (although no accurate data is available on its original elevation). The scenario revealed by the OIP tool enabled a revision of the site's conceptual model, which in its turn has been fostering the process of design an effective solution to prevent the oily product from reaching the surface water at the water channel.