# Migration of LNAPL under the influence of fluctuating water table in subsurface

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In order to verify the accuracy of the numerical analysis in predicting the migration of LNAPL under fluctuating water table conditions, a column test with fluctuating water table was performed. An acrylic column (3.5cm inner diameter, 50cm length) with two pairs of tensiometers (each pair composed of one hydrophobic and one hydrophilic tensiometers) assembled along one side, and three electrical conductivity probes assembled on the opposite side, was filled with fully saturated Toyoura sand (Fig. 1).

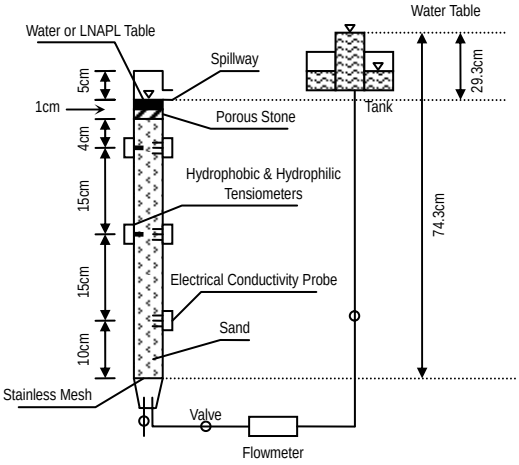


Fig. 1 Apparatus for the column test

Two cycles of descent (incomplete drainage) and ascent (incomplete imbibition) of the water table were achieved by displacing the water tank from its original position (h=74.3cm) to a lower one (h=3.5cm), back again to its upper position and down again once more. The four cycles lasted 89, 61, 66 and 97 hours each. During the drainage processes, LNAPL was automatically infiltrated into the sand at the top of the column in a volume equal to that of the exiting water. During the imbibition processes, water was also automatically infiltrated into the sand at the bottom of the column in a volume equal to that of the exiting LNAPL. In this way, the saturation of the sand was guaranteed at all times and, therefore, it can be assured that the test was carried out in a fully LNAPL-water system.

It was found that there is a good correlation among water saturation, capillary pressure and the location of the water table, and that the hysteresis phenomenon makes the *S-p* relations history and path dependant.

**Numerical Analysis (NAPL Simulator)**

The experimental data was then used to validate and adjust the original *NAPL Simulator* code, a complete subsurface flow and transport mathematical model developed by the National Risk Management Research Laboratory of the EPA, to study the movement and fate of NAPL contaminants in near-surface granular soils. After the code made a good prediction of water saturation, water flow, LNAPL flow, water table and LNAPL table of the column test, this modified version was used to simulate the behavior of benzene at a contaminated subsurface under the influence of water table fluctuation and the results were compared to the actual in-situ investigated results.

**Simulation of Benzene Behavior**

The benzene contaminated site suffered from a fluctuating water table during the period of more than 50 years since the release of the contaminant. This information, as well as the geological data of the site and the *S-p* relation obtained in the previous experiment, alimented *NAPL Simulator*, which final results showed great correspondence with the actual investigated results, demonstrating that the modified *NAPL Simulator* code predicts accurately the behavior of benzene under fluctuating water table conditions.