Morphological Variations in Unsaturated Porous Media due to LNAPL Contamination

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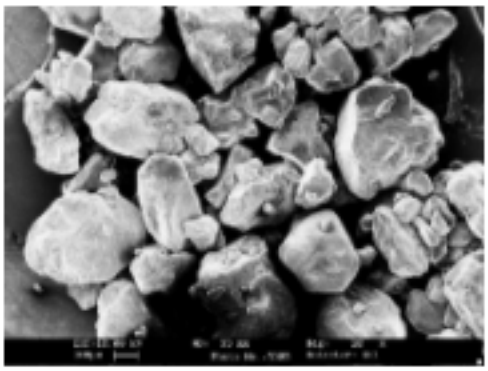
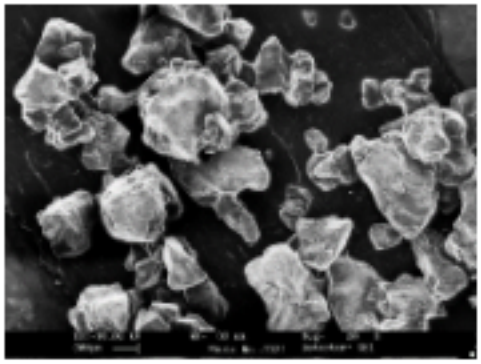
Soil surface morphology is an important functional parameter in fate and transport of pollutants in subsurface. Surface properties of the grains play a crucial role in governing purification extent of polluted soil water systems because adsorption is the major natural governing phenomenon. There are various ways to quantitatively access the pollutants' adsorption capacity of the porous media but microscale qualitative studies for the same have a limited front. Therefore, the aim of present study is to investigate the soil morphological changes on soil grain scale. Batch experiments having different concentration of a Light Non-Aqueous Phase Liquid (LNAPL), toluene, were performed. A series of six batch sets each containing 20 g of oven-dried sand with particle size of 0.5–1.0 mm and 40% porosity were prepared at room temperature under partially saturated condition.

Various concentrations of dissolved LNAPL varying from 5 to 100 ppm were fed in the designed batches. After 24 hours of the incubation, when the soil water concentration reached to equilibrium, the temporary slides of respective soil samples were prepared. To capture the high magnification at pore scale, scanning electron microscopy (SEM) analysis was conducted at magnification of 10×, 20×, 30× and 40×. The results showed that the level of soil surface losses and the number of cavities on soil surface were increased with increasing LNAPL concentration. Furthermore, attenuation in the brightness of the sand particles was observed with increment in LNAPL concentration indicating the more adsorption capacity of toluene at high concentration levels. Moreover, the natural carrying capacity of the porous media under consideration showed direct proportionality relationship with the available water content. Results of this study are helpful in investigating the geochemical stability of soil, remediation strategy and for upscaling of fate and transport of pollutants in subsurface environment.

Keywords: Light Non-Aqueous Phase Liquid (LNAPL), Contaminant Transport, Morphological Analysis , Batch experiment



Vs



05 ppm

Initial phase SEM Analysis
(No Contamination)
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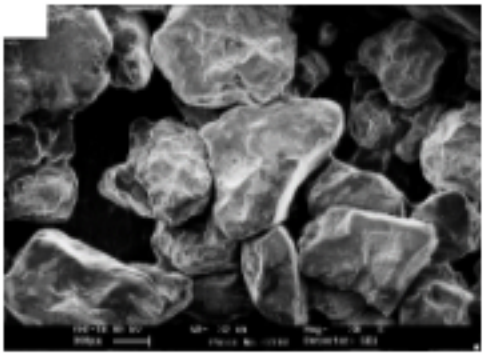
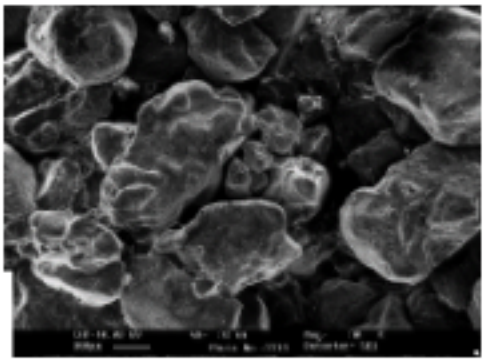
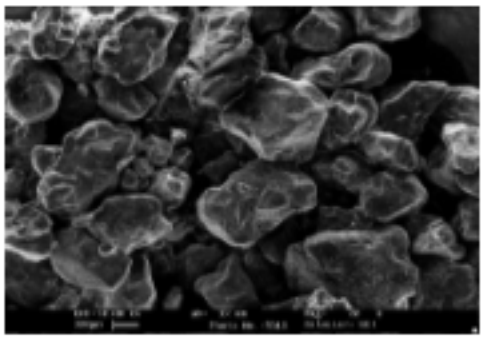


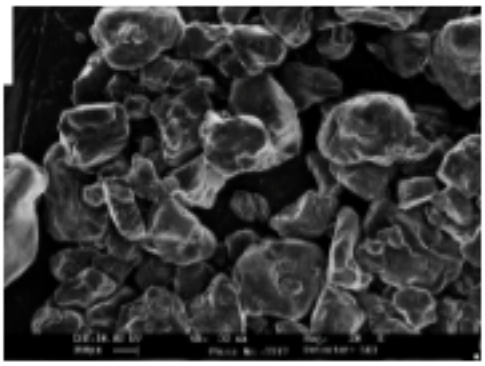
20 ppm



40 ppm

80 ppm





60 ppm

