Soil Water Characteristic Curve and Pore Size Distribution of Life Source Contaminated Clay

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With the diffusion and migration of life source contaminants, the soils experience the variation of moisture state from unsaturation to saturation, and produce complicated physical, chemical and biological reactions, thus transforming the soil properties and structure. Therefore, the investigations on the migration patterns of contaminants in soils, as well as the induced variation in the properties and structure of unsaturated soils at various depths, lay the premise and foundation about the evaluation of environmental effects and engineering geological properties of soils during the migration of contaminants. Based on the physical migration model construction of life source contaminants, life source contaminated clays at various depths were prepared. Subsequently, the soil water characteristic curves of uncontaminated and life source contaminated clay were tested and compared. Furthermore, the pore size distribution of life source contaminated clay was theoretically calculated by means of small incremental method. Meanwhile, the microstructure of life source contaminated clay was observed using scanning electron microscope. The pore size distribution of life source contaminated clay was then quantified and analyzed in order to compare with the theoretical calculation results. Finally, the evolution mechanisms of the clay saturation degree and pore size distribution during the migration of contaminants were revealed. The studies demonstrate that, the life source contaminated clay possesses higher dry density and water content than uncontaminated clay. Meanwhile, with the increase of depth, the life source contaminated clay possesses increasingly low gravimetric water content, wet density and dry density, as well as high saturated gravimetric water content, saturated volumetric water content and saturated permeability coefficient. The soil water characteristic curves (SWCCs) of uncontaminated and life source contaminated clay can be divided into boundary effect region, transition region and residual region. Moreover, the SWCCs of life source contaminated clay intersect with each other, and become steeper and closer to that of uncontaminated clay with the increase of depth. The pore size distribution of life source contaminated clay calculated using small incremental method based on SWCCs is basically consistent with that quantified using MATLAB based on microstructure images. Specifically, with the increase of depth, the life source contaminated clay possesses lager pore size, worse pore uniformity, as well as the pore size distribution transformed from mainly meso- and mini-pores to mostly macro- and meso-pores with the pore size peaks in the range of 5-20 μm. Finally, such effects produce during the migration of life source contaminants in clay as the adsorption of clay particles to organic matters and suspended solids, the complicated chemical reactions between life source contaminants and clay, as well as the formation of biofilms, and induce the reduction of clay porosity and pore size, as well as the increase of clay matric suction, thus inhibiting the migration of life source contaminants gradually.

Keywords: life source contaminated clay, unsaturation, SWCC, pore size distribution

