Hydraulic Characteristics of Mine Tailings by Metaheuristics Approach

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Abstract : A large number of mine tailings are produced every year as part of the extraction process of phosphates, gold, copper, and other materials. Mine tailings are high in water content and have very slow dewatering behavior. The efficient design of tailings dam and economical disposal of these slurries requires the knowledge of tailings consolidation behavior. The large-strain consolidation theory closely predicts the self-weight consolidation of these slurries as the theory considers the conservation of mass and momentum conservation and considers the hydraulic conductivity as a function of void ratio. Classical laboratory techniques, such as settling column test, seepage consolidation test, etc., are expensive and timeconsuming for the estimation of hydraulic conductivity variation with void ratio. Inverse estimation of the constitutive relationships from the measured settlement versus time curves is explored. In this work, inverse analysis based on metaheuristics techniques will be explored for predicting the hydraulic conductivity parameters for mine tailings from the base excess pore water pressure dissipation curve and the initial conditions of the mine tailings. The proposed inverse model uses particle swarm optimization (PSO) algorithm, which is based on the social behavior of animals searching for food sources. The finite-difference numerical solution of the forward analytical model is integrated with the PSO algorithm to solve the inverse problem. The method is tested on synthetic data of base excess pore pressure dissipation curves generated using the finite difference method. The effectiveness of the method is verified using base excess pore pressure dissipation curve obtained from a settling column experiment and further ensured through comparison with available predicted hydraulic conductivity parameters.

Keywords : base excess pore pressure, hydraulic conductivity, large strain consolidation, mine tailings

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