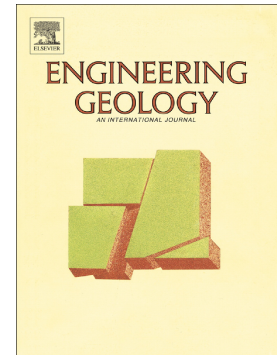


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Investigation of the formation process of a low-permeability unsaturated zone by air injection method in a slope

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Abstract: Slope drainage is crucial to landslide mitigation, yet current drainage technologies still encounter difficulties in achieving fast drainage. Based on the permeability characteristics of unsaturated soil with low water content, this study presents a new drainage measure, known as the air injection method, by injecting compressed air into the soil to form a low-permeability unsaturated zone for slope drainage. A series of physical model tests and numerical simulations are performed to study the formation process of the unsaturated zone by the air injection method. The study shows that the formation process undergoes four phases according to the variations in groundwater level in the slope and the features of the air–water flow in the unsaturated zone at different injection pressures. Additionally, numerical analyses indicate that the two-phase flow in the development of the unsaturated zone gradually transitions from a water-flow- to an air-flow-dominant zone. Furthermore, the expansion of the unsaturated zone by air injection is asymmetrical along the injection point, but tends to align with the downstream slope direction owing to the influence of groundwater flow. The findings are important for the establishment of the theoretical foundation of the air injection method, and the optimization of the air injection scheme. The proposed method and results obtained through laboratory investigation and numerical simulation provide a fresh

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