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A preliminary study on seepage erosion behavior within two layers by permeability tests

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Seepage erosion is defined as the condition when finer particles are carried out of the soil mass under certain hydraulic gradients. The consequence of seepage erosion is to cause progressive failure for a slope and finally slope failure occurs. When the groundwater begins to flow, the sand particles will move as soon as the seepage force is greater than the particle self-weights and inter particle friction forces. Furthermore, according to site investigations and disaster histories on Lin-Kou tableland in Taiwan, we find out that there exists a particular uniform TN sand layer (TN sand) between poorly sorted upper TN gravel layer with fine grain clay (TN gravel) and lower aquitard. This sand layer plays a crucial rule in affecting the seepage erosion of slopes. Therefore, it is necessary to explore the behavior of seepage erosion in order to prevent slopes from such failure mechanism.
First of all, failure cases in Lin-Kou tableland were studied about the geologic conditions and problematic soil layers. Afterwards, the relevant soil samples (TN sand) were collected from the site. Secondly, we mix quartz sands and kaolinite to simulate poorly sorted TN gravel layer. Then, we proceed to do permeability tests of these two soils, TN sand and TN gravel separately. Permeability tests were also performed under the situation when finer particles were carried away by seepage forces to understand its effect on permeability coefficient. Lastly, we level the permeability cell without the cell cap to run the experiments with a single layer of TN gravel and TN sand separately as well as with two layers (gravel above sand) under flows parallel to the layer to know the seepage erosion behaviors.
Based on the results of experiments, the permeability coefficient of TN gravel increased when finer particles dislocated due to seepage forces. Next, the particles close to the bottom of the soil specimen begin to flow with water and consequently the particles in the upper part of specimen collapsed as ‘en masse’ landslide. In the sand specimen, water flows with soil particles and eventually the specimen fails as in flowing failure. However in the two layer specimen, the erosion behavior began with finer particles dislocated downward into TN sand and then flowing out only from sand. As seepage erosion takes place continuously, the two layer soils collapsed.

keywords: seepage erosion, permeability coefficient, permeability test