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Geotechnical Centrifuge and its Application for Geo-Environmental Research

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A mini 0.5 m diameter beam centrifuge has been fabricated at the Universiti Kebangsaan Malaysia in Bangi Selangor. The centrifuge was designed to allow centrifuge testing of soil package for up to 5kg weight with maximum rotational speed of 500 RPM and can accelerate for up to 140 in units of times gravity (xg). The dimension of soil package is 10cm (width) x 28cm (length) x 19.5cm (height). This centrifuge is equipped with digital video camera and high speed stroboscope. The recorded moving images can be stored directly into the computer. Real time video images can also be observed on the LCD monitor installed in the operation room. The centrifuge is controlled via a control box with various buttons and digital displays such as on/off button, RPM controller with digital display. As a safety precaution, the body of the centrifuge is made of double layer 5mm steel with 5cm absorbing membrane as sound barrier. It has a vibration auto switch-off that will automatically stop if the vibration is exceeded the permissible vibration limit. A research on the migration of DNAPL/LNAPL through porous geologic medium was conducted using this newly fabricated mini geotechnical centrifuge. The experiments were carried out at different g-forces; 25-g and 50-g force. The results showed that the contaminant (NAPL) movement in unsaturated soil was retarded upon reaching soils with smaller pore size and migrated laterally. In a case for LNAPL (toluene), the movement of LNAPL was observed to be lateral upon reaching capillary fringe and tended to float on the top of water table. DNAPL (TCE) was observed to migrate vertically through the water table down to the bottom of the model. The NAPL movement at 50g was dominated by vertical movement compare at 25g. The results showed that this centrifuge can be successfully used to model the migration of NAPL in porous medium.