Physical and numerical modeling for assessing chromium migration and retention dynamics in clayey soil.

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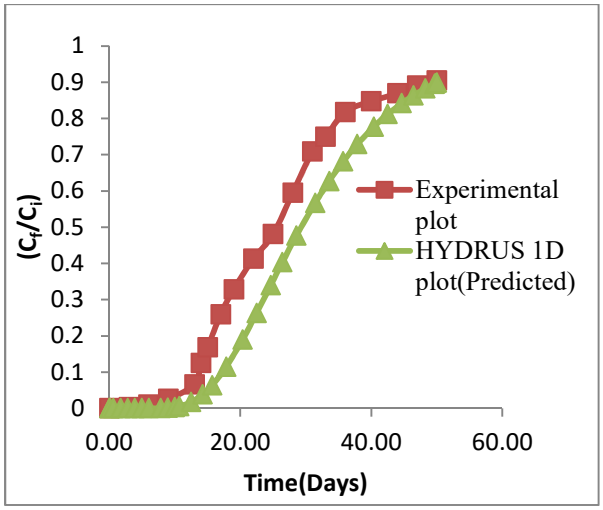
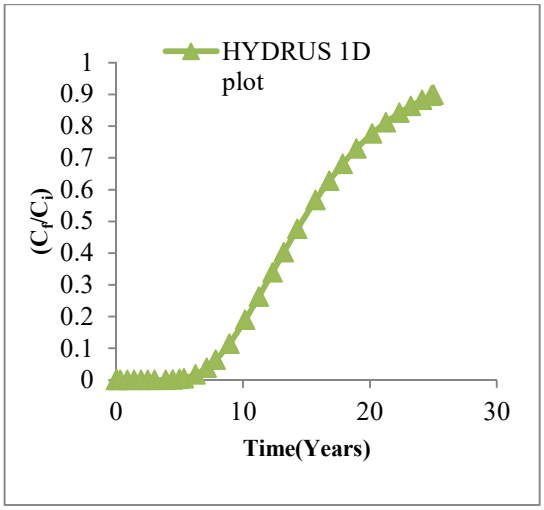


Experimental and HYDRUS 1D predicted Chromium BTCs in vertical column test for soil bed height of 10 cm



HYDRUS 1D predicted Chromium BTC through 1m vertical soil column to be used as liner material in waste containment structures.

Abstract: The disposal of chromium laden sludge from tannery industries is a real challenge to the geo-environmental professional due to sub-surface migration of toxic leachate may cause serious depletion of the soil and groundwater quality. Therefore, scientific disposal of sludge is very much encouraged instead of the poor practice of uncontrolled tripping in an unlined containment structure or any open dumping yard. In the present research work, the migration behavior of Chromium (VI) through clayey soil has been examined through column test for assessing the contaminant buffering potential of the considered soil so that the same can be utilized as a landfill liner material in waste containment structures. The breakthrough curve (BTC) generated from column test data showed soil bed of 10 cm height became exhausted (reached more than 90% saturation with solute) after a period of 45 days. The slope of the BTC was also flat in nature. These indicate that the good Cr (VI) retention

capacity of the clayey soil. Numerical modeling of Cr (VI) transport through the soil column was also performed using HYDRUS 1D solute transport software package. The model predicted results were found closely matching with the experimental BTC (R^2=0.7212, RMSE=0.4418). Thus, the HYDRUS 1D model can be considered as a worthy tool in optimizing the clayey soil liner thickness in chromium laden waste containment structures to arrest toxic leachate migration through sub-surface soil media and also to protect the precious groundwater from contamination.

Keywords: Chromium (VI) pollution, Landfill, Clayey soil liner, Adsorption study, Numerical modelling.