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Effects of MF membranes deformation and permeability on filtration of clay suspension and its solution chemistry

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Abstract

Emergency Events Database (EM-DAT) indicates global increase in the frequency and intensity of natural disasters from 1900 to 2013. This is due to combinations of factors: climate change phenomena and population growth in vulnerable regions. One of first priorities after disaster is to provide safe drinking water to the affected. Membrane technology offers several advantages over conventional treatment. It provides better water quality, much more compact system, more flexible, less dependent on electricity and low cost. Microfiltration (MF) membranes have been regarded as one of the oldest separation technique and used extensively for the removal of particles, turbidity and microorganisms in water treatment. However, membrane fouling and membrane deformation due to blocking and hydrostatic pressure respectively, are limiting factors in water treatment. In understanding this issue, low pressure filtration of clay suspension for water treatment purposes is investigated in this work. The effects of permeability due to variation in solution chemistry of clay suspension, and deformation due to hydrostatic pressure are the parameters studied. Clay is used as solid contaminant; one of multi-components of natural waters and hence, one of the major factors that limits the use of MF for surface water treatment because it causes membrane fouling. Clays are complex colloidal materials, thus their presence in water alter the performance of membranes due to their reactions with variations in solution chemistry as well as with water. Darcy’s law could be used to explain apparent permeability change by changing the concentration of salt. This would explain the electro-viscous effects by altering zeta potential and double layers measurement, and also membrane resistance towards water. This study is important because membrane permeability control might prolong the lifetime of the membrane for water treatment. Membrane deformation is investigated by measuring pure water flux measurement prior to filtration experiment, and hysteresis phenomenon to be observed whether reversible or irreversible membrane deformation has occurred.

Key words: Membrane filtration – clay suspension – MF membrane – deformation – Pure flux measurement – FEGSEM – solution chemistry – solute rejections.