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Investigation of polyethersulfone (PES) hollow fiber membrane for the treatment of acid mine drainage

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Abstract

Efforts in treatment of acid mine drainage (AMD) have been fraught with limitations for the mining industry. Membrane filtration technology is a new alternative employed to treat AMD in this work. A commercially available polyethersulfone (PES) hollow fibre nanofiltration membrane was investigated for its likelihood for the treatment of AMD. The system was configured in a cross flow set up and effects of pH, feed flowrate and operation time were explored in relation to the membrane performance (rejection and flux). Acid mine collected from site had a very high concentration of Iron (1.055 mg/L), sulphate (3639.301 mg/L) and high levels of hardness due to magnesium ions (523.011 mg/L). Also, heavy metals were in trace amounts. Experimental results showed that the maximum rejection of iron was 96.28 % at a pH of 4.37, maximum feed flowrate of 872ml/min and the iron permeate concentration was within the potable water standards (less than 0.100mg/L) inferring suitability of the membrane for AMD amelioration at the aforementioned pH. Furthermore, maximum rejection of sulphate ions was 97.30% at a pH of 6.55 and maximum feed flowrate. In addition, the membrane was efficient in curbing the hardness (91.99 % rejection) of the AMD to the accepted water standards at the pH of 4.37. The reduction of hardness levels, iron, and sulphate concentrations by the membrane were attributed to steric (size) exclusion and electrostatic interaction mechanisms. Although the membrane had a large surface area ($2m^2$), the flux was not that high (ranged from 3 - 4.5 L/m^2hr). Further studies on modification of the polyethersulfone polymer matrix within the realm of enhancing its hydrophilicity henceforth flux are desirable.