A novel clay-based ceramic membrane for wastewater treatment.

Dema A. Almasri[a]*, Jenny Lawler[a], Viktor K. Kochkodan[a]**

[a] Qatar Environment and Energy Research Institute, Hamad Bin Khalifa University, Qatar Foundation, PO Box 34110, Doha, Qatar

*Corresponding author: delmasri@hbku.edu.qa, +974 4454 7424

vkochkodan@hbku.edu.qa +974 4454 8122

Abstract:

Membrane separation technologies have been the most implemented and promising processes for water treatment over the past decade. The membrane market includes both polymeric and ceramic-based membranes, however, it is dominated by the former mainly due to a lower cost of production. Ceramic membranes are considered to be less cost-effective due to the use of relatively expensive oxides as well as the high fabrication sintering temperatures. In this work, we developed a low-cost ceramic disc membrane mainly made from clay for the treatment of wastewater. This is deemed to be a great achievement as the preparation of a durable and effective ceramic disc made of clay is not easily achieved. A thorough characterization of the developed membrane is presented in this work which includes electron microscopy, X-ray diffraction, surface roughness, contact angle measurement, BET surface area, and porosity measurement techniques. Membrane performance tests are conducted in a dead-end filtration cell to determine the effectiveness of the membrane. The results of these tests include flux measurements vs. pressure, phosphate rejection, and oil rejection with time. The flux of the ceramic membrane exceeded 1200 LMH at a pressure of 7 bar and no membrane damage was observed at such a high pressure. At a pressure of 1 bar, the membrane exhibited a satisfactorily high flux of more than 200 LMH. More than 90% of phosphate rejection was observed within the first five minutes of filtration time and decreased with time, indicating an adsorption removal mechanism. The membranes were capable of being reused several times while maintaining more than 70% of the original flux as well as adequate contaminant rejection. The results from this work show that the developed ceramic membranes can be promising, low-cost alternatives to the ones existing in the current market for wastewater treatment.

Keywords: ceramic membrane, filtration, water treatment, low-cost, sustainability