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PII: S2213-3437(17)30411-6
DOI: http://dx.doi.org/10.1016/j.jece.2017.08.027
Reference: JECE 1822

To appear in:

Received date: 27-1-2017
Revised date: 26-7-2017
Accepted date: 18-8-2017

Please cite this article as: Jean Mulopo, Bleach plant effluent treatment in anaerobic membrane bioreactor (AMBR) using carbon nanotube/polysulfone nanocomposite membranes, Journal of Environmental Chemical Engineeringhttp://dx.doi.org/10.1016/j.jece.2017.08.027

Bleach plant effluent treatment in anaerobic membrane bioreactor (AMBR) using carbon nanotube/polysulfone nanocomposite membranes

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Abstract

The pulp and paper industry is one of the largest industrial water users in South Africa, and hence produces considerable volumes of effluents which represent a major source of pollution due their high biological and chemical oxygen demand. The objective of this study was to synthesize and assess the application of carbon nanotube/polysulfone nanocomposite membranes coupled to an anaerobic membrane bioreactor to determine their effectiveness for the treatment of bleach effluent with regard to the removal of chemical oxygen demand (COD) and possible cost saving implications of the process. Carbon nanotube/polysulfone nanocomposite membranes were synthesized using the phase inversion method and characterized using atomic force microscopy (AFM), contact angles and fourier transform infrared radiation (FTIR). A 10 1 anaerobic reactor containing 9 g of geotextile strips (18 x 3.5 cm) was coupled with the synthesized carbon nanotube/polysulfone nanocomposite membrane and operated at an HRT of 12 h and temperature of 25°C without sludge withdrawal. It was found that the addition of carbon nanotubes (CNTs) to the polysulfone nanocomposite membrane increases the fluxes across the membranes, which may be attributed to the presence of the O-H bonds that alters the contact angles and the roughness of the membrane. The effluent COD, volatile fatty acid (VFA), and suspended solids (SS) concentrations were found to be below 45, 32 and 15 mg/l, respectively, during 85 days of operation with intermittent back washing. Low cross flow velocity (CFV) and transmembrane pressure (TMP) were applied to reduce operation cost as well as to minimize shear stress.