Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2020.25723

191 (2020) 82–92
July

Treatment prediction of sugar industry wastewater in moving-bed biofilm reactor using multi expression programming

M. Talebidalouei[a], Seyed Ahmad Mirbagheri[a,*], Pouria Nakhaei[b]

[a]*Faculty of Civil Engineering, K.N. Toosi University of Technology, Tehran, Iran, emails: mirbagheri@kntu.ac.ir (S.A. Mirbagheri), talebi_mary92@yahoo.com (M. Talebidalouei)*
[b]*Faculty of Civil Engineering, Amirkabir University of Technology, Tehran, Iran, email: p.nakhaee@aut.ac.ir (P. Nakhaei)*

Received 27 June 2019; Accepted 14 February 2020

ABSTRACT

Minimizing water consumption and optimizing wastewater treatment of the sugar industry is one of the most water consuming industries that have significant importance. In this research, the advanced treatment of sugar factory wastewater in a three-step process was carried out using a combined process integrating a moving-bed biofilm reactor (MBBR) and membrane separation processes. The integrated system yields a high-quality effluent by resulting 99.25%, 98%, and 99.2% removal for chemical oxygen demand (COD), nitrate, and total suspended solids, respectively. Determining the level of wastewater treatment requires laboratory equipment with sophisticated measuring devices which is time-consuming and costly. Hence, equations for predicting the removal rate of COD and nitrate are derived from the data obtained from the treatment of sugar wastewater with the integrated system. The equations provide a quick and easy initial estimation for researchers. In this regard, wastewater with COD of 2,000 mg/L and nitrate of 55 mg/L were synthesized. The treatment is performed for five filling ratios (FR) of 40%, 45%, 50%, 55%, and 60% of MBBR with the Kaldnes k2, and four hydraulic retention times (HRT) of 6, 8, 10, and 12 h. Artificial intelligence called multi expression programming (MEP) was used to develop models for predicting the COD and nitrate. The input variables are FR and HRT, and the output variable is the final removal level of organic matters. Excellent correlation between the MEP-based models and the experimental results was achieved which indicates that COD and nitrate models are capable of effectively estimating the amount of COD and nitrate removal. Parametric sensitivity analysis was used to determine the impact of input parameter changes on the output parameter.

Keywords: Wastewater; Sugar; Moving-bed biofilm reactor; Membrane separation; Multi expression programming

* Corresponding author.