Nanofiltration treatment of tomato paste processing wastewater: process modeling and optimization using response surface methodology

Ali Alghooneh\textsuperscript{a}, Seyed M.A. Razavi\textsuperscript{a,}\textsuperscript{*}, Seyed Mahmoud Mousavi\textsuperscript{b}

\textsuperscript{a}Division of Food Engineering, Department of Food Science and Technology, Ferdowsi University of Mashhad (FUM), P.O. Box: 91775-1163, Mashhad, Iran, Tel. +98 511 8795620; Fax: +98 511 8763842; emails: Alghooneh.Ali@um.ac.ir (A. Alghooneh), S.Razavi@um.ac.ir (S.M.A. Razavi)

\textsuperscript{b}Department of Chemical Engineering, Ferdowsi University of Mashhad (FUM), P.O. Box: 91775-1111, Mashhad, Iran, Tel. +98 511 8816840; Fax: +98 511 8816840; email: mmousavi@um.ac.ir

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ABSTRACT

Tomato wastewater is characterized by a large amount of suspended solids, red color, and bad smell. In this paper, the effect of transmembrane pressure (10, 15, 20 bar), pH (4, 5, 6), and temperature (30, 40, 50°C) on the permeate flux, total hydraulic resistance, and chemical oxygen demand (COD) rejection of tomato wastewater during nanofiltration treatment was investigated. The flux was found to be approximately constant during long-period operation. The flux was reduced as the pH declined, while it was increased as the temperature and transmembrane pressure increased. The hydraulic resistance (at pH 5 & TMP 1.5 MPa) increased from $5.79 \times 10^{13}$ to $7.25 \times 10^{13}$ 1/m when the temperature increased from 30 to 50°C. The COD rejection was ranged from 75.65 to 85.35%, in which the highest value was obtained at pH 6, TMP 2.0 MPa, and 30°C. The response surface methodology results demonstrated that the quadratic, the two-factor interaction (2.Fi), and the linear polynomial models are highly significant for modeling the flux ($R^2 = 0.98$), hydraulic resistance ($R^2 = 0.96$), and COD rejection ($R^2 = 0.90$), respectively. Numerical optimization determined the optimum conditions based on the highest flux and rejection and the lowest fouling with transmembrane pressure of 20 bars, temperature of 30°C, and pH of 6, respectively.

Keywords: Nanofiltration; Modeling; Optimization; Tomato wastewater

*Corresponding author.

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