Response surface modeling and optimization of upflow anaerobic sludge blanket reactor process parameters for the treatment of bagasse based pulp and paper industry wastewater

R. Sridhar\textsuperscript{a}, V. Sivakumar\textsuperscript{b,*}, K. Thirugnanasambandham\textsuperscript{b}

\textsuperscript{a}Tamil Nadu Pollution Control Board, Salem 635 004, Tamil Nadu, India, email: Sridhar36@yahoo.com
\textsuperscript{b}Department of Food Technology, Kongu Engineering College, Perundurai, Erode 638052, Tamil Nadu, India, Tel. +91 4294 226606; Fax: +91 4294 220087; emails: dresivakumar@yahoo.com (V. Sivakumar), thirusambath5@gmail.com (K. Thirugnanasambandham)

Received 30 May 2014; Accepted 22 November 2014

\begin{abstract}

The interactive effects of influent chemical oxygen demand (COD\textsubscript{in}), hydraulic retention time (HRT), and temperature on the performance of an upflow anaerobic sludge blanket reactor, operated in continuous mode, were studied for the anaerobic biodegradation of bagasse effluent from pulp and paper industry. Experiments were conducted based on Box–Behnken design and analyzed using response surface methodology. COD\textsubscript{in} (4,400–6,800 mg/l), HRT (15–27 h), and temperature (20–40\degree C) were the operating variables considered for this study. Three dependent parameters viz., percentage of COD removal, COD removal rate, and biogas production were either directly measured or calculated as response. Analysis of variance showed a high coefficient of determination value ($R^2$) of 0.9990 for percentage COD removal, 0.9960 for COD removal rate, and 0.9953 for biogas production thus ensuring a satisfactory fit of the second-order polynomial regression model with the experimental data. Maximum values of percentage COD removal (84.3\%), COD removal rate (230.9 mg/l h), and biogas production (21.2 l/d) were observed at optimum COD\textsubscript{in}, HRT, and temperature of 6212 mg/l, 23 h, and 35\degree C, respectively.

Keywords: Bagasse effluent; UASB reactor; Response surface methodology; Optimization; Percentage COD removal; Biogas

\end{abstract}