Mathematical Modeling of Distillery Wastewater Biomethanation in Fluidized-bed Bioreactor

Sk Masud Hossain, Manas Das

Abstract

An anaerobic fluidized- bed reactor was designed to treat distillery wastewaters for biogas generation using actively digested aerobic sludge of a sewage plant. The optimum digestion time was 8 h and optimum initial pH of feed was observed as 7.5 respectively. The optimum temperature of feed was 40°C and optimum feed flow is 14 L/ min with maximum OLR was 39.513 kg COD m^{-3} h^{-1} respectively. The OLR was calculated on the basis of COD inlet in the bioreactor at di erent flow rates. Maximum CH_4 gas concentration was 63.56 % (v/v) of the total (0.835 m^3 /kg COD m^{-3} h^{-1}) biogas generation, corresponding to 0.530 m^3 /kg COD m^{-3} h^{-1} at optimum digestion parameters. Maximum COD and BOD reduction of the distillery wastewaters were 76.82% (w/w) and 81.65% (w/w) with maximum OLR of 39.513 kg COD m^{-3} h^{-1} at optimum conditions respectively. The rate constant (k) was measured as 0.31 h^{-1} in fluidized-bed bioreactor and followed a first order rate equation. The specific growth rate (μ) was 0.99 h^{-1} and maximum sp. growth rate (μ_{max}) was 1.98 h^{-1} respectively. The bacterial yield coefficient (Y) was determined as 0.319 /kg COD m^{-3} h^{-1} at optimum parameters. The studies also dealt with the mathematical modeling of the experimental data on biomethanation and suggested modeling equations relating to kinetic parameter (rate constant, k), maximum specific growth rate (μ_{max}) with respect to COD (substrate) removal. The mathematical model was also analyzed for hydrodynamic pressure (Δp) vs feed flow (u) and hydrodynamic pressure (Δp) with respect to CH_4 gas yields. The linear and non-linear equations which fitted the models were obtained.

Keywords:Biomethanation, anaerobic, optimum condition, modeling

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