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Production of Rhamnolipids from Different Resources and Estimating the Kinetic Parameters for Bioreactor Design

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Abstract : Rhamnolipids biosurfactants have distinct properties given them importance in many industrial applications, especially their great new future applications in cosmetic and pharmaceutical industries. These applications have encouraged the search for diverse and renewable resources to control the cost of production. The experimental results were then applied to find a suitable mathematical model for obtaining the design criteria of the batch bioreactor. This research aims to produce Rhamnolipids from different oily wastewater sources such as petroleum crude oil (PO) and vegetable oil (VO) by using Pseudomonas aeruginosa ATCC 9027. Different concentrations of the PO and the VO are added to the media broth separately are in arrangement (0.5 1, 1.5, 2, 2.5 % v/v) and (2, 4, 6, 8 and 10%v/v). The effect of the initial concentration of oil residues and the addition of glycerol and palmitic acid was investigated as an inducer in the production of rhamnolipid and the surface tension of the broth. It was found that 2% of the waste (PO) and 6% of the waste (VO) was the best initial substrate concentration for the production of rhamnolipids (2.71, 5.01 g rhamnolipid/l) as arrangement. Addition of glycerol (10-20% v glycerol/v PO) to the 2% PO fermentation broth led to increase the rhamnolipid production (about 1.8-2 times fold). However, the addition of palmitic acid (5 and 10 g/l) to fermentation broth contained 6% VO rarely enhanced the production rate. The experimental data for 2% initially (PO) was used to estimate the various kinetic parameters. The following results were obtained, maximum rate or velocity of reaction (Vmax) = 0.06417 g/l.hr), yield of cell weight per unit weight of substrate utilized (Yx/s = 0.324 g Cx/g Cs) maximum specific growth rate (μmax = 0.05791 hr^{-1}), yield of rhamnolipid weight per unit weight of substrate utilized (Yp/s)=0.2571gCp/g Cs), maintenance coefficient (Ms =0.002419), Michaelis-Menten constant, (Km=6.1237 gmol/l), endogenous decay coefficient (Kd=0.002375 hr^{-1}). Predictive parameters and advanced mathematical models were applied to evaluate the time of the batch bioreactor. The results were as follows: 123.37, 129 and 139.3 hours in respect of microbial biomass, substrate and product concentration, respectively compared with experimental batch time of 120 hours in all cases. The expected mathematical models are compatible with the laboratory results and can, therefore, be considered as tools for expressing the actual system.

Keywords : batch bioreactor design, glycerol, kinetic parameters, petroleum crude oil, Pseudomonas aeruginosa, rhamnolipids biosurfactants, vegetable oil
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