ABSTRACT

MASS PRODUCTION OF BIODEGRADABLE COPOLYMERS FROM RENEWABLE RESOURCES

Co polymer of poly hydroxy butyrate (PHBV), featured more flexibility and improved processivity than biopolymer PHB, due to its similarity in physical and thermal properties with petroleum derived plastics. Therefore, the mass production of PHBV were extensively explored in the present investigation up to 70L bioreactor from a variety of gram negative (*Ralstonia eutropha Cupriavidus necator*) *and* gram positive bacteria (*Bacillus thuringiensis*) using low cost renewable substrate, glycerol. This was performed by the addition of statistically optimized concentrations of selected electron acceptors (Valeric / Propionic) acids & at optimized time interval between two additions during batch cultivation, followed by fed-batch cultivation conditions wherein the pseudo steady state with respect to substrate (glycerol) was maintained. The optimized copolymer production was verified in 7L bioreactor cultivation and scale up was attempted using various scale up criteria (P/V, k_La, Π, t_m, N_{Re}) from 7L to 15L/70L bioreactor. It emerged from the extensive calculations that constant P/V scale up criteria was the best scale up criteria as it features similar values of crucial scale up parameters which were evaluated using an abstract term, parametric index which is the ratio of scale up parameter at higher scale to lower scale bioreactor. Therefore, it was implemented for scale up of batch cultivations from 7L to 15L bioreactor by *R. eutropha* and for both batch and fed-batch cultivations from 7L to 70L bioreactor by *C. necator* and *B. thuringiensis*. The intracellular copolymer (PHBV) produced was extracted from the biomass harvested after the completion of fermentations and was extensively characterized by GPC, XRD, FTIR NMR, DSC and TGA in order to map their properties to the biopolymers used for various societal and biomedical applications. The results of the shake flask batch cultivations were experimentally verified in 7 liter bioreactor and successfully scaled up to 15L bioreactor using *R. eutropha* to produce a maximum of 10.29 g/L, 0.946 g/L and 4.53 g/L of biomass, HV and PHBV concentration respectively. A maximum of 4.12 g/L, 12.88 g/L and 19.82 g/L of HV, PHBV and biomass concentration respectively were obtained using fed batch cultivation with *C. necator* demonstrating successful scale up. The maximum of 0.636g/L, 4.56g/L and 10.74g/L of HV, PHBV and biomass concentration respectively were produced in 70L bioreactor using model-based fed-batch cultivation of *B. thuringiensis*.