Abstract

An effort has been made to design and fabricate a new type of bioreactor specially meant for animal cell culture. Existing bioreactors like CSTR, Bubble Column reactor, air lift reactors, etc. are not suitable for the purpose. The bioreactor is named a 'See-Saw' bioreactor. The name is derived from its principle of operation in which liquid columns in either limbs of the reactor alternately goes up and down. The oxygen transfer in this type of bioreactor has been studied by a distributed parameter model. The working volume of the reactor is very small to within 15 litres.

Emphasis had been laid on development of a suitable control strategy such that more enzymes/metabolites can be produced from this small volume bioreactor. This is the major objective of the work. The model which is developed from mass balance concept describes the bioprocess incompletely. The model parameters often vary with time due to metabolic variations, physiological and genetic modifications. The reproducibility of the biotechnological experiments are also poor. Thus a bioprocess, in general, is a time-varying parameter, non-linear, undermodelled multivariable system plagued by uncertainities.

A control stretegy, namely time delay control (TDC), has been applied. It is designed as a tracking controller such that the process variables follow optimal trajectories within finite error bounds. In a bioprocess most of the process variables are not measurable. A suitable observer or 'software sensor' has been designed. The optimal trajectories of different

bioprocess variables have been derived using genetic algorithms. Besides, environmental control for temperature and pH value of the bioreactor fluid are in operation using seperate controllers.

The derived control law and the 'software sensor' performances have been verified by experimentation in the laboratory on yeast culture. Two operating modes, fedbatch and continuous, have been used. The experiment time varied between 8 and 12 hours. The results of the experimentation are presented. The off-line laboratory assay results come to within 20 percent of the set values. The experimental and the estimated results show an error margin within 20 percent.