Cleaning industries wastewaters using a sludge disintegration system

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The problem of excess sludge

One problem with the conventional activated sludge process is the production of excess sludge which has to be disposed of by the operator of the plant. Disposing excess sludge accounts for 50-60% of total operating cost in a wastewater treatment plant. Traditional methods for treating excess sludge, which include the use of land ll sites, incineration and dumping at sea are becoming increasingly problematic due to environmental issues and a combination of stringent legal requirements. One way to reduce sludge production is through the addition of a sludge disintegration unit (SDU) to the bioreactor system. The SDU converts a certain proportion of biomass within the reactor into a combination of organic particulates and soluble substrate, which can be hydrolysed and consumed by other biomass.

Methods of investigation

The model of a membrane bioreactor (MR) with the addition of a SDU is adopted from the paper that was published in 2003 by Yoon. The model consists of a system of three non-linear ordinary differential equations with each of them representing the concentration of substrate, the concentration of biomass and the concentration of particulates. The specific growth rate in this analysis is given by a contois expression which is different from Yoon's model. Here we have employed analytical techniques which include finding the steady state solutions and determining the stability as a function of residence time, in order to investigate the behaviour of the model. Our primarily aim is to minimise the amount of substrate and the amount of mixed liquor suspended solids (MLSS), or what we called the \sludge".

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See: www.ice-em.org.au/vs09.htm

Results and discussions

The results obtained are used to evaluate the performance of the bioreactor depend upon the process parameters of the SDU. These are the main interests of biological engineers who design the structure of the plant. The steady state diagrams of substrate and MLSS show that at sufficiently high residence time both substrate and MLSS contents of the membrane bioreactor are independent of the operation of the sludge disintegration unit. Thus the main role of the SDU is to enhance the bioreactor performance at “low" residence time.

The zero excess sludge production curve in parameter space, as a function of the dimensionless residence time and the sludge disintegration factor, is the most important result we concluded in the analysis. The curve clearly identifies the regions of zero, positive and negative excess sludge production. It also pointed out a critical value for the sludge disintegration factor, D_{crit}, above which, for any value of the residence time above the washout value, the sludge produced in the reactor is below the pre-specified target value. It is shown that this critical value can be determined by solving two simultaneous equations.

Future work

Our research has been extended to investigate a continuous flow reactor with a sludge disintegration unit. The analysis is essentially the same with some slightly changes in the model equations. We planned to publish our work after the completion of the investigation, in which this will lead to insights into the performance of membrane and continuous bioreactors so as to reduce both the effluent and MLSS leaving the reactors.

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