

## Batch Process

~~Batch Process Engineering Session 2007/8~~

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#### Coursework Problem Sheet One

You should provide written answers to the following assignment, using Word (also possibly Excel), by Thursday 25<sup>th</sup> October 2007. Please hand in your work to the Student Support Office.

1. In a batch reactor being operated in a semi-batch mode, a reagent B is added to an initial reactor charge of 20 litres. This charge contains reagent A at a concentration of 0.1 moles/litre but does not contain reagent B. Reagent B is fed into the reactor at a rate of 0.75 litres/minute and the concentration of reagent B in the input stream is 0.02 moles/litre. Assume that for the reaction between the two reagents the reaction rate is effectively first order with respect to reagent B given that reagent A is in substantial excess. Using the module lecture-notes as a guide, show that the rate of change in the concentration of reagent B with time is described by a first order differential equation of the following form and define the terms in the equation.

$$\frac{dC_B}{dt} = \frac{(C_{B0} - C_B)}{\tau + t} - k'C_B$$

Solve this differential equation to find an equation relating the concentration of reagent B,  $C_B$ , to the elapsed time  $t$ . Given that the first order rate constant for the reaction is 0.4 minutes<sup>-1</sup> plot a graph of  $C_B$  versus  $t$ .

2. You have been provided with a copy of an article entitled 'The Role of Process Simulation in Pharmaceutical Process Development and Product Commercialization' by Demetri Petrides, Alexandros Koulouris and Pericles Lagonikos published in *Pharmaceutical Engineering*, 2002, Vol.22 No 1.

Taking this paper as a starting point and a minimum of three further papers or articles from the literature, write a short review of the process simulation tools that are available to model, specifically, batch processes. Your review should discuss which aspects of batch process design and engineering can be modelled with process simulation tools and, the features of the simulation tools that are specifically designed for modelling batch processes. Your review should also discuss the strengths and weaknesses of process simulation tools for modelling batch processes.

You must provide full citations for the papers that you have read in compiling your review. The review should be a minimum of 2000 words.