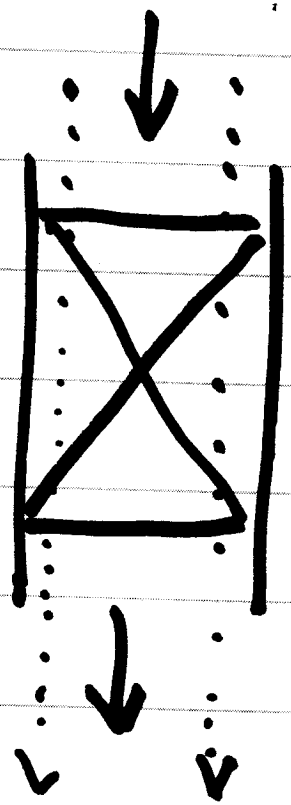
Prof Shanker
Lec-1
12-12-12

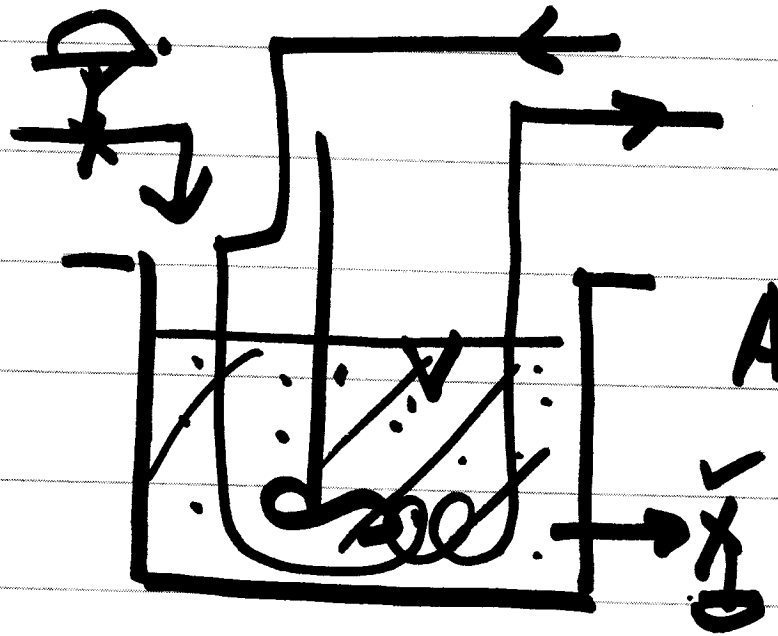
# Advanced Reaction Engineering

12 Dec 2012
1030-1130
Revised



Tubular Reactors

Plug flow.



$A \rightarrow B$ Or

$A + B = C + D.$

Design Eqns

Stirred Vessels

- Batch.
- Continuous (CSTR)

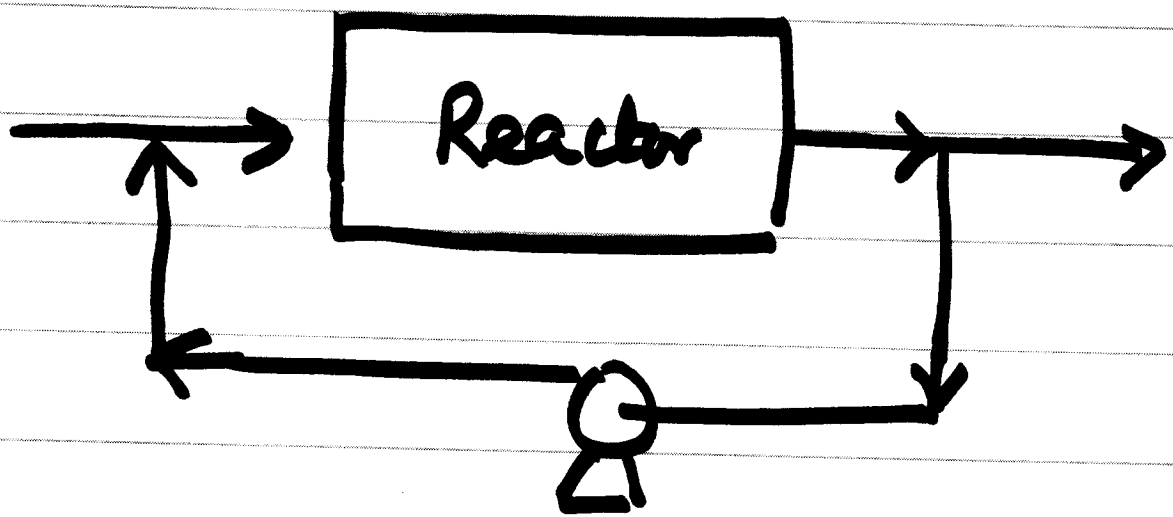
~~A≠B~~ =

$$A \rightarrow B$$

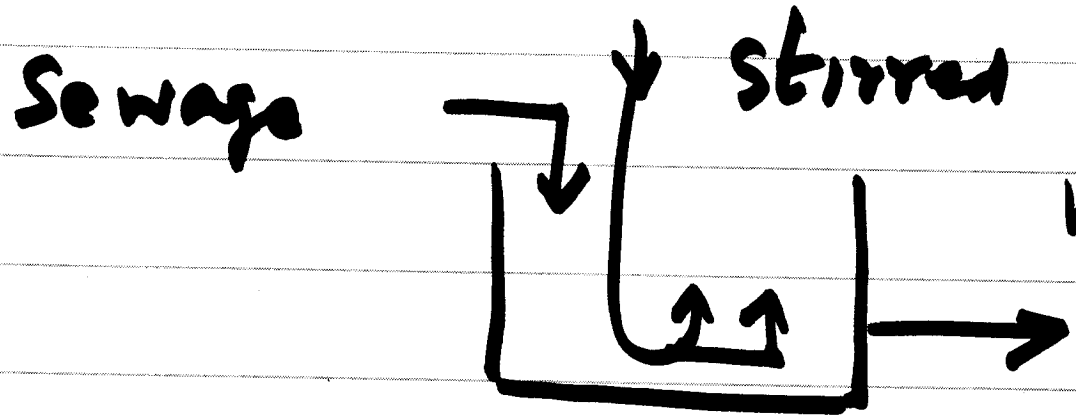
Where the reaction is autocatalytic

$$r_A = -k C_A C_B.$$

$C_6H_{12}O_6$ + Saccharomyces Cerevisiae → $C_2H_5OH$ + $CO_2$ + more cells




Plug Flow Recycle Reactor




$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$$

+ cells

+ more cells.

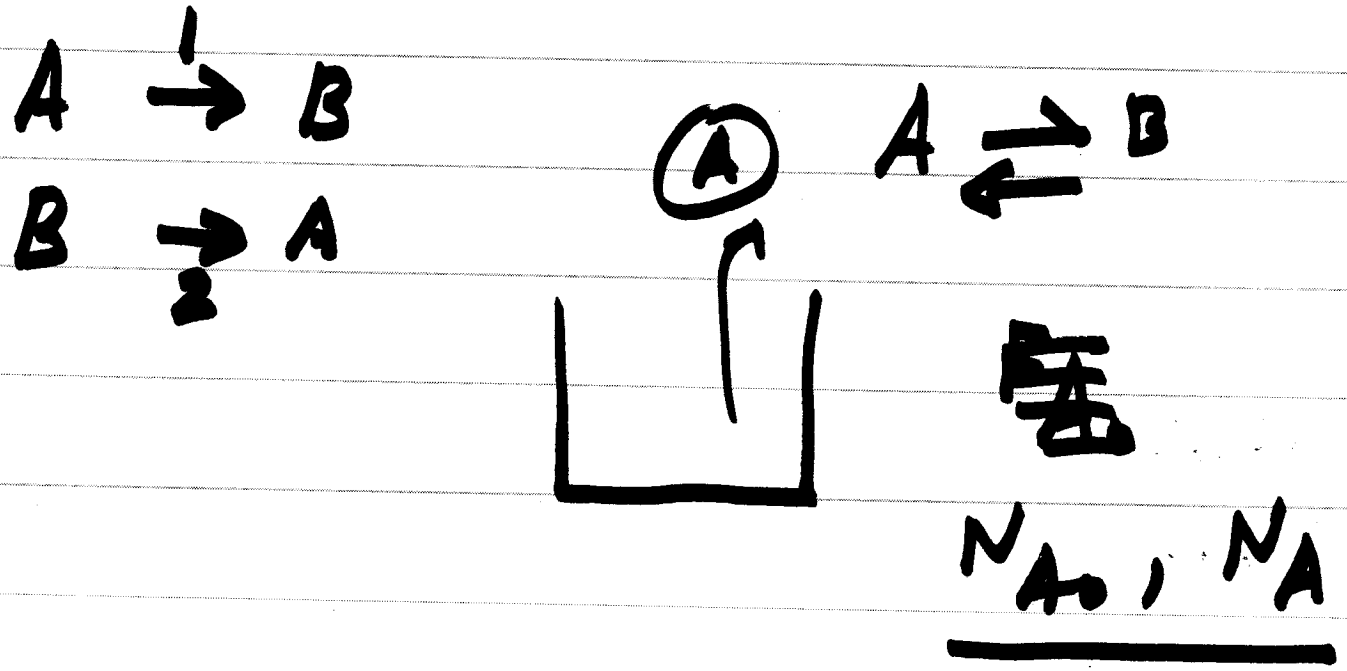
1 Introduction

2 Design Equation for ideal Reactors

3 Plug flow Recycle Reactors

4 Plug flow Recycle Reactors - Illustration
examples

Q



## 5. Multiple reactions

$$A + B = C + D \Rightarrow C + D - A - B = 0$$

P species | $\alpha_{11} A_1 + \alpha_{12} A_2 + \dots \alpha_{1n} A_n = 0$

$\alpha_{p1} A_1 + \alpha_{p2} A_2 + \dots \alpha_{pn} A_n = 0$

} ind. Reactions.

## 6. Multiple Reactions in Soil environment.

$$NO_2^- \rightarrow NH_4^+ \quad (1)$$

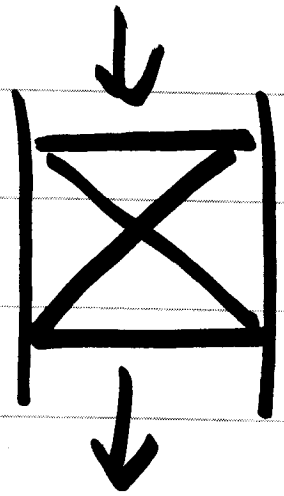
$$NO_2^- \rightarrow NO_3^- \quad (2)$$

$$NO_2^- + NH_4^+ = N_2 + 2H_2O \quad (3)$$

$$NH_4^+ \rightarrow \text{cell synthesis} \rightarrow \text{food crops} \quad (4)$$

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + \text{Water} + \text{Energy} \quad -(5)$$

# 7. Catalyst Deactivation



kinetics

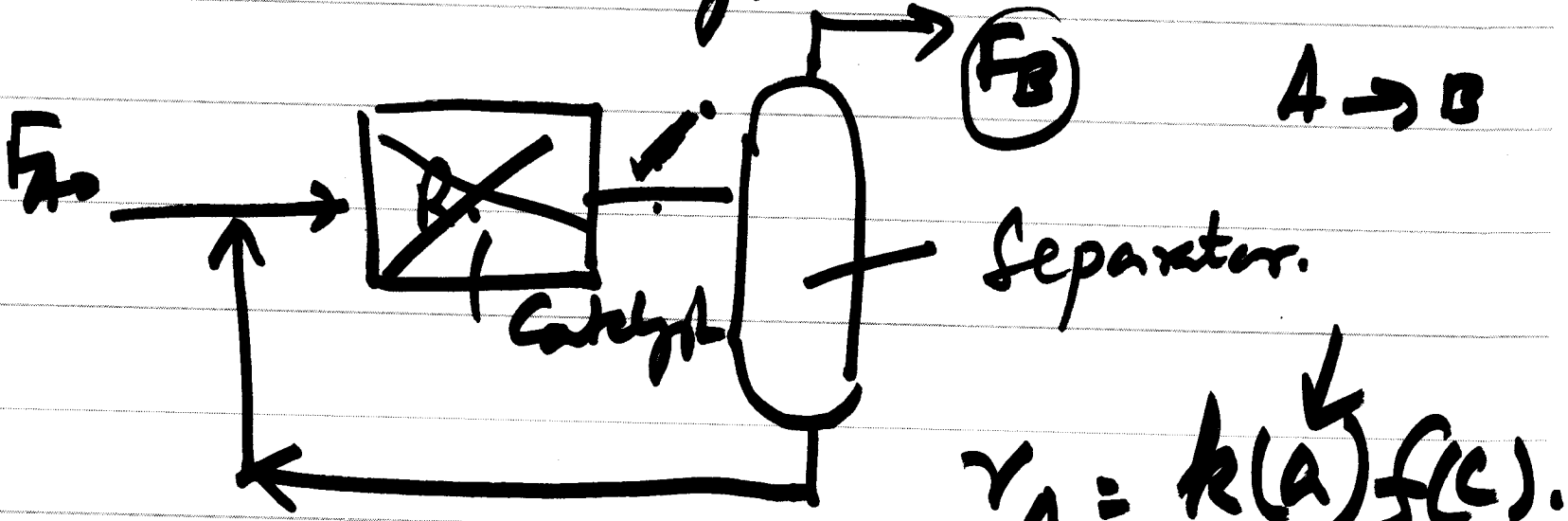
$$r_d = k_d a^m \phi(c)$$

$$-\frac{da}{dt} = r_d.$$

12

8) Process Evaluation

- Catalyst deactivation

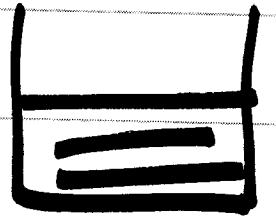



$$r_A = k(a) f(c).$$

## 1) Time dependent operation

### (1) Batch process

$A + B = C + D$

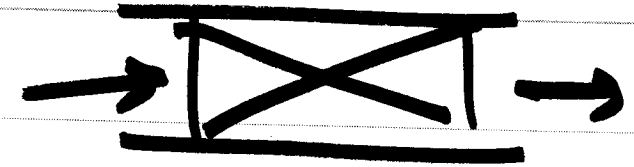


$t = 0$

$C_{A0}$

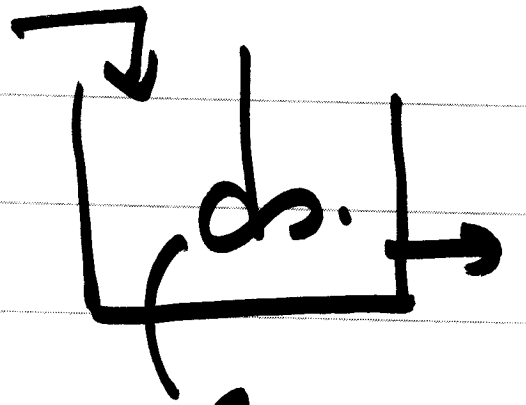
$C_{B0}$

### (2)



Start up.

## Example



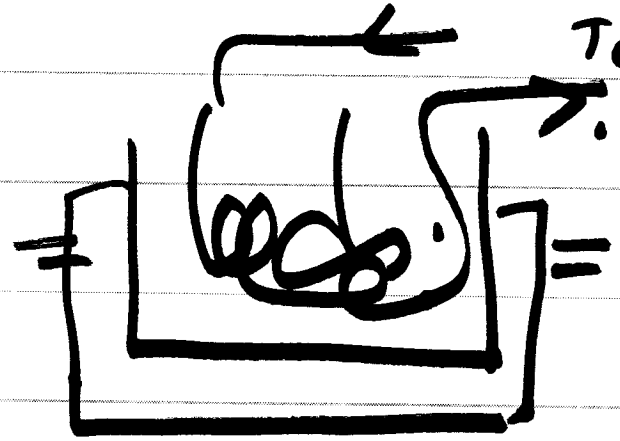

Start up time $C_{Ai} = \checkmark (C_{A0})$

= time required to reach steady state

10) Adding heat

Removing heat.

Energy Balance – Stirred Vessels




Plug flows