socrative
A showbie PRODUCT

Name ____________
Date ____________

# Quizz 4: Reactors

Score ____________

**1.** Defining the current electricity consumption as W_comp_inter, and the electricity consumption with no inter-cooling as W_comp_no_inter, what is the relative energy saving (E_rel) thanks to inter-cooling.
(W_comp_no_inter - W_comp_inter)/W_comp_no_inter

- (A) 42 %
- (B) 36 %
- (C) 27 %
- (D) 13%

**W_comp with inter-cooling = 1999 kW (A)**
**W_comp without inter-cooling = 3433 kW (B)**

**(B-A)/B = 41.7 %**

**2.** If you were to perform sensitivity analysis on the operating temperature of the reactor, you would most probably need a calculator block to link all useful variables together. Indicate which variable(s) would you need to define (stream/block name) and their sequence (import/export variable). Also indicate which one you would vary in the sensitivity analysis block.

**Good practice is to define a parameter (TMETH) as an import variable then to define all temperature impacting variables as export variables and write in the calculate tab:**
**TVAR1 = TMETH**
**TVAR2 = TMETH**

**In our case, there are 2 variables that are to be considered. The temperature of heater 1, and the temperature of heater 3. No need to consider the reactor temperature as it is apecified by the inlet stream, defined itself by the heater 1.**

**3.** What is the effect of the purge on the purity of the MeOH stream (S11).

- (A) A larger purge tends to increase the purity of the MeOH stream
- (B) A larger purge tends to decrease the purity of the MeOH stream
- (C) The purge has no direct impact on the purity of the MeOH stream

**Recycling enhance the production of MeOH, but also of H2O. Changing the purge manually (or through sensitivity analysis) one can confirm that a larger purge yield purer (but fewer) MeOH.**

**4.** With a GHSV of 3500 m3/(kg_cat h), what is the YIELD of the RPlug flow reactor ? (purge at 0.07, T = 250°C, P = 50 bar)

RESET IT TO 20 FOR FUTURE CALCULATIONS

- (A) 85 %
- (B) 83 %
- (C) 72 %
- (D) 69 %

**GHSV can be changed in the CAT-LOAD calculator block. It somehow dictates how large the flow is compared to the amount of catalyst (size of the reactor). Increasing this value reduced the reactor for a given flow rate and hence reduces the yield.**

**5.** Cancel the recycling (i.e. set the purge to 1) to get the single-path yield for our process including the RPlug reactor (R1). Separately, create 2 new processes as follows:

1) add a stream with 1.08414 kg/s and T = 250, P = 50 bar, and a molar composition: CO (25%), H2 (75%). Connect it to a RGibb's reactor (RGCO) and add a leaving material stream

2) add a stream with 1.08414 kg/s and T = 250, P = 50 bar, and a molar composition: CO2 (25%), H2 (75%). Connect it to a RGibb's reactor (RGCO2) and add a leaving material stream

Which of the following answers is/are correct?

- (A) The duty of RGCO is more negative than the duty of RGCO2
- (B) The duty of RGCO is more negative than the duty of R1
- (C) The duty of R1 is more negative than the duty of RGCO
- (D) The duty of R1 is more negative than the duty of RGCO2
- (E) The duty of RGCO2 is more negative than the duty of RGCO
- (F) The duty of RGCO2 is more negative than the duty of R1
- (G) The duty of RGCO will always be more negative than the duty of R1  at any recycling rates (i.e. any purges)

**The RGibb's reactor simulates most optimal cataylst performance for a reaction set. In this aspect, RGCO yield will be greater than R1, resulting in a more negative duty (exothermic reactions). (B: True)**

**However, the reaction involving CO2 is ~3 times less exothermic per mole of H2 (only 16 kJ/mol against 45 kJ/mol). Even more impacting, the RWGS reaction is consuming also part of the H2. All in all, the MeOH yield is much higher for CO/H2 stream than CO2/H2 stream.**
**For these reasons even with best catalyst, the CO2 hydrogenation will be less favoured than our kinetic modelling. (D: True)**

**if B and D both True —> A: True, C: False, E: False, F: False**

**All of this is true, without recycling (single path) and no longer holds if we start increasing the recycling rate up to 85-90 %. (G: False)**