PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Final Examination : Semester I — Academic Year : 2006

Date : 4 October 2006 — Time : 13.30 – 16.30

Subject : 230 - 351 Computer Applications for Chemical Engineers — Room : R300

Student Name: ..... ID no. : .....

Number of questions : 2

Time : 3 hours

Total marks : 100

Notes are not allowed. One diskette A is provided.

Calculators are not allowed.

Perform simulation by Aspen Plus Program

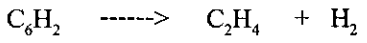
Question	Full Marks	Marks Received
1	40	
2	60	
Total	100	

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

One diskette A and this paper with answer sheet are used for grading.

Student Name: ..... ID no. : .....

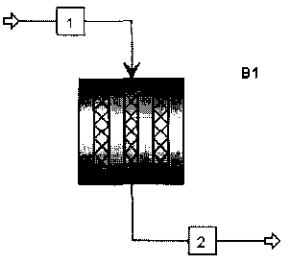
1. Ethylene is produced from ethane with hydrogen gas by-product in a plug flow reactor according to the reaction below. Simulation information also shown below.



Ethane ------> Ethylene + Hydrogen

Unit Operation Block	RPlug
Reacting Phase	Vapor
Reaction	Kinetic
	LHHW
	k=0.072
	n=0
	E=82 kcal/mol
	T_0=1000K
	Driving Force
	Constants A,B,
	C ,D for Term1,2
Rate Basis	Reac(Vol)
Property Method	SYSOP0
Property Sets	HXDESIGN
	THERMAL
	TXPORT
	VLE
	VLLE

Student Name: ..... ID no. : .....



Set up the Aspen Plus process flow sheet for this question. Use the Unit Operation Block type RPlug. Enter simulation specifications from the provided information. Provide your own other specifications which you think necessary.

Ethane feed rate is 0.65 lbmol/sec at 1100 K and 6 atm. Reaction is in vapor phase.

The RPlug reactor operating condition is "constant at inlet temperature".

The RPlug reactor is 20 feet long and 3 feet diameter.

The reaction is rate-controlled kinetic of the type Langmuir-Hinshelwood-Hougen-Watson (LHHW).

(Note that you need to go to the reactions subfolder and create a reaction by selecting "New" and give it a name. Then select type LHHW.)

In the reactions subfolder and on the kinetics tab provide extra specifications by clicking on the "Driving Force" button.

For the "Enter Term :" select "**Term1**" and enter **exponent** values: 1 for ethane, 0 for ethylene and 0 for hydrogen. And enter 0 for for all four driving force constants A,B,C,D.

For the next "Enter Term :" select "**Term2**" and enter **exponent** values: 0 for ethane, 0 for ethylene and 0 for hydrogen. And enter -10000000 for driving force constant A and 0 for all other three driving force constants B,C,D.

Close this window and go back to the RPlug Block and add the reaction set to the block.

Student Name: ..... ID no. : .....

Run the simulation program.

1a) Write down the flow rates and compositions for stream 1 and 2 in your answer sheet.

1b) For the LHHW kinetic explain the meaning of parameters k, K, n and write the driving force expression.

1c) Calculate the reactor per cent yield.

After you have completed the simulation for this question, **save** your file on to your diskette in drive A under the file name xxQ1. Where xx is your computer number.

(40 marks)

Answers to Question 1

Student Name: ..... ID no. : .....

2. Propylene glycol is produced from the reaction of propylene oxide and water in a CSTR reactor. The product is separated in a distillation column. The system does not form azeotropic mixture. Select distillation column model type.

propylene oxide + water (excess) ---→ propylene glycol

C_3H_6O + H_2O ---→ $C_3H_8O_2$

Formula in program library are:

(C3H6O_4) (H2O) (C3H8O2_2)

Reaction phase: Liquid

Rate basis: Reac(vol)

Use Property method: Wilson-2

Reaction Kinetic: Power law

k = 1.79E+13

n = 0

E = 32400 Btu/lbmol

T_0 = not specified

Exponent for propylene oxide = 2

Exponent for water = 0

Exponent for propylene glycol = 0

Specifications for Block B1 (CSTR)

Pressure: 3 Bar, Heat Duty: 0 Watt

Valid phases: Liquid only, Specification type: Reactor volume

Reactor volume: 1.1356 m^3

Specifications for Block B2 (Distillation Column)

Number of stages: 22, Feed stage: 8

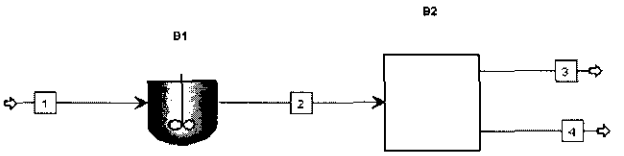
Reflux ratio: 2, Distillate to feed mole ratio: 0.7

Condenser pressure: 15 psia, Reboiler pressure: 60 psia

Set up the Aspen Plus process flow sheet for this question. Enter simulation specifications from the provided information. Provide your own other specifications which you think necessary and run the simulation program.

2a) After you have completed the simulation for this question, **save** your file on to your diskette in drive A under the file name xxQ2. Where xx is your computer number.

Student Name: ..... ID no. : .....



Set up the Aspen Plus process flow sheet for this question. Enter simulation specifications from the provided information. Provide your own other specifications which you think necessary and run the simulation program.

2a) After you have completed the simulation for this question, **save** your file on to your diskette in drive A under the file name xxQ2. Where xx is your computer number. Write down the flow rates and compositions for stream 1,3 and 4 in your answer sheet.

2b) Change the process conditions for stream 1 (do not change specifications for Blocks B1 and B2) in order to get the best product purity. For these best conditions write down the flow rates and compositions for stream 1,3 and 4 in your answer sheet.

Do not save the conditions in question part 2a on to diskette drive A.

(60 marks)