Name- Surname......Student Code.....

Prince of Songkla University Faculty of Engineering

Final Examination: 1 st Semester	Academic Year: 2014
Date: 8 th December 2014	Time: $9.00 - 12.00$
Subject: 231-436 Com App for Chem Eng	Room: Com 1

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาค การศึกษา

- อนุญาตให้นำเอกสาร และดำรา เข้าห้องสอบได้
- ห้ามนำโทรศัพท์มือถือ เครื่องคิดเลข คอมพิวเตอร์โน้ตบุ๊ก ทุกรุ่นเข้าห้องสอบ
- ห้ามหยิบยืมเอกสาร ห้ามดิดต่อสื่อสาร กับผู้ร่วมสอบ
- เขียนชื่อ และรหัสทุกหน้า
- กรณีกระดาษคำตอบไม่พอให้ใช้ด้านหลังได้
- ใช้ดินสอทำข้อสอบได้
- ข้อสอบมีทั้งหมด 2 ข้อ (9 หน้า รวมปก)

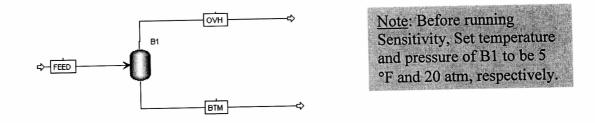
ข้อ	คะแนนเต็ม	คะแนนที่ได้
1(a)	20	
1(b)	20	
2(a)	10	
2(b)	15	
2(c)	15	
รวม	80	

รศ.ดร. ลือพงศ์ แก้วศรีจันทร์ ผู้ออกข้อสอบ

#ชุดที่ 1

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1. (40 points): Mixed gas stream of hydrogen, nitrogen and hydrocarbons is fed to a flash vessel in order to obtain vapor and liquid phases which came out into OVH and BTM streams, respectively.



Feed stream conditions and thermodynamic package entirely used are listed below:

		Mola	r flow	Alia	s formu	ıla
		rate (lb	mol/hr)			
Hydroger	1	25		22		
Nitrogen	-	13	1	V 2		
Methane		40	(CH4		
Cyclohex	ane	1.24	4 (C6H	12-1	
Benzene		0.00)3 (C6H	6	
						an e
Contraction and Contraction of Contraction		Temp (°F)	42	0	
				20		
		Pressur		20		
K13819819	vsheet Sections	Pressur Reference	d Information	20		
Property methods &	e han de la de la serie de		d Information Method name:		Methods A	ssistan
Property methods & Method filter: Base method:	& options COMMON NRTL	Reference	d Information	20	Methods 4	
Property methods & Method filter: Base method: Henry components	& options COMMON NRTL	Reference	d Information Method name: NRTL		Methods A	
Property methods & Method filter: Base method:	& options COMMON NRTL s: ation options	Reference	Information Method name: NRTL Modify Vapor EOS: Data set:		ESIG	V S
Property methods & Method filter: Base method: Henry components	& options COMMON NRTL s: ation options	Reference V V	ed Information Method name: NRTL Vapor EOS: Data set: Liquid gamma:		Gallerin birks	
Property methods & Method filter: Base method: Henry components Petroleum calcula Free-water method	& options COMMON NRTL ation options od: STEAM-TA 3	Reference V V	Information Method name: NRTL Modify Vapor EOS: Data set:		ESIG	86 K 80 K
Property methods & Method filter: Base method: Henry components Petroleum calcula Free-water metho Water solubility:	& options COMMON NRTL ation options od: STEAM-TA 3	Reference V V	ed Information Method name: NRTL Vapor EOS: Data set: Liquid gamma: Data set:	Ţ.	ESIG I GMRENON I	

Flash vessel (B1) is selected from Model Palette of Separators (Flash2)

(a) You have to use model analysis tools for the sensitivity for varying FLASH tank temperature in order to find (1) molar flow rate (in lbmol/ hr) of overhead stream (OVH) (2) mass fraction of cyclohexane in OVH and (3) mass fraction of methane in BTM. *(Set pressure of B1 to be 20 atm during sensitivity operation)*

#ชุดที่ 1

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Explain your variables used in sensitivity analysis

Define (5 points)

	D_{1}
Flowsheet variable	Definition (as shown in your simulation)

Vary (5 points)

Manipulated variable	Value of manipulated variable
	Overall range
	Lower
	Upper
	#points = 4

Show your sensitivity results (10 points)

- 🔺 🐼 Model Analysis Tools
 - 🔺 🔯 Sensitivity
 - 🔺 🐼 S-1 💽 Input
 - Results

Point #	Manipulated	molar flow rate	mass fraction	mass fraction
variable	V	V V	V V	¥
1				
2				
3				
4				

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(b) You have to use model analysis tools for optimization (without constraints) in order to minimize the objective function of {mass flowrate of cyclohexane in OVH stream+ mass flowrate of methane in BTM stream}. In this case set *temperature of B1 to be 6 °F*.

Express your variables used in optimization analysis

Define (4 points)

Flowsheet variable	Definition (as shown in your simulation)

Vary(4 points)

Manipulated variable	Manipulated variable limits
<u>^</u>	
	Lower
	Upper

FORTRAN code for minimization (2 points)

nter executable Fortran statements ————————————————————————————————————	Define	Objective & Constraints	⊘ Vary	Fortran	Declarations	Information
	nter executa	ble Fortran statements				
	executa	ble Fortran statements				

#ชุคที่ 1

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Show your optimization results (10 points)

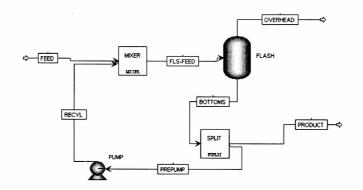
🔄 Sensi To Optir 4 🛛 To O O	mization			
lesults	Status			
ariable re	esults Variable	Initial value	Final value	Units

Show your stream results after successful optimization

	втм	F	EED		OVH	
Temperature F	on ganta on adapted hantseterariot as debeleraded					
Pressure psia						
Vapor Frac						
Mole Flow Ibmol/hr						
Mass Flow Ib/hr						
Volume Flow cuft/hr						
	rmat: CHEM_E		Stream T	able	Copy All	
	ermat: CHEM_E		Stream T	able	Copy All OVH	
Display: All streams 👿 Fo			Consideration of the state of t			
Display: All streams 💌 Fo			EED			
Display: All streams 💽 Fo Mole Flow Ibmol/hr		F	EED)
Display: All streams 💽 Fo Mole Flow Ibmol/hr HYDROGEN		F 25	5 3			
Display: All streams Fo Mole Flow Ibmol/hr HYDROGEN NITROGEN		22 1: 41	5 3)

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2. (40 points) Considering a flash vessel of hydrocarbon separation; the feed stream contains methane, ethane, propane, n-butane, 1-butene and Hexachloro-1,3 butadiene; the feed rate of each component is 50, 100, 700, 870, 1176 and 5,130 lbm / h, respectively. Previous entering to the flash tank, the mixture of feed stream is mixed with the RECYL stream to form FLS-FEED stream via a Mixer unit as shown below. The BOTTOMS stream of the FLASH tank is separated onto two streams (PRODUCT and RECYL) via a splitter FSplit unit.



Feed stream, FLASH tank conditions, Pump specification and thermodynamic package entirely used are listed below:

FEED str	eam	Mas flow rate (lbm/hr)	A	lias formul	a
Methane		50	CH4		
Ethane		100	C2H	6	
Propane		700	C3H	8	
n-Butane		870	C4H	10-1	
i-Butene		1176	C4H	8-1	
HEXACHLO	DRO-	5130	C4CI	L6	
1,3 Butadien	e				
R. Line . Isto	The Pringel of				1995
		Temp (°F)	85		
		Pressure (psia)	50		
	tank co	onditions: 41°F	and 25	psia	
Global Flowsh	eet Sections	Referenced Info	rmation	psia	
Global Flowsh Property methods & o Method filter:	peet Sections ptions COMMON	Referenced Info	rmation	-	Assistan
Global Flowsh Property methods & o Method filter: Base method:	eet Sections	Referenced Info	rmation ame:	-	Assistan
Global Flowsh Property methods & o Method filter: Base method:	peet Sections ptions COMMON	Referenced Info	rmation ame:	Methods .	
Global Flowsh	eet Sections ptions COMMON SRK	Referenced Info	rmation ame: [¥	Methods,	
Global Flowsh Property methods & o Method filter: Base method: Henry components:	neet Sections ptions COMMON SRK	Referenced Info	rmation ame: [¥	Methods .	×
Global Flowsh Property methods & o Method filter: Base method: Henry components: Petroleum calculatio	neet Sections ptions COMMON SRK	Referenced Info	rmation in ame:	Methods,	
Global Flowsh Property methods & o Aethod filter: Base method: Henry components: Petroleum calculatio Free-water method: Water solubility:	COMMON SRK SRK STEAM-TA 3	Referenced Info Method n SRK C Mod FOS: Data set:	ify	Methods,	
Global Flowsh Property methods & o Method filter: Base method: Henry components: Petroleum calculatio Free-water method: Water solubility: Electrolyte calculatio	COMMON SRK SRK STEAM-TA 3	Referenced Info	ify	Methods,	×
Global Flowsh Property methods & o Method filter: Base method: Henry components: Petroleum calculatio Free-water method: Water solubility:	neet Sections COMMON SRK n options STEAM-TA 3 n options	Referenced Info	rmation is ame:	ESSRK 1	

#ชุดที่ 1

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		Mixers/Splitter	s Separators	Exchangers	Columns	Reactors	Pressure Changer	rs]	
(mod	el palette)	Pump	Compr	MCompr	- H	Pipe	Pipeline		
K STORE OF		harmonic			· ~ ·	1	1		
Section .	Specifications	Calcu	lation Optic	ons Fla	sh Options	Utility	Informa	Ition	
	Pump		0	Turbine					
	Pump outlet spec Discharge pres Pressure increa Pressure ratio:		and the sale interaction of the sale of th						
			25	psi					
0	Power required			hp					
I	Use performan	ice curve to	determine	discharge c	onditions				
the second s	ciencies mp:			Driver:					
	DOTTOMC				W OVER				
lisplay: All streams 🗶 Fo	ormat: CHEM_E	Y Str	eam Table	Copy All					
4	BOTTOMS	FEED	X	FLS-FEED	✓ OVER	HEAD 💌	PRODUCT	★ RECYL	
Temperature F	1998, 101 (1998) and								
Pressure psia									
Vapor Frac									
Mole Flow Ibmol/hr									
Mass Flow Ib/hr									
	BOTTOMS	FI	EED	FLS	-FEED	OVERH	EAD ⊻		
Mole Flow Ibmol/hr									
METHANE									
ethane									
PROPANE									
N-BUTANE	1								
1-BUTENE									
1,3BUTAD						m			

.

(b) Using 'Flowsheeting options' for 'Design Spec' to get mass fraction of Hexachloro 1,3-Butadiene in stream 'OVERHEAD' equal to 0.0007 by varying temperature of the FLASH tank.

Express your simulation by writing down variables and their definitions on the following windows.

Tonowing windows.
a) Opefine (4 points)
b) Spec (4 points)
(4 points)
c) Vary (4 points)
d) Click Results after successful simulating(2 points)
 Design Specs BS-1
Constant Input
Fill all design spec results in the following window:
Results Status
- Variable results
Variable Initial value Final value Units
e) <u>Ans.</u> Temperature = $^{\circ}F(1 \text{ points})$

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(c) Using 'Flowsheeting options' for 'Design Spec' to get molar flow of isobutene in the stream 'OVERHEAD' equal to 5.0 lbmol/h by varying pressure of the FLASH tank.

Express your simulation by writing down variables and their definitions on the following windows.

a) Define (4 points)
@C
b) Spec (4 points)
c) Vary (4 points)
d) Click Results after successful simulating (2 points)
🖌 🐼 Design ស្រុecs
▲ 🔯 DS-2
Input
Results
Fill all design spec results in the following window:
Results Status
⊂Variable results
Variable Initial value Final value Units
e) <u>Ans.</u> Pressure = Psia (1 points)