

AZAS TEKNIK KIMIA II

PERTEMUAN KE EMPAT TENTANG VAPORIZATION AND
COOLING OF MIXTURE

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Kerjakan di kelas: campuran senyawa

Tentukan Panas yang diperlukan untuk menaikkan suhu 100 mol/jam campuran 50% Air dan 50 % etanol dari 25 °C menjadi 150 °C.

Data dari Tabel B.1:

Senyawa	bp (°C)	ΔH_v (kJ/mol)
Air	100	40,656
etanol	78,5	38,58

Senyawa	a	b	c	d
Air (l)	$75,4 \times 10^{-3}$			
Air (g)	$33,46 \times 10^{-3}$	$0,688 \times 10^{-5}$	$0,7604 \times 10^{-8}$	$-3,593 \times 10^{-12}$
Etanol (l)	$103,1 \times 10^{-3}$			
Etanol (g)	$61,34 \times 10^{-3}$	$15,72 \times 10^{-5}$	$-8,749 \times 10^{-8}$	$19,83 \times 10^{-12}$

Jawaban slide 2

n =	100	mol
T1 =	25	°C
T2 =	150	°C

$$\Delta H_{air} = n \int_{25}^{100} C_p(l) dT + n \cdot \Delta H_v + n \int_{100}^{150} C_p dT(v)$$

$$\Delta H_{aLKOHOL} = n \int_{25}^{78,5} C_p(l) dT + n \cdot \Delta H_v + n \int_{78,5}^{150} C_p dT(v)$$

Senyawa	$Q1 = n \cdot c_p \cdot dT \text{ (kJ)}$	$Q2 = n \cdot \Delta H_v \text{ (kJ)}$	$Q3 = n \cdot c_p \cdot dT \text{ (kJ)}$	$Q_i = Q1 + Q2 + Q3$
H ₂ O	282,75	2032,8	86,08274596	2401,632746
C ₂ H ₅ OH	275,7925	1929	279,3979877	2484,190488
Q =				4886

Example: vaporization and cooling of mixture:

An equimolar liquid mixture of benzene (B) and toluene (T) at 10 °C is fed continuously to a vessel in which the mixture is heated to 50 °C. The liquid product is 40.0 mole% B, and the vapor product is 68.4 mole% B. How much heat must be transferred to the mixture per mole of feed?

Substances	bp (°C)	ΔH_v (kJ/mol)
C ₆ H ₆	80,1	30,765
C ₇ H ₈	110.62	33,47

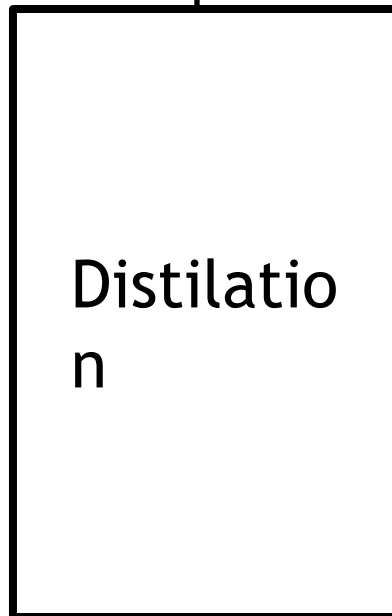
Substances	a	b	c	d
C ₆ H _{6(l)}	126,5x10 ⁻³	23.4x10 ⁻⁵	0	0
C ₇ H _{8(l)}	148,8x10 ⁻³	32,4x10 ⁻⁵	0	0
C ₆ H _{6(v)}	74,06x10 ⁻³	32,95x10 ⁻⁵	-25,20x10 ⁻⁸	77,57x10 ⁻¹²
C ₇ H _{8(v)}	94,18x10 ⁻³	38x10 ⁻⁵	-27,86x10 ⁻⁸	80,33x10 ⁻¹²

Mass Balance:

Basis : 1 mol feed

Feed , 1 mol, 10°C

0.5 C_6H_6
0.5 C_7H_8



V mol 50°C , 34.8 mm Hg = 0,46 atm
0.684 C_6H_6
0.316 C_7H_8

Substitusi (1) ke (2):

$$\begin{aligned} 0,5 &= 0,684 (1-L) + 0,4L \\ 0,5 &= 0,684 - 0,684L + 0,4L \\ 0,184 &= 0,284 L \\ L &= 0,648 \text{ mol} \\ V &= 0,352 \text{ mol} \end{aligned}$$

Neraca Total:

$$1 = V + L$$

$$V = 1 - L \quad (1)$$

Neraca Benzen

$$0,5 = 0,684V + 0,4 L \quad (2)$$

L mol 50°C , 34.8 mm Hg
0.4 C_6H_6
0.6 C_7H_8

Energy Balance

$$\begin{aligned}
 Q = \Delta H &= n \int_{10}^{50} C_{p_m}(l).dT + n \int_{10}^{bp} C_{p_m}(l).dT + n \int_{bp}^{50} C_{p_m}(v).dT \\
 &= n \int_{10}^{50} cp.dT_{benzen(l)} + n \int_{10}^{50} cp.dT_{toluen(l)} + n \int_{10}^{bp} cp.dT_{benzen(l)} + n.\Delta H_{v,benzen} + n \int_{bp}^{50} cp.dT_{benzen(v)} \\
 &+ n \int_{10}^{bp} cp.dT_{toluen(l)} + n.\Delta H_{v,toluen} + n \int_{bp}^{50} cp.dT_{toluen(v)}
 \end{aligned}$$

Energy Balance

Basis

1mol

T reference = 10 oC

[illegible]

Senyawa	input		output						
	n(mol)	H (kJ/mol)	n(l) (mol)	H ,kJ	n(v) (mol)	H ,kJ	n. ΔHv , kJ	H,KJ	ΔH TOTAL
C6H6 (l)	0,5	0	0,2592	1,3843354					
C7H8 (l)	0,5	0	0,3888	2,465303					
C6H6 (v)					0,240768	2,31296745	7,4072275	-0,68435325	9,03584172
C7H8 (v)					0,111232	1,88409379	3,722935	-0,82845184	4,778576984
			SUM	3,8496384					13,8144187
Steam									17,6640571

SOAL DIKERJAKAN

Campuran cair equimolar dari benzene (B) dan toluene pada 10 °C diumpankan terus menerus ke menara distilasi di mana campuran dipanaskan sampai 50 °C. Produk vapor yang diinginkan 100 mol terdiri dari 70 mole% B dan 30 % mol toluene, produk cair sebesar 40 mole % B dan sisanya merupakan toluen. Berapa banyak panas yang harus ditransfer ke campuran per mol umpan?

From the Table B.1:

Substances	bp (°C)	ΔH_v (kJ/mol)
C_6H_6	80,1	30,765
C_7H_8	110.62	33,47

From the Table B.2:

Substances	a	b	c	d
$C_6H_{6(l)}$	$126,5 \times 10^{-3}$	23.4×10^{-5}	0	0
$C_7H_{8(l)}$	$148,8 \times 10^{-3}$	$32,4 \times 10^{-5}$	0	0
$C_6H_{6(v)}$	$74,06 \times 10^{-3}$	$32,95 \times 10^{-5}$	$-25,20 \times 10^{-8}$	$77,57 \times 10^{-12}$
$C_7H_{8(v)}$	$94,18 \times 10^{-3}$	38×10^{-5}	$-27,86 \times 10^{-8}$	$80,33 \times 10^{-12}$

SOAL: Kerjakan Di kelas

