AZAS TEKNIK KIMIA II

PERTEMUAN KE LIMA

TENTANG GAS PREHEATER

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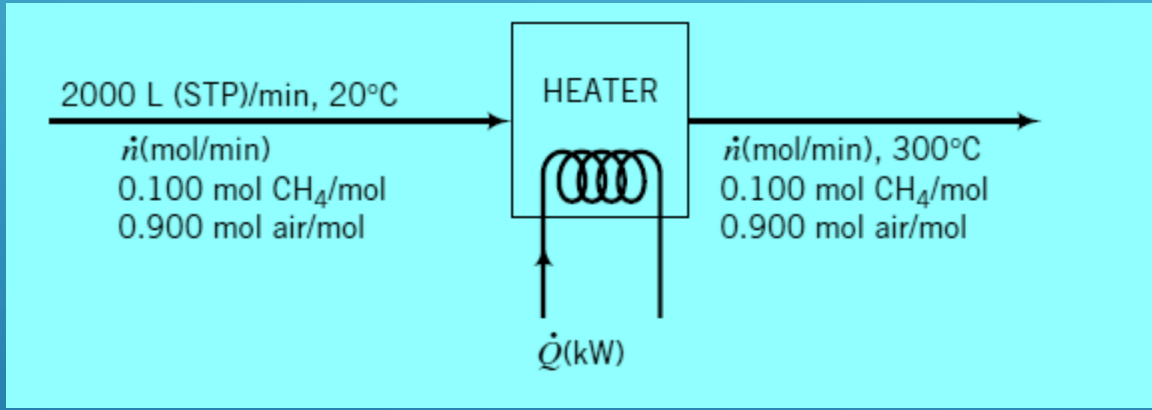
GAS PREHEATER

Stream containing 10% CH4 and 90% air by volume is to be heated from 20 C to 300 C.

Calculate the required rate of heat input in kilowatts if the flow rate of the gas is 2000 liters (STP)/min.



At STP 1 mole = 22,4 L
Then
2000 L /min= 89,3 mole/min

Substances	a	b	c	d
$CH_{4(v)}$	0,03431	$5,469x10^{-5}$	$0,3661x10^{-8}$	$-11x10^{-12}$
Air(v)	**0,02894**	**0,000004147**	**3,191E-09**	**-1,965E-12**

JAWABAN DENGAN CARA 1

$$Q = \Delta H = n \int_{20}^{300} Cp_m(v).dT$$

$$= n_{CH4} \int_{20}^{300} cp.dT_{CH4} + n_{air} \int_{20}^{300} cp.dT_{air}$$

$$= 8{,}93[(34{,}31x10^{-3})(300-20) + \frac{5{,}469x10^{-5}}{2}(300^2-20^2)$$

$$+ \frac{0{,}3661x10^{-8}}{3}(300^3-20^3) - \frac{11x10^{-12}}{4}(300^4-20^4)]$$

$$+ 80{,}37[(28{,}94x10^{-3})(300-20) + \frac{0{,}4147x10^{-5}}{2}(300^2-20^2)$$

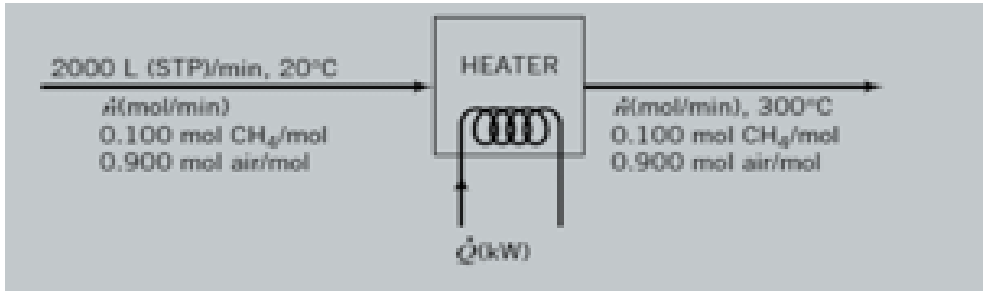
$$+ \frac{0{,}3191x10^{-8}}{3}(300^3-20^3) - \frac{1{,}965x10^{-12}}{4}(300^4-20^4)]$$

$$Q = 776\,kJ/\text{min} = 12{,}93\,\text{kJ/sec} = 12{,}93\,\text{kW}$$

JAWABAN DENGAN CARA 2

Stream containing 10% CH4 and 90% air by volume is to be heated from 20 C to 300 C.

Calculate the required rate of heat input in kilowatts if the flow rate of the gas is 2000 liters (STP)/min.



Substances	a	b	c	d
$CH_{4(v)}$	0,03431	5,469E-05	3,661E-09	-1,1E-11

mol=	2000	liter (stp)	1	mol	=	89,28571	mol
		min	22,4	liter (stp)			min

CEK CARA DI EXCEL

Tref CH4 20 C

Tref Air 25 C

Senyawa	n(in)	Hin	n(out)	H(out)
CH4	8,928571		8,928571429	
AIR	80,35714		80,35714286	

$$H_{(CH4)out} = \int_{Tref}^{Tout} Cp\ dT$$

$$H_{(CH4)out} = \int_{20}^{300} (0,03431 + 5,469X\,10^{-5}T + 0,3661\,X10^{-8}T^2 - 11,0X10^{-12}T^3)dT$$

$$H_{(CH4)In} = \int_{Tref}^{20} Cp\ dT$$

$$H_{(CH4)In} = \int_{20}^{20} Cp\ dT$$

Tout 300

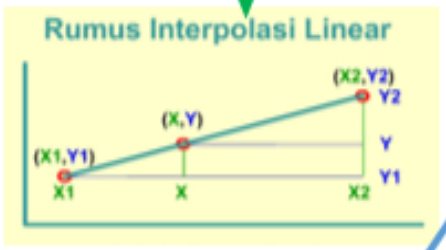
Tref 20

Senyawa	n(in)	Hin	n(out)	H(out)
CH4	8,928571	0	8,928571429	12,11
AIR	80,35714	-0,144	80,35714286	8,17

Energy Balance $Q = \Delta H = \sum_{OUT} niHi - \sum_{in} niHi$

Q= 776,233266 KJ/min

12,9372211 Kw



$$\frac{x-x1}{x2-x1} = \frac{y-y1}{y2-y1}$$

Table B.8 Specific Enthalpies of Selected Gases: SI Units

$\hat{H}$(kJ/mol)
Reference state: Gas, P_{ref} = 1 atm, T_{ref} = 25°C

T	Air	O_2	N_2	H_2	CO	CO_2	H_2O
0	−0.72	−0.73	−0.73	−0.72	−0.73	−0.92	−0.84
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	2.19	2.24	2.19	2.16	2.19	2.90	2.54
200	5.15	5.31	5.13	5.06	5.16	7.08	6.01
300	8.17	8.47	8.12	7.96	8.17	11.58	9.57
400	11.24	11.72	11.15	10.89	11.25	16.35	13.23
500	14.37	15.03	14.24	13.83	14.38	21.34	17.01
600	17.55	18.41	17.39	16.81	17.57	26.53	20.91
700	20.80	21.86	20.59	19.81	20.82	31.88	24.92
800	24.10	25.35	23.86	22.85	24.13	37.36	29.05
900	27.46	28.89	27.19	25.93	27.49	42.94	33.32
1000	30.86	32.47	30.56	29.04	30.91	48.60	37.69
1100	34.31	36.07	33.99	32.19	34.37	54.33	42.18
1200	37.81	39.70	37.46	35.39	37.87	60.14	46.78
1300	41.34	43.38	40.97	38.62	41.40	65.98	51.47
1400	44.89	47.07	44.51	41.90	44.95	71.89	56.25
1500	48.45	50.77	48.06	45.22	48.51	77.84	61.09

SOAL TUGAS KERJAKAN MENGGUNAKAN EXCEL KIRIM JAWABAN DI E_LEARNING

- Stream containing 20% C2H4 and 80% air by volume is to be heated from 10 C to 260 C. Calculate the required rate of heat input in kilowatts if the flow rate of the gas is 3000 liters (STP)/min.

Substances	a	b	c	d
$C2H_{4(v)}$	0,04075	0,0001147	-6,891E-08	1,766E-11

Table B.8 Specific Enthalpies of Selected Gases: SI Units

$\hat{H}$(kJ/mol)
Reference state: Gas, $P_{ref} = 1$ atm, $T_{ref} = 25°C$

T	Air	O_2	N_2	H_2	CO	CO_2	H_2O
0	−0.72	−0.73	−0.73	−0.72	−0.73	−0.92	−0.84
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	2.19	2.24	2.19	2.16	2.19	2.90	2.54
200	5.15	5.31	5.13	5.06	5.16	7.08	6.01
300	8.17	8.47	8.12	7.96	8.17	11.58	9.57
400	11.24	11.72	11.15	10.89	11.25	16.35	13.23
500	14.37	15.03	14.24	13.83	14.38	21.34	17.01
600	17.55	18.41	17.39	16.81	17.57	26.53	20.91
700	20.80	21.86	20.59	19.81	20.82	31.88	24.92
800	24.10	25.35	23.86	22.85	24.13	37.36	29.05
900	27.46	28.89	27.19	25.93	27.49	42.94	33.32
1000	30.86	32.47	30.56	29.04	30.91	48.60	37.69
1100	34.31	36.07	33.99	32.19	34.37	54.33	42.18
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1300	41.34	43.38	40.97	38.62	41.40	65.98	51.47
1400	44.89	47.07	44.51	41.90	44.95	71.89	56.25
1500	48.45	50.77	48.06	45.22	48.51	77.84	61.09

Sebuah aliran liquid mengandung 60%-wt C_2H_6 dan 40%-wt C_4H_{10} dipanaskan dari suhu 150K menjadi 200K pada tekanan 5 bar. Hitung panas masuk yang diperlukan per kg campuran. Perubahan energi kinetik dan potensial diabaikan. Diketahui data entalpi C_2H_6 dan C_4H_{10} dengan asumsi entalpi komponen campuran sebagai komponen murni pada suhu yang sama (Perry's Chemical Eng.Handbook).

OUTPUT :

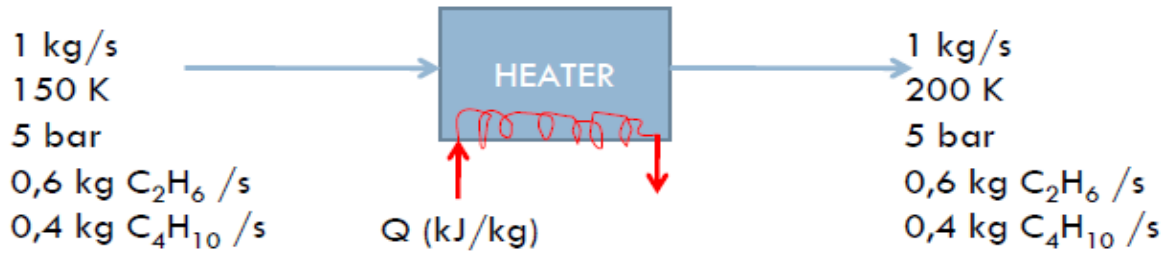
$\Delta H\ C_2H_6 = 434{,}5$ kJ/kg

$\Delta H\ C_4H_{10} = 130{,}2$ kJ/kg

INPUT :

$\Delta H\ C_2H_6 = 314{,}3$ kJ/kg

$\Delta H\ C_4H_{10} = 30$ kJ/kg



Sehingga:

$$Q = \Delta H = \sum_{out} m_i H_i - \sum_{in} m_i H_i$$

$$Q = 0{,}6\frac{kg\ C_2H_6}{s}\left|\frac{434\ kJ}{kg} + 0{,}4\frac{kg\ C_4H_{10}}{s}\right|\frac{130\ kJ}{kg} - [(0{,}6)(314{,}3) + (0{,}4)(30)]\frac{kJ}{s} = 112\ kJ/s$$

$$Q = \frac{112\ kJ/s}{1\ kg/s} = 112\ kJ/kg$$