School of Industrial Engineering

Politecnico di Milano, Campus Piacenza

Exercises of "Fundamentals of Chemical Processes for Energy and Environment"

Exercise 1

	y out
CH_4	2%
O_2	24%
CO_2	38%
H_2O	36%

Exercise 2

CH_4 in NG	79.61%
N_2 in NG	20.39%
e Air %	15%

Exercise 3

Results: 100 mol/h C_4H_{10} basis

	e% = 0 χ = 100%		**e% = 20 χ = 100%**		**e% = 20 χ = 90%**	
	n^{out} (mol/h)	**y^{out}**	**n^{out} (mol/h)**	**y^{out}**	**n^{out} (mol/h)**	**y^{out}**
C_4H_{10}	0	0	0	0.0000	10	0.0025
O_2	0	0	130	0.0328	195	0.0494
N_2	2444	0.1196	2932.8	0.7401	2932.8	0.7429
CO_2	400	0.1495	400	0.1009	360	0.0912
H_2O	500	0.7309	500	0.1262	450	0.1140

Exercise 4

Results: assuming 100 mol/s dry products as the basis

H/C ratio = 3.978

e% = 49.8%

	n^{in} (mol/s)
O_2	22.409
N_2	84.258
H_2O	14.918

Exercise 5

Results: 1 mol/s inlet C_2H_6 as the basis

	n^{in} (mol/s)	n^{out} (mol/h)	y^{out}	y^{out}_{dry}
C_2H_6	1	0.1	0.00412	0.00417
O_2	5.25	2.325	0.09590	0.09698
N_2	19.75	19.75	0.81460	0.82377
CO	0	0.45	0.01856	0.01877
CO_2	0	1.35	0.05568	0.05631
H_2O	0	0.27	0.01114	-

Exercise 6

Results: 1 mol/s inlet O_2 as the basis

	n in (mol/s)	n out (mol/s)	y^{out}
C_2H_4	3	2.100	58.12%
C_2H_4O	0	0.810	22.42%
O_2	1	0.343	9.49%
CO_2	0	0.144	3.99%
CO	0	0.036	1.00%
H_2O	0	0.180	4.98%

Exercise 7

Composition of the stream lines (molar fractions)

	Fresh Feed	Reactor Feed	Reactor Outlet	Recycle	Purge	Product
H_2	0.7040	0.7000	0.3889	0.6364	0.6364	0.0000
CO_2	0.2560	0.2800	0.1944	0.3182	0.3182	0.0000
Inert	0.0400	0.0200	0.0278	0.0455	0.0455	0.0000
CH_3OH	0.0000	0.0000	0.1944	0.0000	0.0000	0.5000
H_2O	0.0000	0.0000	0.1944	0.0000	0.0000	0.5000

Flow rates: 155 kmol/h CH_3OH produced

	Fresh Feed	Reactor Feed	Reactor Outlet	Recycle	Purge	Product
Flow	679.3	1107.1	797.1	427.8	59.3	310.0

Composition of the stream lines (molar flow rates, 100 kmol/h reactor feed)

	Fresh Feed	Reactor Feed	Reactor Outlet	Recycle	Purge	Product
H_2	43.439	70	28	24.561	3.439	0
CO_2	15.719	28	14	12.281	1.719	0
Inert	0.246	2	2	1.754	0.246	0
CH_3OH	0	0	14	0	0	14
H_2O	0	0	14	0	0	14

Exercise 8

Results: 100 kg/h oil assumed as the basis (MM_{Air} = 28.96 g/mol)

	n^{out} (kmol/h)	y^{out}	y^{out}_{dry}
SO_2	0.09375	0.0015	$1.671*10^{-3}$
O_2	2.46	0.0403	0.0439
N_2	46.30	0.7577	0.8252
CO_2	7.25	0.1187	0.1292
H_2O	5.00	0.0818	-

SO_2 in the exhausts = 1671 ppm

Scrub Flow = 39.51 kmol/h (dry flow)

Bypass Flow = 16.59 kmol/h (dry flow)