1)

1112|4

tid	conc	E(t)	t*E(t)	t2*E(t)	exp(-kt)	exp(-kt)*E
100	10	6,19E-05	0,006192	0,619195	0,941765	5,8314E-05
200	80	0,000495	0,099071	19,81424	0,88692	0,00043934
300	130	0,000805	0,241486	72,44582	0,83527	0,00067235
400	200	0,001238	0,495356	198,1424	0,786628	0,00097415
500	350	0,002167	1,083591	541,7957	0,740818	0,00160549
600	400	0,002477	1,486068	891,6409	0,697676	0,00172799
700	250	0,001548	1,083591	758,5139	0,657047	0,0010171
800	120	0,000743	0,594427	475,5418	0,618783	0,00045978
900	80	0,000495	0,44582	401,2384	0,582748	0,00028867
1000	0	0	0	0	0,548812	0
	1615	0,01	5,532508	3359,443	6,55118	0,00721403

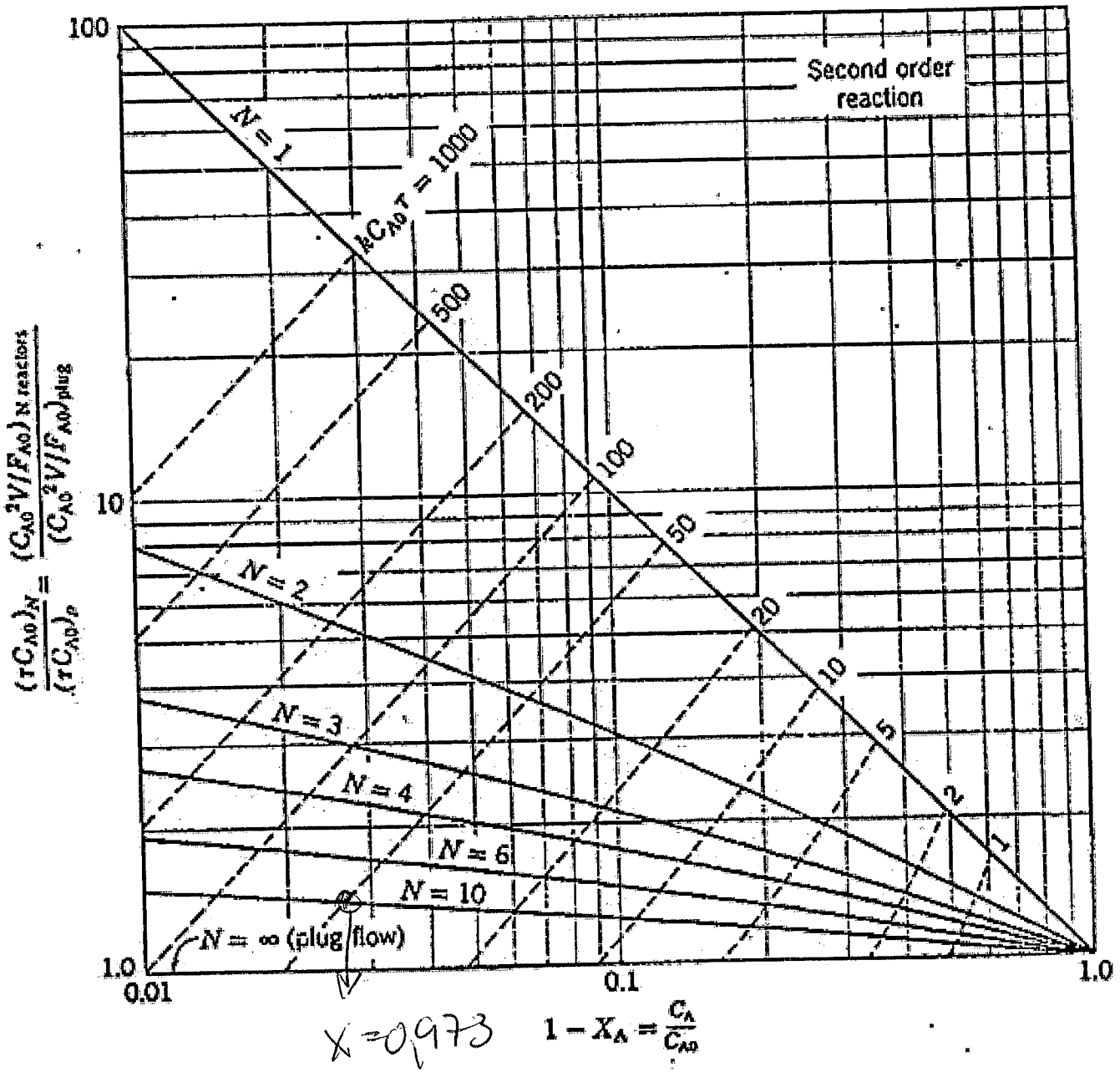
161500

Ca0=	150		
k=	0,0006	ktauCA0=	49,8
tau=	553,2508		
varians=	29857,85		
			0
N=	10,25145		-0,00475772
Dea/vL=	0,051417		
	0,048774		
	ur diagram		
x tank=	0,973		
x disp=	0.975		
x segreg=	0,278597		

$0,101 = 2x - 2x^2$

$\Rightarrow X \approx 0,053$

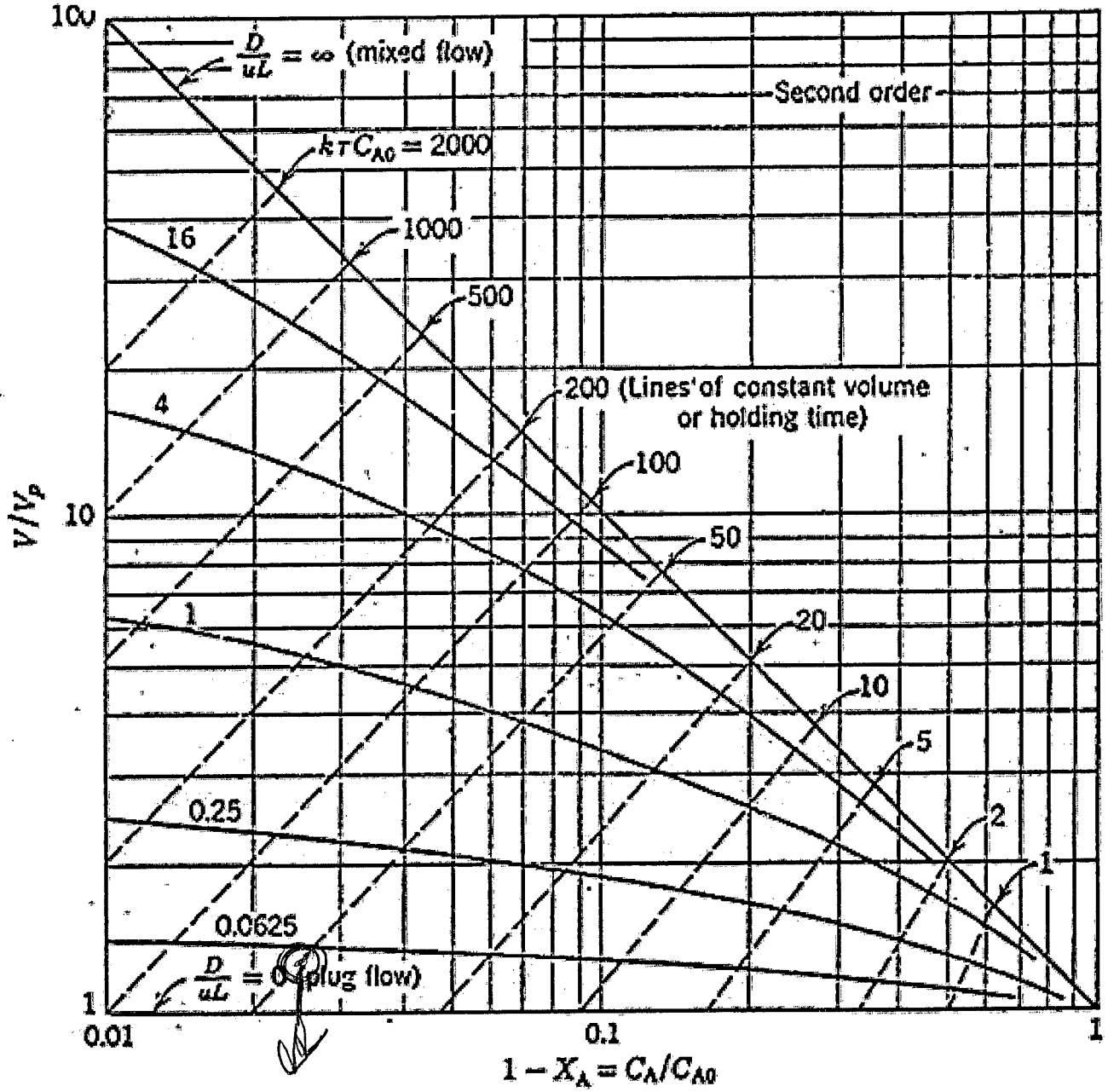
$\frac{Den}{VL} = 0,053$



$X = 0.973$

$kC_{A0}\tau = 50$

$N = 10$



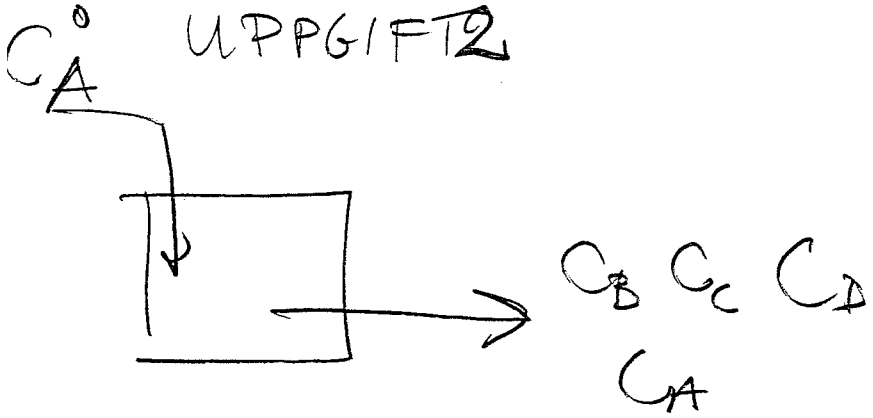
$$KTC_A^0 = 50$$

$$\frac{Da}{VL} = 0,052$$

0,045

$\Rightarrow X = 0,975$

UPPG1FT2



$A \rightarrow B + C \qquad r_1 = k_1 \cdot C_A$

$B \rightarrow D + C \qquad r_2 = k_2 \cdot C_B$

$$q C_A^\circ - q C_A - k_1 C_A V = 0$$

$$C_A = \frac{C_A^\circ}{(1 + k\tau)} = \frac{10}{(1 + 3{,}6 \cdot 10^{-4} \cdot 2000)} = 5{,}81$$

$C_A = 5{,}81 \ \text{kmol/m}^3$

$$q C_B^\circ - q C_B + (k_1 C_A - k_2 C_B) V = 0$$

$$C_B = \frac{k_1 V C_A}{q + k_2 V} = \frac{k_1 \tau C_A}{1 + k_2 \tau} = \frac{3{,}6 \cdot 10^{-4} \cdot 2000 \cdot 5{,}81}{1 + 3{,}4 \cdot 10^{-4} \cdot 2000} =$$

2,49

$$-qC_L + (k_1 C_A + k_2 C_B) V = 0$$

$$C_L = (k_1 C_A + k_2 C_B) \tau = 0$$

$$= (3{,}6 \cdot 10^{-4}\ 5{,}81 + 3{,}4 \cdot 10^{-4} \cdot 2{,}49) \cdot 2000 = 5{,}88 \ \text{mmol/l}^3$$

UPPGIFT 3

$$N = N^0 e^{-k_d t}$$

$$\frac{1}{t} \ln \frac{N}{N^0} = -k_d$$

$k_d(85) = 0{,}345$

$k_d(100) = 0{,}570$

min^{-1}

$$k_d = k_d^\circ e^{-\frac{E_d}{R}\frac{1}{T}}$$

$$\frac{k_d(85)}{k_d(100)} = \frac{0{,}345}{0{,}570} = e^{-\frac{E_d}{R}\left[\frac{1}{(85+273{,}15)} - \frac{1}{(100+273{,}15)}\right]}$$

$\Rightarrow E_d = 37{,}2 \text{ kJ/mol}$ (ev 37,1)

$\Rightarrow k_d^\circ = 88{,}322 \cdot 10^3 \text{ min}^{-1}$

---

b) TDP_{20}

$$1 \cdot 10^6 = e^{k_d 20} \Rightarrow k_d = 0{,}691$$

$$\frac{0{,}691}{0{,}570} = e^{-\frac{37{,}2 \cdot 10^3}{8{,}314}\left(\frac{1}{T} - \frac{1}{373{,}15}\right)}$$

$\Rightarrow T = 379{,}23\text{K} = 106{,}1\ ^\circ\text{C}$

---

k_d		
min^{-1}	h^{-1}	s^{-1}
0,345	20,7	0,00575
0,570	34,2	0,0095

k_d (110)

0,691	41,46	0,0115

c) $\tilde{\tau} = \frac{V_r}{q} = \frac{5}{1} = \underline{\underline{5\,h = 300\,min}}$

$k_d^{110} = 88,3 \cdot 10^3 \, e^{-\frac{37,2 \cdot 10^3}{8,314}\left(\frac{1}{383,15}\right)} = 0,7487 \; min^{-1}$

TANK $N = \frac{N^0}{(1 + k\tilde{\tau})} \Rightarrow$

$\frac{N}{N^0} = \frac{1}{(1 + 0,7487 \cdot 300)} = 0,00443$

$= 0,44\,\%$

FALDON $\frac{N^0}{N} = 225,6$ KUAR.

SAT3 $N = N^0 e^{-k_d \tilde{\tau}} \Rightarrow$

$\frac{N}{N^0} = e^{-0,75 \cdot 300} = 2,84 \cdot 10^{-98}$

UPPGIFT 4

$$\mu = \mu_{max}\frac{S}{S+\beta X} \qquad X = Y_{X/S}(S^0 - S)$$

$$\Big\} \Rightarrow \mu = \mu_m \frac{S}{S + Y_{X/S}(S^0 - S)\beta}$$

$$\frac{1}{\mu} = \frac{1}{\mu_m}\left(1 - \beta Y_{X/S}\right) + \frac{1}{\mu_m} Y_{X/S} S^0 \beta \left(\frac{1}{S}\right)$$

ALT 1

$\frac{1}{D}$	D	S	$\frac{1}{S}$	X	X/S
12,82	0,078	10	0,1	1,3	0,13
14,08	0,071	6	0,167	1,82	0,303
13,5	0,074	8	0,125	1,56	0,195
18,83	0,053	2	0,5	2,34	1,17
13,70	0,073	6	0,167	1,82	0,303
19,61	0,051	2	0,5	2,34	1,17

ALT 2 $\frac{1}{\mu} = \frac{1}{\mu_m}\left(1 + \beta \frac{X}{S}\right.$

ALT 1) LUTNING $\frac{19,3 - 11,0}{0,5} = 16,6 = \frac{Y_{X/S} S^0 \beta}{\mu_m}$ (1)

$\frac{1}{\mu} = \frac{1}{\mu_m}(1 - \beta Y_{X/S})$ DÅ $\frac{1}{S} = 0$ $\frac{1}{\mu} = 11,0$ (2)

(2) $\Rightarrow$ $11\,\mu_m = 1 - \beta Y_{X/S} \Rightarrow \mu_m = \frac{1 - \beta Y_{X/S}}{11}$

$$16,6 = \frac{11 \cdot \gamma_{x/s} 5^\circ \beta}{(1 - \beta \gamma_{x/s})}$$

$$\beta = \frac{16,6}{(11 \gamma_{x/s} 5^\circ + 16,6 \cdot \gamma_{x/s})} = 0,54$$

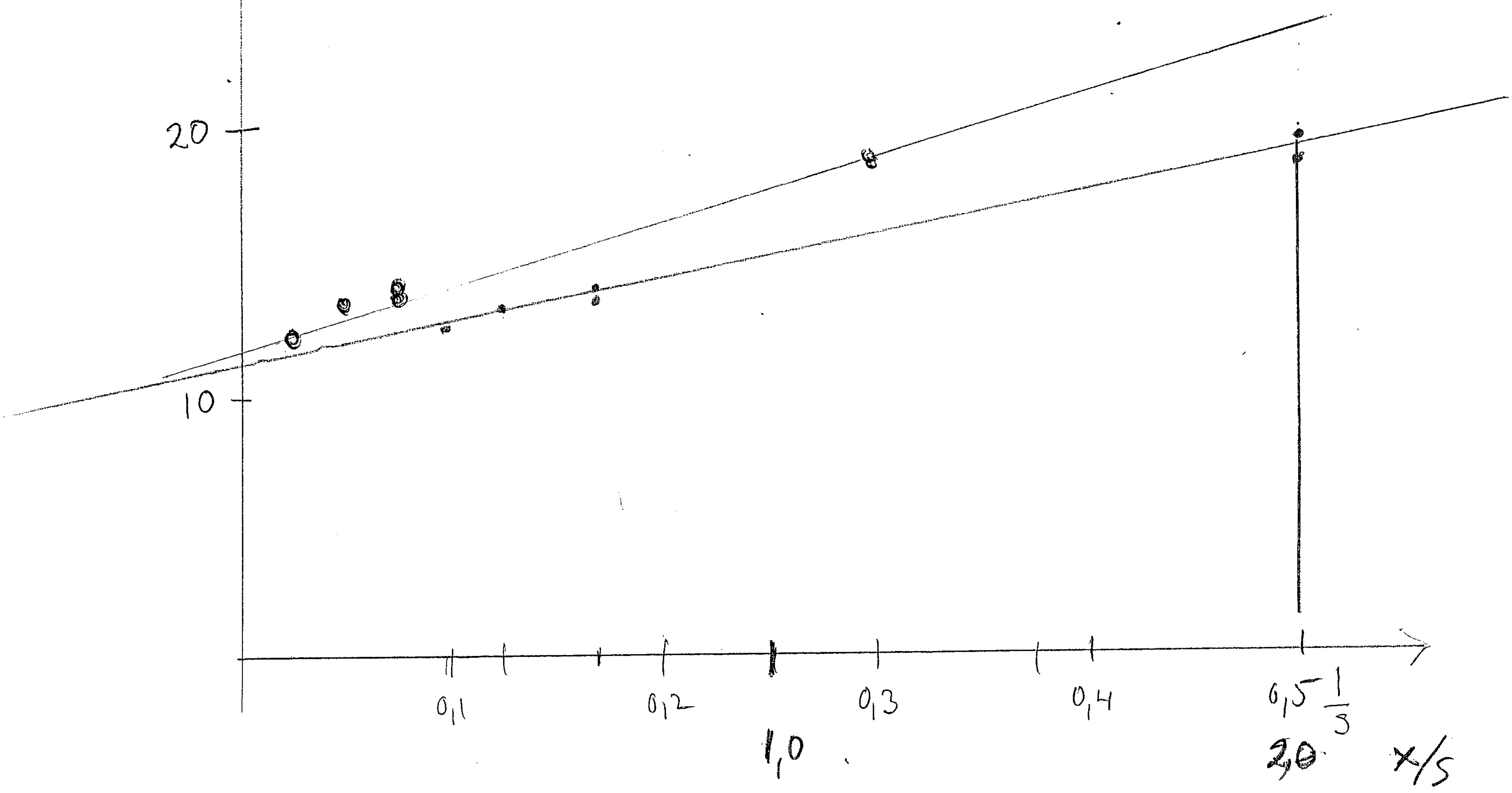
$$\Rightarrow \mu_m = 0,0845$$

ALT 2 LUTNING $\frac{23,8 - 11,6}{2} = 6,1$

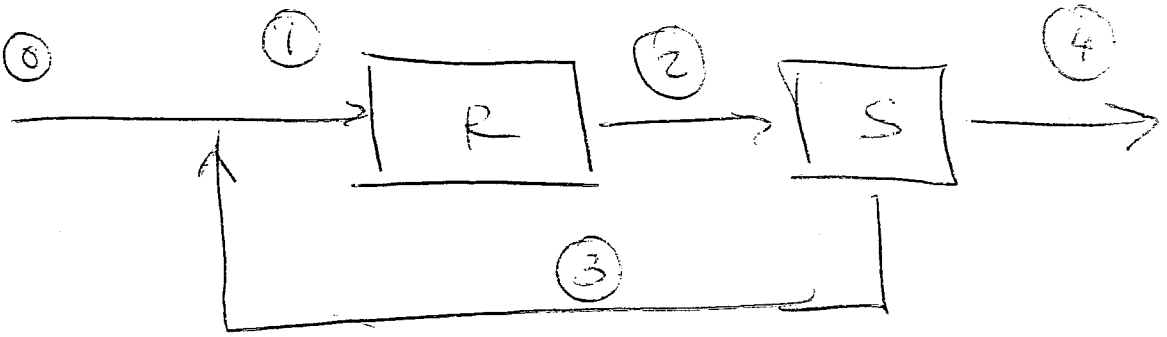
$$\frac{\beta}{\mu_m} = 6,1 \quad \text{MR LUTNING}$$

$$\frac{1}{\mu_m} = 11,6 \Rightarrow \mu_m = 0,086$$

$$\Rightarrow \beta = 0,525$$


20
10
0,1
0,2
1,0
0,3
0,4
0,5
1/3
2,0
x/s

5 11214



$$2HCl + \frac{1}{2}O_2 \longrightarrow H_2O + Cl_2 \quad (1)$$

$$Cl_2 + \underset{(B)}{C_6H_6} \longrightarrow \underset{(BCl)}{C_6H_5Cl} + HCl \quad (2)$$

MICROBILANS SUR TOUT L'ANL.

$$F_B^0 \longrightarrow F_{BCl}^4 \Rightarrow F_{BCl}^4 = 1\ mol/s.$$

90 % AU MOINS HCl $\Rightarrow$ BCl $\Rightarrow$

$$F_{HCl}^0 = \frac{1}{0,9} = 1,11\ mol/s.$$

MICROBILANS SUR REACTEUR

N) $F_{HCl}^1 = F_{HCl}^0 + F_{HCl}^3$

UT) $F_{HCl}^2 = 0,02 \cdot F_{HCl}^1 = F_{HCl}^3$

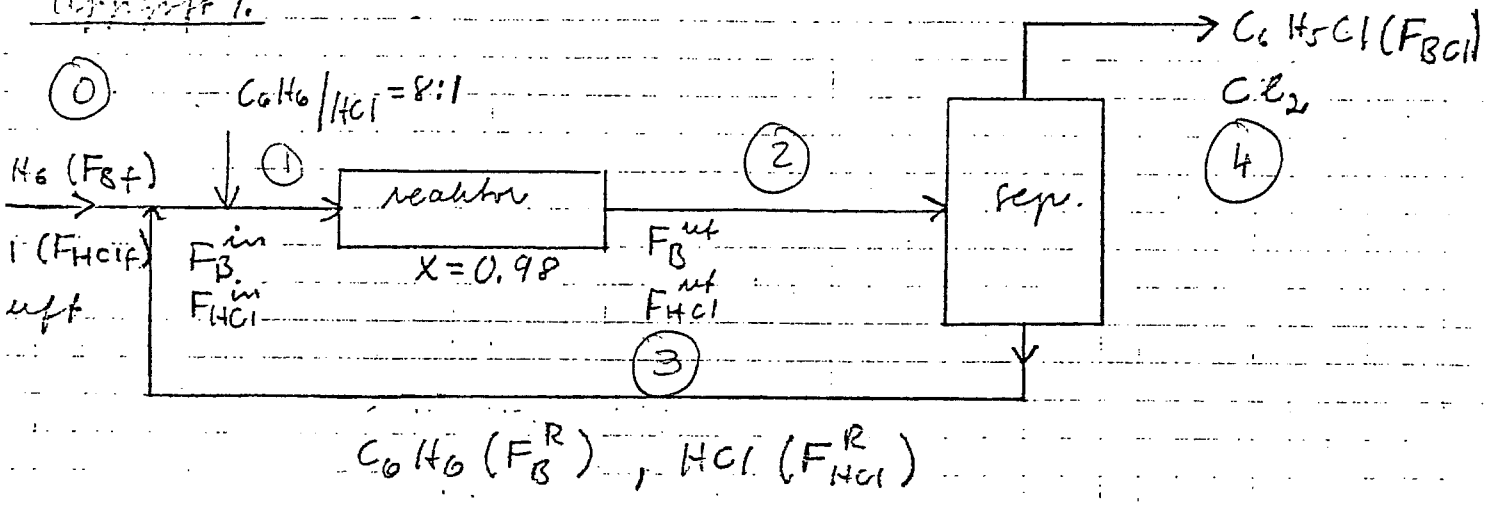
$$F_{HCl}^1 = F_{HCl}^0 + 0,02 \cdot F_{HCl}^1 \Rightarrow F_{HCl}^1 = \frac{1,111}{0,98} = 1,132$$

1 ①

$$\frac{F_B^1}{F_{HCl}^1} = 8 \Rightarrow F_B^1 = 8 \cdot 1{,}1326 = 9{,}06 \text{ mol/s}$$

$$\Rightarrow F_B^1 = F_B^0 + F_B^3 \Rightarrow F_B^3 = 8{,}06 \text{ mol/s}$$

Uppgift 1.



Reaktioner: $2HCl + 1/2 O_2 \rightarrow H_2O + Cl_2$ (1)

$Cl_2 + C_6H_6 \rightarrow C_6H_5Cl + HCl$ (2)

B BCl

Materialbalanser över hela anläggningen:

B: $F_{B0}^{0} - 0 + \nu_{2B} R_2 = 0$ R_2 = molar omsättning vid reaktion 2,

BCl: $0 - F_{BCl}^{4} + \nu_{2BCl} R_2 = 0$

$F_{BCl}^{4} = R_2 = F_{B0}^{0} = 1$ mol/s

90% av förbrukad HCl ger BCl

$0,9 \cdot F_{HCl0}^{0} = 1$

$F_{HCl0}^{0} = 1.11$ mol/s

HCl i reaktorinflödet: $F_{HCl}^{in(1)} = F_{HCl0}^{0} + F_{HCl}^{R(3)} = F_{HCl0}^{0} + F_{HCl}^{ut(2)}$

HCl i reaktorutflödet: $F_{HCl}^{ut(2)} = F_{HCl}^{in(1)} (1 - 0.98)$

$F_{HCl}^{ut(1)} = F_{HCl0}^{0} + F_{HCl}^{in(1)} (1 - 0.98)$

$F_{HCl}^{in(1)} = \frac{F_{HCl0}^{0}}{0.98} = 1,0826$ mol/s $= 1,1326$ mol/s

9,06

B i reaktorinflödet: $F_B^{in} = 8 \cdot F_{HCl}^{in} = \frac{8 F_{HCl0}}{0.98} = \frac{8 \cdot 1}{0.98 \cdot 0.9} = 9.07 \frac{mol}{s}$

Recirkulerad B: $F_B^R = F_B^{in} - F_{B1} = 9.07 - 1 = 8.07$ mol/s

14/12-2014

10p

UPPGIFT 6

$X = CH_{1,8}O_{0,48}N_{0,25}$ $\quad M_X = 24,98$

$S = CH_2O_{4/3}$ $\quad M_S = 35,33$

FÖRBRUKAD MÄNGD S = D 135 cmol

$S_V^N = 135$ mc-mol/l.

$S^{UT} = 0,75$ mc-mol/l $\Big\} \Delta S = 134,25$ mc-mol/l.

FÖRBRUKAD $NH_3 = 0,31$ g/l $= 0,018$ $\frac{mol}{l}$.

$\Rightarrow$ VIA N-BALANS $\quad Y_{NH_3/S} = 0,134$

PROD X $= \frac{0,018}{0,25} = 0,073$ $\frac{cmol}{l}$.

$\Rightarrow Y_{X/S} = \frac{0,073}{0,134,25} = 0,5433$

KONSUMPTION GLYCERAT $134,25 \cdot 0,16 =$

21,48 mcmol/lh. $= 7,16$ $\frac{mmol}{lh}$ $C_3H_6O_$

RQ CO_2 BILDAT UR KOLBALANS

$$0 = 1 - 0{,}5433 - Y_{CO_2/S} \Rightarrow Y_{CO_2/S} = 0{,}457$$

O_2 UR γ BALANS

$$Y_{O_2/S} = \frac{1}{4}\left[\gamma_S Y_{S/S} + \gamma_X Y_{X/S}\right] = \frac{1}{4}\left[3{,}33 - 4{,}09 \cdot 0{,}543\right.$$

$$\left(\begin{array}{l} \gamma_S = 4 + 2 - 2 \cdot 4/3 = 3{,}33 \\ \gamma_X = 4 + 1{,}8 - 0{,}48 \cdot 2 - 3\,0{,}25 = 4{,}09 \end{array}\right) \Longrightarrow$$

$$Y_{O_2/S} = 0{,}27$$

$$RQ = \frac{0{,}457}{0{,}27} = 1{,}69$$

$$1 \cdot S + \underset{0{,}136}{0{,}5433 \cdot 0{,}25\ NH_3} + 0{,}27\ O_2 \longrightarrow$$

$$0{,}543\ X + 0{,}457\ CO_2 + \cancel{O}\ H_2O$$

SVÅR

$$\simeq 0{,}71$$