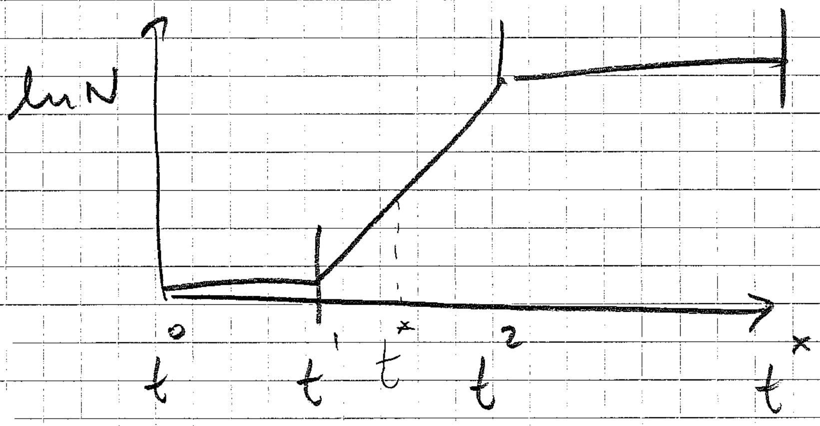
130823

UPPG 1



$$N^0 = \frac{8,75 \cdot 10^{7} \cdot 4}{(4+8)} = 2,92 \cdot 10^7$$

$N^* = 7,3 \cdot 10^7$

$t^* = 4h$

$N = N^0 e^{\mu t}$

t	N
4	$7,3 \cdot 10^7$
7	$1,9 \cdot 10^8$
t^{final}	$7,5 \cdot 10^8$

TILLVÄXTFAS (4–7h)

$\Rightarrow \frac{N^7}{N^4} = e^{\mu(7-4)} \Rightarrow \mu = 0,32 \ h^{-1}$ $G = \frac{\ln 2}{\mu}$

$G = 2,17 \ h$

NÄR HAR VI $2,92 \cdot 10^7$

$\Delta t = 2,88$

$t^* \Rightarrow N^* = 2,92 \cdot 10^7$

$$\frac{7,3 \cdot 10^7}{2,92 \cdot 10^7} = e^{0,32(4-t^*)} \Rightarrow t^* = 1,12 \ h$$

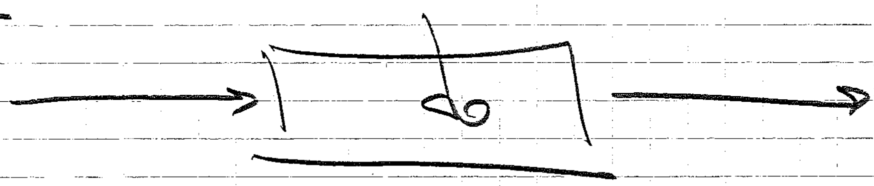
NÄR NÅR VI $7,5 \cdot 10^8$

$$\frac{N^{t^*}}{N^4} = \frac{7,5 \cdot 10^8}{7,3 \cdot 10^7} = e^{\mu(t^* - 4)} \Rightarrow t^* = 11,31$$

TID LOGFAS = <u>10,18 h</u>

UPPG 2

KEMOSTAT



$S^{IN} = 7,3 \; g/l$

$q_x = 0,17 \cdot \frac{S}{(0,3+S)} \cdot X$

$Y_{x/s} = 0,28 \; g/g$

$\left(\frac{g}{lh}\right)$

RESPIRAT UT

$X = CH_{1,8}O_{0,5}N_{0,2}$

$N = NH_3$

$D = 0,1$

BERÄKNA DX, DCO_2

MB

$q X^0 - q X + \mu X V = 0$ (1)

$q S^0 - q S - \mu X V Y_{s/x} = 0$ (2)

(1) ⇒ $(X^0 = 0)$ = $\mu = D = 0,1$ ⇒

$S = 0,43 \; g/l$

$X = Y_{x/s} \cdot (7,3 - 0,43) = 1,92 \; g/l$

$DX = 0,192 \; g/lh$

DCO_2 ?

VI VET KOLBALANS

$$CH_2O \rightarrow Y_{X/S} X + Y_{CO_2/S} CO_2$$

FÖRBRUKAD MÄNGD $\underset{(1/h)}{S} = (7{,}32 - 0{,}43) / M_S = 0{,}23$ mol

PSS

BILDAD MÄNGD $X = 0{,}078$ mol

$\Rightarrow$ MOL CO_2 PROD $= 0{,}152$ mol $=$ 6,69 g/l

$= 0{,}669$ g/lh

B MAX $\Rightarrow$ $0{,}17 \cdot \dfrac{7{,}3}{(7{,}3 + 0{,}3)} = \underline{\underline{0{,}163}} \leftarrow D_{max}$

C

MAXIMERA DX = SAMMA SOM MAXIMERA $D(S^0 - S)$

MIN $DS = 0{,}17 \cdot \dfrac{S}{(K_S + S)} \cdot X \cdot S = \dfrac{0{,}17\, S^2 \left(Y_{X/S}(S^0 - S)\right)}{K_S + S}$

$\dfrac{d(DS)}{dS} \Rightarrow \quad S_{1,2} = K_S\left(-1 \pm \sqrt{\dfrac{K_S + S^0}{K_S}}\right) = 1{,}21$

(−) giçh

$S = 1{,}21 \Rightarrow X = 2{,}705$ $\quad D = 0{,}136$

$\Rightarrow Dx = 0{,}232 \; g/eh.$

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UPPG 3

$A + R \rightarrow 3R$ TUB

$V_r = F_A \int_0^{0,95} \frac{dx}{r}$ $r = f(X_A)$

$C_A = F_A / F_{TOT} \cdot \frac{P}{RT}$

$\frac{P}{RT}^{\circ} = C_{TOT}^{\circ} = 4 \text{ kmol/m}^3$ $F_{TOT}^{\circ} = 1 \text{ kmol/s}$

$\Rightarrow q = 0,25 \text{ m}^3/\text{s} \Rightarrow F_A^{\circ} = 0,5 \text{ kmol/s}$

$F_A = F_A^{\circ}(1 - X_A)$

$F_R = F_R^{\circ}(1 + 2X_A)$ $\Big\}$ $F_{TOT} = F_A^{\circ}(2 + x)$

$F_A^{\circ} = F_R^{\circ}$

$\Rightarrow C_A = \frac{(1-x)}{(2+x)} \cdot P/RT$

$V_r = \frac{F_A^{\circ}}{k(P/RT)^2} \underbrace{\int_0^{0,95} \frac{(2+x)}{(1-x)} dx}_{I}$

$I = \int_0^{0,95} \frac{-(1-x)+3}{(1-x)} dx = \int_0^{0,95} \left(-1 + \frac{3}{1-x}\right) dx = [-x - 3\ln(1-$

$\left[-x - 3\ln(1-x)\right]_0^{0,95} = 8,04$

$$V_r = \frac{0{,}5 \cdot 10^{3} \cdot 8{,}04}{8 \cdot 10^{-5} \cdot 1{,}6 \cdot 10^{7}} = 3{,}14 \, m^3$$

$(C_{TOT})^2$

RIMLIGT ?

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t	N	T
12	$1,3\cdot10^{11}$	120
25	$1,6\cdot10^{8}$	120

a) DRT $\qquad N = N^0 e^{-k_d t}$

$k_d(120) = ?$ $\qquad \ln\left(\frac{1,6\cdot10^{8}}{1,3\cdot10^{11}}\right)\frac{-1}{(\Delta t)} = k_d$

$\Rightarrow k_d = 0,51 \text{ min}^{-1}$

DRT = DECIMAL REDUCTION TIME (120)

$N = \frac{N_0}{10} \Rightarrow 0,1 = e^{-0,51\cdot(DRT)} \Rightarrow$

DRT = 4,515 min

b) $E_d = 37\cdot10^3$ J/mol

$k_d = k_d^0 e^{-E/RT}$

sök $k_d(140)$ $\qquad \frac{k_d(140)}{k_d(120)} = e^{-\frac{37\cdot10^3}{8,314}\left[\frac{1}{(140+273,15)} - \frac{1}{(120+273,15)}\right]}$

$\Rightarrow$ HL = 1,73 $\Rightarrow k_d(140) = 0,882$

$0,1 = e^{-0,882\cdot(DRT)^{140}} \Rightarrow DRT^{140} = 2,61$ min

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NR 6

S	μ	1/S	$1/\mu$	X	X/S
0,8	0,13	1,25	7,7	0,144	0,18
0,5	0,12	2	8,33	0,18	0,36
0,3	0,11	3,33	9,09	0,204	0,68
0,2	0,09	5	11,11	0,216	1,08

$$\frac{1}{\mu} = \frac{1}{\mu_{max}}\left(\frac{K_x X + S}{S}\right) = \frac{1}{\mu_{ma}}\left(k_x \frac{X}{S} + 1\right)$$

ALT1) PLOTTA X/S MOT $\frac{1}{\mu}$?

LUTNING = $\frac{K_x}{\mu_{max}}$ BRYTNING MED YAXEL $\frac{1}{\mu_{max}}$

ALT2 $X = Y_{X/S}(S^0 - S)$ SÄTT IN I MODELL

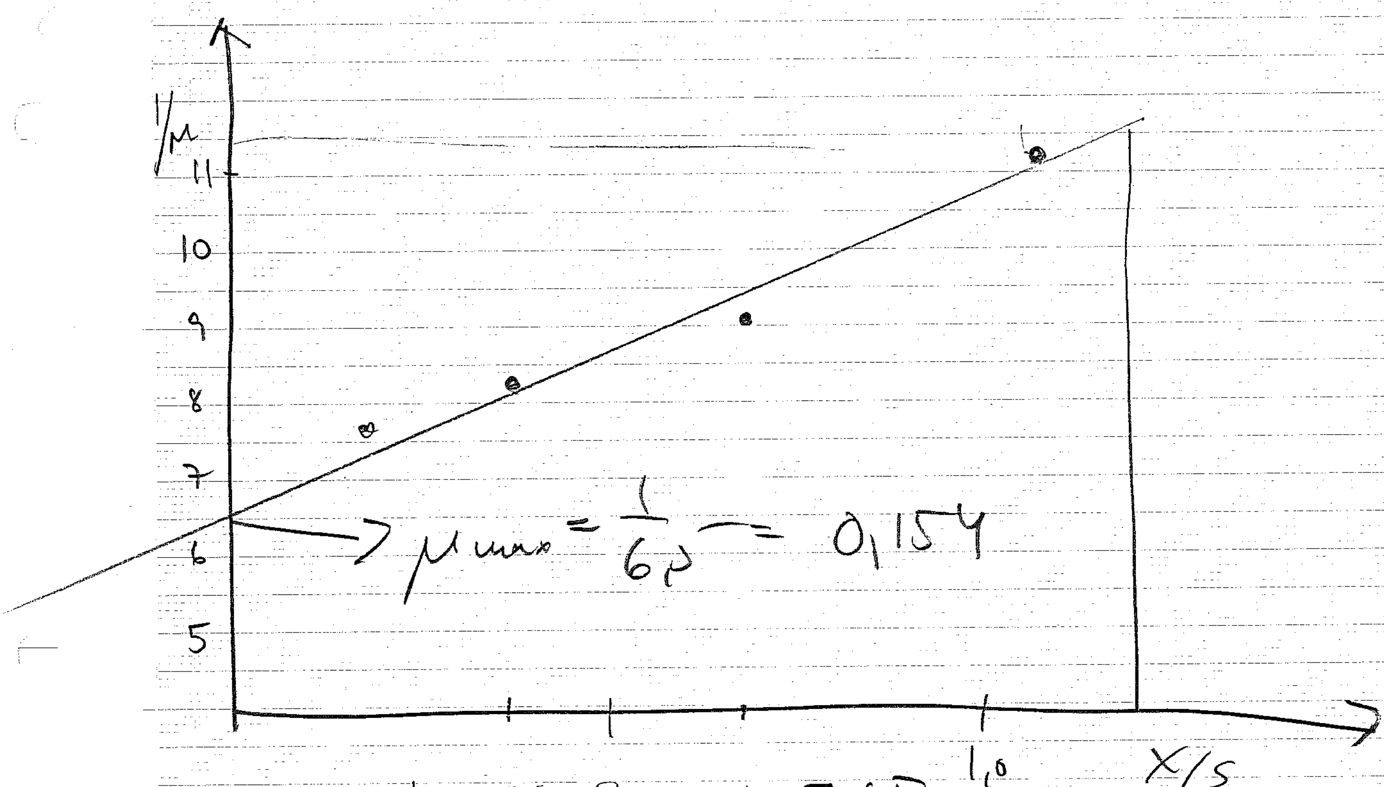
$$\mu_{max}\frac{S}{K_x X + S} = \mu_{max}\frac{S}{K_x Y_{X/S}(S^0 - S) + S} = \mu_{max}\frac{S}{S(1 - Y_{X/S} k_x) + k_x Y_{X/S} S^0}$$

$$\frac{1}{\mu} = \frac{1}{\mu_{max}}\left[(1 - Y_{X/S} \cdot k_x) + k_x Y_{X/S} S^0 \cdot \frac{1}{S}\right]$$

PLOTTA $\frac{1}{\mu}$ MOT $\frac{1}{S}$ $\Rightarrow$ $\frac{1}{\mu} = 6,5$ DÅ $1/S = 0$ $\Rightarrow$

$\mu_{max} =$

ALT I



$\Rightarrow \mu_{max} = \frac{1}{6,5} = 0,154$

$$\text{LUTNING} = \frac{11,5 - 6,5}{1,2} = 4,17 \Rightarrow$$

$K_X = 0,64$

ALT 2

1) $\frac{(1 - 0,12\, k_x)}{\mu_{max}} = 6,5$

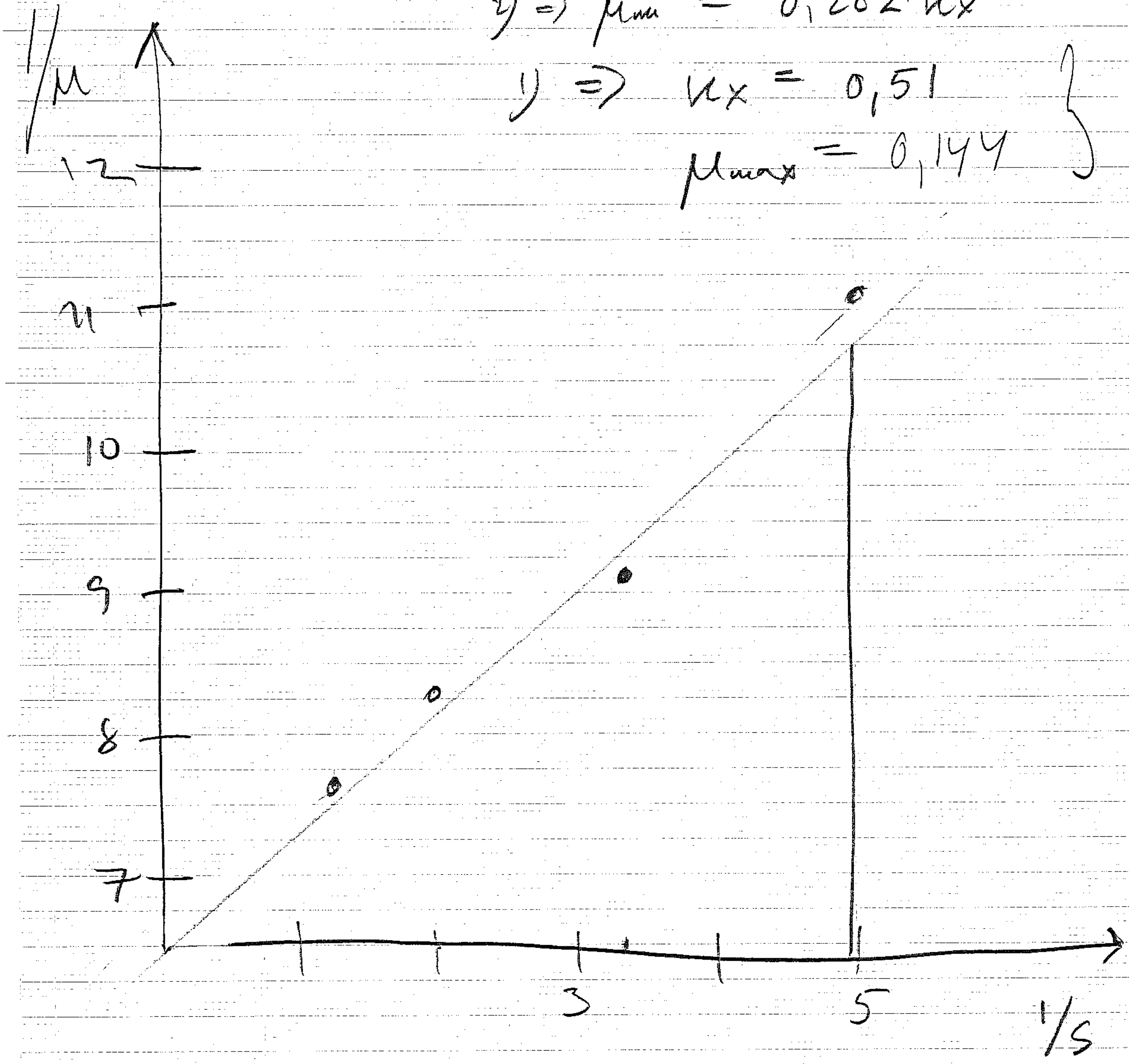
2) $\frac{k_x \cdot 0,12 \cdot 2,0}{\mu_{max}} = 0,85$

$\Rightarrow$

2) $\Rightarrow \mu_{max} = 0,282 \cdot k_x$

1) $\Rightarrow k_x = 0,51$

$\mu_{max} = 0,144$



$\text{LUTNING} = \frac{10,75 - 6,5}{5} = 0,85$

BRYT Y AXEL $\Rightarrow \left(\frac{1}{S}\right) = 0 \Rightarrow \frac{1}{\mu} = 6,5$