

2/8-2012

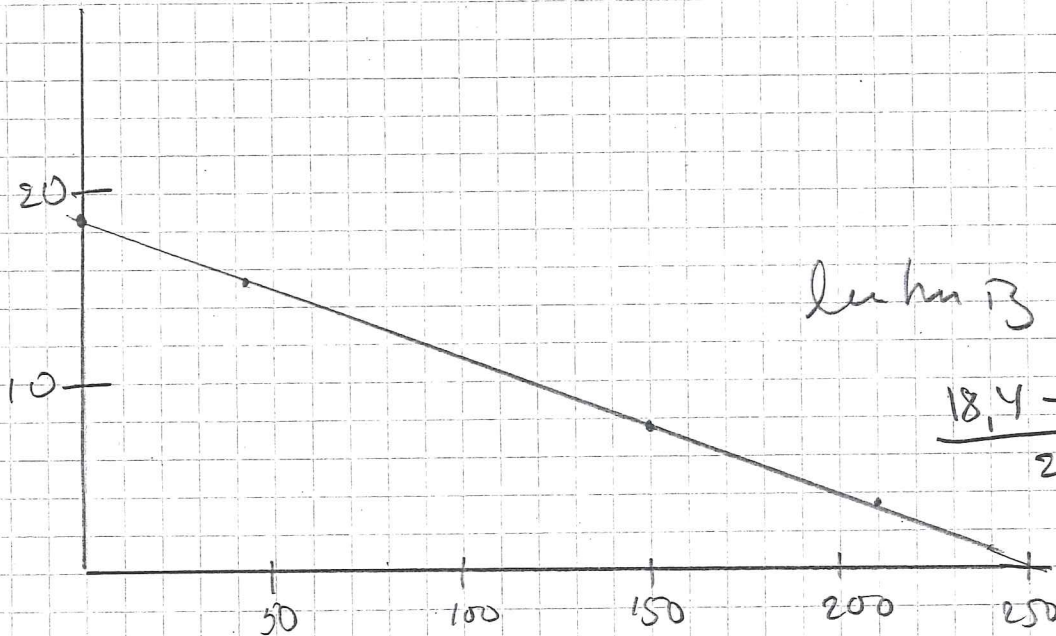
Bioréacteur

z)

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

t	N	ln N
0	$1,0 \cdot 10^8$	18,42
42	$4,7 \cdot 10^6$	15,36
150	$2,2 \cdot 10^3$	7,7
210	$3,1 \cdot 10^1$	3,43



$$\text{Pente } \ln N = -k_d$$

$$\frac{18,4 - 0}{250} = 0,0736 \text{ s}^{-1}$$

a) DRT

$$\frac{N}{N^0} = 0,1 = e^{-k_d t} \Rightarrow \text{DRT} = 31,29 \text{ s}$$

B)

$$E = 297 \text{ kJ/mol}$$

$$k_d(105) = 0,073 = k_d^0 e^{-\frac{297 \cdot 10^3}{8314 \cdot (273,15 + 105)}} \Rightarrow k_d^0 =$$

$$k_d^0 = 7,83 \cdot 10^{39} \text{ s}^{-1}$$

$$\frac{N^-}{N^0} = e^{-kt} = 1 \cdot 10^{-6}$$

$$k_d = 0,0230 \text{ s}^{-1} \Rightarrow$$

$$0,023 = 7,83 \cdot 10^{39} e^{\frac{-29710^3}{8314 \cdot T^*}}$$

$$-95,63 = -29710^3 / RT$$

$$T^* = 373,15$$

$$TDP = 900,4 \text{ } ^\circ\text{C}$$

$$k_d^{(120)} = 7,83 \cdot 10^{39} e^{\frac{-29710^3}{8314 \cdot 393,15}} = 2,706 \text{ s}^{-1}$$

$$\frac{N^-}{N^0} = \frac{1}{(1+kt)} \approx \frac{1}{kt} = 1 \cdot 10^{-6} \Rightarrow$$

$$kt \approx 1 \cdot 10^6 \Rightarrow \tilde{t} = 369549 \text{ s}$$

$$6159 \text{ min}$$

GANBU $\frac{m^4}{m^4 E^4}$

$$\boxed{102,6 \text{ m}}$$

$$\neq \text{LÖDET} = 10 \text{ l/m} \Rightarrow$$

$$\tilde{t} = \frac{V}{Q} \Rightarrow V = 10 \text{ l/m} \cdot 102,6 = 1026 \text{ l} = 1,03 \text{ m}^3$$

3)

HA → B

$$r = k \cdot C_A^2$$

$$\int_0^{0.95} \frac{v}{F_A^0} = \int_0^{0.95} \frac{dx}{r}$$

$$C_A = \frac{F_A}{F_{TOT}} \cdot C_{TOT}$$

$$\frac{v}{F_A^0} =$$

$$C_{TOT} = \frac{p}{RT}$$

$$\frac{20 \cdot 10^5}{8.314 \cdot (553 + 273)}$$

$$= 290,476 \text{ mol} \\ = 0,29 \text{ kmol/l}$$

$$\frac{F_A^0}{Q} = \frac{p}{RT}$$

$$F_A = F_A^0 (1-x)$$

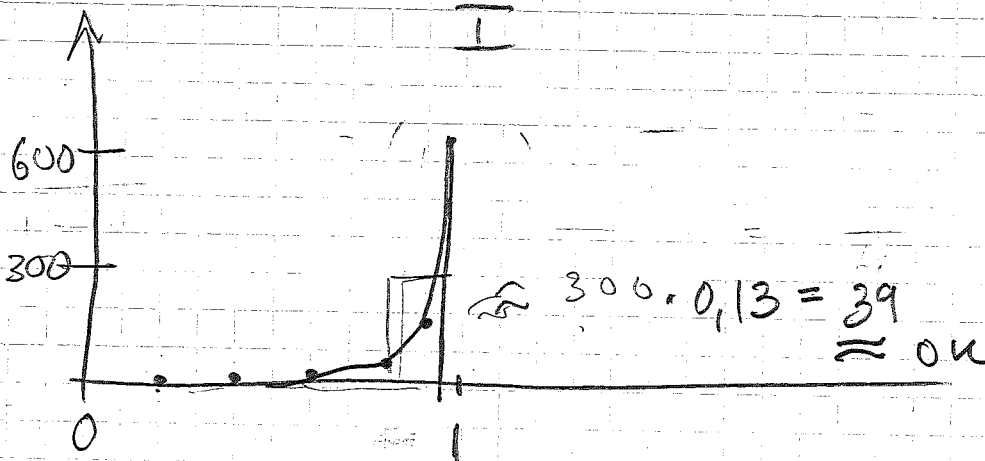
$$F_I = F_A^0$$

$$F_B = F_A^0 \cdot x \cdot \frac{1}{4}$$

$$F_{TOT} = F_A^0 (2-x)$$

$$\int_0^{0.95} \frac{dx}{r} = \frac{(RT)^2}{k(F_A^0)^2} \int_0^{0.95} \frac{\left(2 - \frac{3}{4}x\right)^2}{(1-x)^2} dx$$

☞ LÖSES ENKURASTNUMER



x	I
0	4
0.1	4.57
0.2	5.35
0.3	
0.4	8.03
0.5	
0.6	15.02
0.7	

NUMERISCH 0-0.8 ⇒ 0.2 [4/2 + 5.35 + 8.03 + 15.02] + 49/2 = 10.97

0.8-0.95 ⇒ 0.05 [49/2 + 82.5 + 75.6 + 66.3/2] = 30.705

I = 41.67 OK

ANALYTISCH

Matte
ger

$$\frac{\left(2 - \frac{3}{4}x\right)^2}{(1-x)^2} = \frac{A}{1-x} + \frac{B}{(1-x)} + \frac{C}{(1-x)^2}$$

$$A \cdot (1-x)^2 + B(1-x) + C = \left(2 - \frac{3}{4}x\right)^2$$

$$A(1+x^2-2x) + B - Bx + C = 4 + \frac{9}{16}x^2 - 3x$$

$$Ax^2 = \frac{9}{16}x^2 \Rightarrow A = \frac{9}{16}$$

$$(-2A + B)x = -3(x) \Rightarrow B = 3 - 2A = \frac{48-9}{16}$$

$$B = \frac{30}{16} = \frac{15}{8}$$

$$A + B + C = 4 \Rightarrow$$

$$C = 4 - \frac{9}{16} - \frac{30}{16} = \frac{64 - 9 - 30}{16} = \frac{25}{16}$$

$$I_1 = A \cdot 0,95 =$$

$$I_2 = -B \ln(1-x) = B \ln(1-0,95)$$

$$I_3 = +C(1-x)^{-1} = c \left[\frac{1}{0,05} - 1 \right] = 20 \cdot C$$

$$I_1 = 0,534$$

$$I_2 = +5,617$$

$$I_3 = 31,25$$

$$I = \underline{36,86}$$

$$F_A^0 = 20 \cdot \frac{P}{RT} = 20 \cdot 0,29 = 5,8 \text{ kmol/h}$$

$$V = \frac{F_A^0}{k(C^*)^2} \cdot I = \frac{5,8 \cdot 36,86}{6,1 \cdot (0,29)^2} = 416,73 \text{ m}^3$$

Görstör



4)

		0,5 h
	0h	5h
S	5	12,5
X	1,5	1,5
P	2,0	2,6
V	0,5	5,5

} ⇒ $Q = \frac{5}{5} = 1 \text{ l/h}$

REAGENT SUBSTRAT = $S^0 V^0 + Q \cdot \Delta t \cdot 22 - S^5 V^5$
 $= 5 \cdot 0,5 + 1 \cdot 5 \cdot 22 - 12,5 \cdot 5,5 = 4375$

BLINDAD X = $X^5 V^5 - X^0 V^0 = 1,5 \cdot 5,5 - 1,5 \cdot 0,5 = 7,5$
 P = $P^5 V^5 - P^0 V^0 = 2,6 \cdot 5,5 - 2,0 \cdot 0,5 = 13,3$

0 → 5h

⇒ $\forall x/s = 0,17$

$\forall p/s = 0,304$

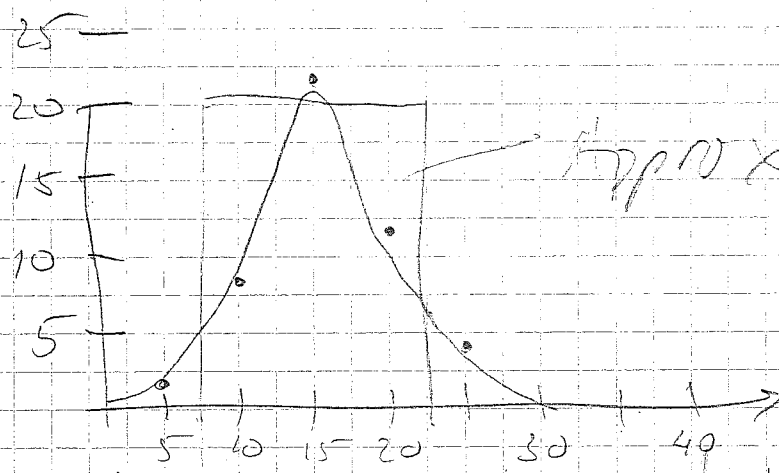
B) PROD BLOMASERA

	3	5
X	0,8	1,5
V	3,5	5,5

⇒ $X_p^{3-5} = 5,45 \text{ g}$

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5)



t	t^2	$E(t)$	t	$E(t)$	$t^2 E(t)$
0	0	0			
5	2	$8.33 \cdot 10^{-3}$		1	
10	8	$3.33 \cdot 10^{-2}$			
15	22	$9.2 \cdot 10^{-2}$		1	
20	40	$5.0 \cdot 10^{-2}$			
25	62	$1.67 \cdot 10^{-2}$		1	
30	90	0			
		$\sum 48.5$			
		240			

$$N = \frac{\langle t \rangle}{\delta^2}$$

$$\langle t \rangle = \int_0^{\infty} t E(t) dt$$

$$\delta^2 = \int_0^{\infty} t^2 E(t) dt - \langle t \rangle^2$$

$$N = 11.28$$

$$x = 1 - e^{-k \langle t \rangle} = 0.996$$

t	cr	E(t)	t*E(t)	t ² *E(t)
0	0	0	0	0
5	2	0,0083333	0,0416667	0,2083333
10	8	0,0333333	0,3333333	3,3333333
15	22	0,0916667	1,375	20,625
20	12	0,05	1	20
25	4	0,0166667	0,4166667	10,416667
30	0	0	0	0
	48	0,2	3,1666667	54,583333
	240		15,833333	272,91667

sigma = 22,222222

N= 11,28125

X tub = 0,99608

$$b) \quad q_x = \frac{0,2 \cdot s}{(0,15 + s)} \cdot x$$

$$s^0 = 2,3 \text{ g/l}$$

$$Y_{H_2S} = 0,22 \text{ g/g}$$

BADA S INFLÜßE.

$$-s \cdot x + \mu \cdot x \cdot V = 0 \quad \Rightarrow \quad \mu = D$$

$$D = 0,12 = \frac{0,2 \cdot s}{(0,15 + s)} \Rightarrow$$

$$s = \frac{0,15 \cdot 0,12}{(0,2 - 0,12)} = \underline{\underline{0,225}}$$

$$x = Y_{H_2S} (s^0 - s) = 0,22 \cdot (2,3 - 0,225) \\ = 0,4565$$

$$1 \text{ mol} \quad M_x = 12 + 1,8 + 0,5 \cdot 16 + 0,2 \cdot 14 = 24,6$$

$$M_s = 30$$

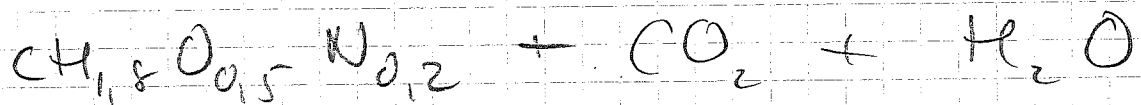
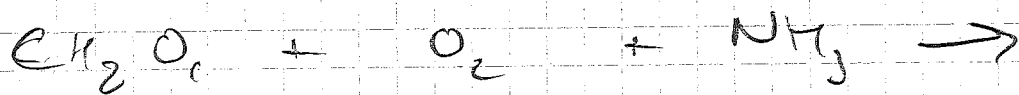
$$M_{NaCO_2} = 44$$

$$x_{mol} = 0,01856 \quad (s^0 - s) = 0,0692 \text{ mol} \Rightarrow CO_2$$

$$44 = 0,13 + 0,7$$

real bildad $(O_2 = \text{?})$

$$Y_{X_{\text{gas}}} = \frac{0,01856}{0,0692} = 0,2682 \Rightarrow Y_{CO_2} = 0,7318$$



$$Y_{NH_3/s} = 0,2 \cdot Y_{X/s} = 0,05364 \frac{\text{mol}}{\text{mol}} = 0,0304 \frac{g}{g}$$

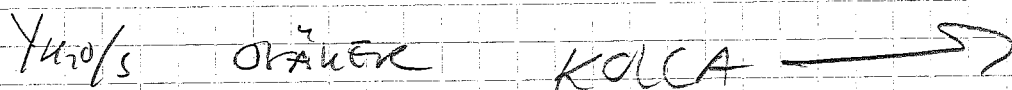
$$r_x = 4 + 1,8 - 0,5 \cdot 2 - 3 - 0,2 = 4,2$$

$$r_B = 4 + 2 - 2 = 4$$

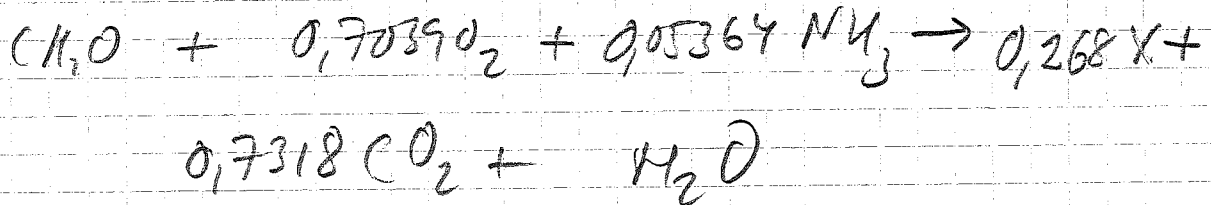
$$r_{O_2} = -4$$

$$r_x \Phi_x = r_s \Phi_s + r_{O_2} \Phi_{O_2}$$

$$Y_{O_2/s} = -\frac{1}{4} (4,2 \cdot 0,282 - 4 \cdot 1) = 0,7039$$



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Washout:

$$D_w = 0,2 \cdot \frac{2}{(0,15 + 1)}$$

washout $2a^0 s = s^0 = 2,3 \Rightarrow$

$$D_w = 0,2 \cdot \frac{2,3}{2,45} = \underline{\underline{0,18776}}$$

→ H₂O balans

$$H \quad 2 + 0,0536 \cdot 3 = 0,268 \cdot 1,8 + x H_2O$$

$$x = \frac{1,6784}{2} = 0,839$$

$$O \quad 1 + 0,7 \cdot 3 = 0,268 \cdot 0,5 + 0,7318 \cdot 2 + x H_2O$$

$$x = 0,8024$$

NAŠTAN LIKA

$$Dx = 0,12 - 0,4565 = 0,05478 \text{ g/dl}$$

$$D(O_2) = 0,12 \cdot 0,1304 \cdot (2,3 - 0,1225) = 0,0076 \text{ g/dl}$$