Aalto University
Chemical Engineering

FILTRATION

___ / ___ 200__
Work done

____
Made by

____
Student number

MARKINGS:

Given in: ___ / ___ 200__ ____

Examined: ___ / ___ 200__ ____ **RET / PASS**

___ / ___ 200__ ____ **RET / PASS**

___ / ___ 200__ ____ **RET / PASS**

___ / ___ 200__ ____ **RET / PASS**

Passed: ___ / ___ 200__ ____

1. GENERAL

In this work constant-pressure filtration is studied. Filter cake and filter media resistance is calculated. Pressure effect is also studied by calculating specific cake resistance and compressibility of cake.

2. MEASURING DATA

Filter media resistance and filtration measurements are represented in appendix 1. Total area of filter cake is:

$A =$

3. CONCENTRATION OF SOLID IN FEED

Measurements to determine concentration of solid in feed are represented in Appendix 2. The concentration of solid in feed can be calculated following (sample 1 as an example):

$w_1 =$

The concentration of solid in feed is:

4. RESISTANCES

The basic equation of filtration is:

$$\Delta p = \left(\frac{\alpha c V}{A} + R_{SV} \right) \frac{dV/dt}{A} \eta \tag{1}$$

Eq. (1) can be written:

$$\frac{dt}{dV} = \frac{\alpha c \eta}{\Delta p A^2} V + \frac{\eta R_{SV}}{\Delta p A} = KV + B \tag{2}$$

Integration of Eq. (2) gives:

$$\frac{t}{V} = \frac{K}{2} V + B \tag{3}$$

Which is a basic equation of constant-pressure filtration, where:

$$K = \frac{\alpha c \eta}{\Delta p A^2} \qquad B = \frac{\eta R_{SV}}{\Delta p A} \tag{4}$$

and where assumptions are:

- constant concentration of solid in feed
- constant density
- K and B constants

Thus a plot t/V versus V will be linear, with a slope equal to $K/2$, where cake resistance (α) can be calculated, and an intercept of B from which filter medium resistance (R_{SV}) can be determined.

Plots $t/V = f(V)$ to every filtration experiment are shown in Appendix _____.

Filtration #	Δp mH_2O	$K/2$	B
1			
2			
3			
4			

From such plots the values of α and R_{SV} can be calculated using equations:

$\alpha =$

$R_{SV} =$

Values (filtration 1):

$\alpha_1 =$

$R_{SV,1} =$

Cake resistance and filter medium resistance are

Filtration#	Δp mH_2O	α	R_{SV}
1			
2			
3			
4			

5. FILTER MEDIUM RESISTANCE MEASUREMENTS

When the feed is not containing solids, filter cake is not formed. From Eq. (1):

$$\Delta p = R_{SV} \frac{dV/dt}{A} \eta \tag{5}$$

Eq. (5) can be written:

$$\frac{dt}{dV} = \frac{\eta R_{SV}}{\Delta p A} = B \tag{6}$$

Integration of Eq. (6) gives:

$$\frac{t}{V} = B \tag{7}$$

and where assumptions are:

- constant concentration of solid in feed
- constant density
- *K* and *B* constants

Thus a plot t/V versus V will be linear. A plot $t/V = f(V)$ for determine filter medium resistance is shown in Appendix ___. From the plot value of B = _____ can be determined.

Filter media resistance R_{SV} is:

6. PRESSURE EFFECT

Specific cake resistance dependence on pressure can be defined as follows:

$$\alpha = \alpha_0 (\Delta p)^S \tag{8}$$

where parameter α_0 is constant specific cake resistance and S is compressibility of cake. Eq. (8) can be written:

$$\log(\alpha) = \log(\alpha_0) + S \log(\Delta p) \tag{9}$$

If constant specific cake resistance follows Eq. (8), a plot of Eq. (9) is linear from which specific cake resistance and compressibility of cake can be determined. A plot of Eq. (9) is shown in Appendix ___.

From the plot

$\log(\alpha_0)$ =

α_0 =

S =

7. INCORRECT ESTIMATE AND CONCLUSIONS

8. APPENCIES

Measurements:

	Filter media resistance	**Filtration 1**	**Filtration2**	**Filtration3**	**Filtration4**
pressure difference Δp mH_2O					
filtrate T °C					
t min	**V l**	**V l**	**V l**	**V l**	**V l**

Calculating mass fractions

Mass fraction of dried matter in feed.

sample #	m1 g	m2 g	m3 g	$m_3 - m_1$ g	$m_2 - m_3$ g	w
1						
2						
3						
					average	

m_1 = evaporating dish
m_2 = evaporating dish+ suspension
m_3 = evaporating dish+ evaporation residue