LAMPIRAN PERHITUNGAN ANALISA FILTRASI

A. Lampiran Perhitungan

1. Densitas (ρ)

$$\rho = \frac{\text{massa piknometer isi} - \text{massa piknometer kosong}}{\text{volume piknometer}}$$

Dimana ; ρ = massa jenis / densitas (gr/ml)

Tabel 3. Data Perhitungan Densitas

Uji	Massa Piknometer Isi (gr)	Massa Piknometer Kosong (gr)	Volume Piknometer (ml)
1.	41,51	16,84	25
2.	41,52	16,84	25
3.	41,75	16,84	25
4.	41,52	16,84	25
5.	41,68	16,84	25
6.	41,69	16,84	25

a.) ρ1 (t=30 s) = $\rho = \frac{(41{,}51-16{,}84)\ gr}{25\ ml} = 0{,}9868\ gr/ml$

b.) ρ2 (t=30 s) = $\rho = \frac{(41{,}52-16{,}84)\ gr}{25\ ml} = 0{,}9872\ gr/ml$

c.) ρ3 (t=30 s) = $\rho = \frac{(41{,}75-16{,}84)\ gr}{25\ ml} = 0{,}9964\ gr/ml$

d.) ρ4 (t=30 s) = $\rho = \frac{(41{,}52-16{,}84)\ gr}{25\ ml} = 0{,}9872\ gr/ml$

e.) ρ5 (t=30 s) = $\rho = \frac{(41{,}68-16{,}84)\ gr}{25\ ml} = 0{,}9936\ gr/ml$

f.) ρ6 (t=30 s) = $\rho = \frac{(41{,}69-16{,}84)\ gr}{25\ ml} = 0{,}994\ gr/ml$

2. Viskositas (μ)

$$\mu = \frac{tx \times \rho x}{t0 \times \rho 0} \times \mu_0$$

Keterangan :

- μ_x : viskositas sampel (Cp)
- μ_0 : viskositas air (Cp)
- t_x : waktu sampel (s)
- t_0 : waktu air (s)
- ρ_x : densitas sampel (g/ml)
- ρ_0 : densitas air (g/ml)

Tabel 4. Data Perhitungan Viskositas

Uji	Densitas sampel (gr/ml)	Densitas air (gr/ml)	Waktu sampel (s)	Waktu air (s)
1.	0,9868	1	0,91	0,8
2.	0,9872	1	0,94	0,8
3.	0,9964	1	0,85	0,8
4.	0,9872	1	0,93	0,8
5.	0,9936	1	0,95	0,8
6.	0,994	1	0,83	0,8

a.) μ1 (t=30 s) = $\frac{0{,}91 \ x \ 0{,}9869 \ gr/ml}{0{,}8 \ x \ 1 \ gr/ml}$ x 1,002 cp = 0,7392 cp = 0,0007392 Ns/m^2

b.) μ2 (t=30 s) = $\frac{0{,}94 \ x \ 0{,}9872 \ gr/ml}{0{,}8 \ x \ 1 \ gr/ml}$ x 1,002 cp = 0,7633 cp = 0,0007633 Ns/m^2

c.) μ3 (t=30 s) = $\frac{0{,}85 \ x \ 0{,}9964 \ gr/ml}{0{,}8 \ x \ 1 \ gr/ml}$ x 1,002 cp = 0,6838 cp = 0,0006838 Ns/m^2

d.) μ4 (t=30 s) = $\frac{0{,}93 \ x \ 0{,}9872 \ gr/ml}{0{,}8 \ x \ 1 \ gr/ml}$ x 1,002 cp = 0,7552 cp = 0,0007552 Ns/m^2

e.) μ5 (t=30 s) = $\frac{0{,}95 \ x \ 0{,}9936 \ gr/ml}{0{,}8 \ x \ 1 \ gr/ml}$ x 1,002 cp = 0,7664 cp = 0,0007664 Ns/m^2

f.) μ6 (t=30 s) = $\frac{0{,}83 \ x \ 0{,}994 \ gr/ml}{0{,}8 \ x \ 1 \ gr/ml}$ x 1,002 cp = 0,6693 cp = 0,0006693 Ns/m^2

3. Tahanan Medium Filter (Rm)

$$Rm = \frac{B\ A(-\Delta P)}{\mu} \quad \text{..... (4)}$$

Dimana :

R_m = tahanan medium filter (m^{-1})

μ = viskositas (Pa.s)

C_s (kg solid/m^3)

ΔP = *pressure drop* (N/m^2)

K_p ($^S/_{m^6}$)

A = luas filter (m^2)

B ($^S/_{m^3}$)

Tabel 5. Data Perhitungan Tahanan Medium Filter (Rm)

Uji	B ($^S/_{m^6}$)	A (m^2)	ΔP (N/m^2)	μ (N.s/m^2)
1.	2288,6	0,2209	6,87E+06	0,739E-03
2.	2973,5	0,2209	4,90E+06	0,763E-03
3.	2333,9	0,2209	2,94E+06	0,6838E-03
4.	2952	0,2209	4,90E+06	0,755E-03
5.	2422,4	0,2209	2,94E+06	0,766E-03
6.	2977	0,2209	6,87E+06	0,6693E-03

a.) $Rm1 = \frac{(2288{,}6\ ^S/_{m^6})\ x\ (0{,}2209\ m^2)\ x\ (6865000 N/m^2)}{(0{,}000739\ N.s/m^2)}$ = 4,7E+12 1/m

b.) $Rm2 = \frac{(2973{,}5\ ^S/_{m^6})\ x\ (0{,}2209\ m^2)\ x\ (4903000 N/m^2)}{(0{,}000763\ N.s/m^2)}$ = 4,22E+12 1/m

c.) $Rm3 = \frac{(2333{,}9\ ^S/_{m^6})\ x\ (0{,}2209\ m^2)\ x\ (2942000 N/m^2)}{(0{,}0006838\ N.s/m^2)}$ = 2,22E+12 1/m

d.) $Rm4 = \frac{(2952\ ^S/_{m^6})\ x\ (0{,}2209\ m^2)\ x\ (4903000 N/m^2)}{(0{,}000755\ N.s/m^2)}$ = 4,23E+12 1/m

e.) $Rm5 = \frac{(2422{,}4\ ^S/_{m^6})\ x\ (0{,}2209\ m^2)\ x\ (2942000 N/m^2)}{(0{,}000766\ N.s/m^2)}$ = 2,05E+12 1/m

f.) $Rm6 = \frac{(2977\ ^S/_{m^6})\ x\ (0{,}2209\ m^2)\ x\ (6865000 N/m^2)}{(0{,}0006693\ N.s/m^2)}$ = 6,75E+12 1/m

4. *Specific Resistance to Filtration* (SRF)

$$SRF = \frac{2 .b .P .A^2}{\mu .c} \qquad \text{……..(3)}$$

Dimana :

t = waktu filtrasi (detik) V = volume filtrat (m^3)

μ = viskositas dinamis filtrat (Ndet/m^2) P = tekanan filtrasi (N/m^2)

SRF = *spesific resistance to filtration* (m/kg) A = luas filter (m^2)

c = konsentrasi solid total (lumpur awal + bahan pengkondisi) (kg/m^3)

Rm = resistensi medium filter (1/m) b = $\left(\frac{\mu . SRF . c}{2 . P . A^2}\right)$ (s/m^6)

- Menghitung nilai konsentrasi solid total + koagulan (c)

  Volume lumpur = 12 Liter = 12 dm^3 = 0,012 m^3

  Massa jenis lumpur (ρ) = 721 kg/ m^3 (Anonim, 2016)

  Volume pelarut = 30 lt = 0,0030 m^3

  Massa lumpur (kg)

  m= ρ x v

  =721 kg/ m^3 x 0,012 m^3 = 8,652 kg

  $c = \frac{massa\ lumpur\ (kg)}{volume\ pelarut\ (m^3)} = \frac{8{,}652\ kg}{0{,}0030\ m^3}$ = 288,400 kg/m^3

Tabel 6. Data Perhitungan *Spesific Resistance to Filtration* (SRF)

Uji	b (s/m^6)	A (m^2)	P (N/m^2)	μ (N.s/m^2)	c (kg/m^3)
1.	2288,6	0,2209	6,87E+06	0,739E-03	288,400
2.	2973,5	0,2209	4,90E+06	0,763E-03	288,400
3.	2333,9	0,2209	2,94E+06	0,6838E-03	288,400
4.	2952	0,2209	4,90E+06	0,755E-03	288,400
5.	2422,4	0,2209	2,94E+06	0,766E-03	288,400
6.	2977	0,2209	6,87E+06	0,6693E-03	288,400

a. SRF1 $= \frac{(2288{,}6\ {}^{S}/_{m}6\ )\ x\ (0{,}2209\ m2)^2 x\ (6865000 N/m^2)}{(0{,}0007392\ N.s/m^2)\ \ x\ (288{,}400\ kg/m^3)}$ = 7,19E+09 m/kg

b. SRF2 $= \frac{(2973{,}5\ {}^{S}/_{m}6\ )\ x\ (0{,}2209\ m2)^2 x\ (4903000 N/m^2)}{(0{,}0007633\ N.s/m^2)\ \ x\ (288{,}400 kg/m^3)}$ = 6,46E+09m/kg

c. SRF3 $= \frac{(2333{,}9\ {}^{S}/_{m}6\ )\ x\ (0{,}2209\ m2)^2 x\ (2942000 N/m^2)}{(0{,}0006838\ N.s/m^2)\ \ x\ (288{,}400\ kg/m^3)}$ = 3,398E+09 m/kg

d. SRF4 $= \frac{(2952\ {}^{S}/_{m}6\ )\ x\ (0{,}2209\ m2)^2 x\ (4903000 N/m^2)}{(0{,}0007552\ N.s/m^2)\ \ x\ (288{,}400\ kg/m^3)}$ = 1,01E+10 m/kg

e. SRF5 $= \frac{(2422{,}4\ {}^{S}/_{m}6\ )\ x\ (0{,}2209\ m2)^2 x\ (2942000 N/m^2)}{(0{,}0007664\ N.s/m^2)\ \ x\ (288{,}400\ kg/m^3)}$ = 3,15E+09 m/kg

f. SRF6 $= \frac{(2977\ {}^{S}/_{m}6\ )\ x\ (0{,}2209\ m2)^2 x\ (6865000 N/m^2)}{(0{,}0006693\ N.s/m^2)\ \ x\ (288{,}400\ kg/m^3)}$ = 1,033E+10 m/kg

5. Kadar Air (*Moisture Content*)

$$Kadar\ Air = \frac{B - C}{B}\ x\ 100\%$$

Dengan keterangan berikut :

B = berat cawan + sampel awal (mg)

C = berat awan + sampel setelah dioven 1 jam (mg)

Tabel 7. Data Perhitungan Kadar Air *(Moisture Content)*

Uji	Koagulan	Plate	B (gr)	C (gr)
1.	Tawas	1	550	390
		2	520	380
		3	500	370
2.	Tawas	1	710	530
		2	620	470
		3	540	420
3.	Tawas	1	740	560
		2	700	550
		3	670	530
4.	$FeCl_3$	1	780	580
		2	710	540
		3	690	530
5.	$FeCl_3$	1	850	650
		2	700	550
		3	670	530
6.	$FeCl_3$	1	910	640
		2	840	630
		3	770	580

a.)MC1

Platte 1 = $\frac{(550 - 390)\ gram}{550\ gram}$ x 100 % = 29,091 %

Platte 2 = $\frac{(520 - 380)\ gram}{520\ gram}$ x 100 % = 26,923 %

Platte 3 = $\frac{(500 - 370)\ gram}{500\ gram}$ x 100 % = 26,000 %

b.)MC2

Platte 1 = $\frac{(710 - 530)\ gram}{710\ gram}$ x 100 % = 25,352 %

Platte 2 = $\frac{(620 - 470)\ gram}{620\ gram}$ x 100 % = 24,194 %

Platte 3 = $\frac{(540 - 420)\ gram}{540\ gram}$ x 100 % = 22,222 %

c.)MC3

Platte 1 = $\frac{(740 - 560)\ gram}{740\ gram}$ x 100 % = 24,324 %

Platte 2 = $\frac{(700 - 550)\ gram}{700\ gram}$ x 100 % = 21,429 %

Platte 3 = $\frac{(670 - 530)\ gram}{670\ gram}$ x 100 % = 20,896 %

d.)MC4

Platte 1 = $\frac{(780 - 580)\ gram}{780\ gram}$ x 100 % = 25,641 %

Platte 2 = $\frac{(710 - 540)\ gram}{710\ gram}$ x 100 % = 23,944 %

Platte 3 = $\frac{(690 - 530)\ gram}{690\ gram}$ x 100 % = 23,188 %

e.)MC5

Platte 1 = $\frac{(850 - 650)\ gram}{850\ gram}$ x 100 % = 23,529 %

Platte 2 = $\frac{(700 - 550)\ gram}{700\ gram}$ x 100 % = 21,429 %

Platte 3 = $\frac{(670 - 530)\ gram}{670\ gram}$ x 100 % = 20,896 %

f.)MC6

Platte 1 = $\frac{(910 - 640)\ gram}{910\ gram}$ x 100 % = 29,670 %

Platte 2 = $\frac{(840 - 630)\ gram}{840\ gram}$ x 100 % = 25,000 %

Platte 3 = $\frac{(770 - 580)\ gram}{770\ gram}$ x 100 % = 24,675 %

6. Yield

$$Y = \frac{w \,.\, V}{t \,.\, A} \qquad \text{..... (9)}$$

Dimana :

Y = Nilai Yield (kg/m^{2}h) A = luas filter (m^2)

w = massa cake yang tertahan di filter (kg/m^3) t = waktu per volume filtrat (s)

V = volume filtrat (m^3)

- Menghitung nilai w (massa yang tertahan difilter)

$$w = \frac{massa\ cake\ (kg)}{volume\ pelarut\ (m3)}$$

Tabel 8. Data Perhitungan masaa cake tertahan difilter (w)

Uji	Massa cake (kg)	V (m^3)
1.	1,57	0,032
2.	1,87	0,032
3.	2,11	0,032
4.	2,18	0,032
5.	2,22	0,032
6.	2,52	0,032

1) $w = \frac{1{,}57\ (kg)}{0{,}032\ (m3)}$ = 49,063 kg/m^3

2) $w = \frac{1{,}87\ (kg)}{0{,}032\ (m3)}$ = 58,438 kg/m^3

3) $w = \frac{2{,}11\ (kg)}{0{,}032\ (m3)}$ = 65,938 kg/m^3

4) $w = \frac{2{,}18\ (kg)}{0{,}032\ (m3)}$ = 68,125 kg/m^3

5) $w = \frac{2{,}22\ (kg)}{0{,}032\ (m3)}$ = 69,375 kg/m^3

6) $w = \frac{2{,}52\ (kg)}{0{,}032\ (m3)}$ = 78,750 kg/m^3

Tabel 12. Data Perhitungan Yield

Uji	w (kg/m^3)	V (m^3)	t (s)	A (m^2)
1.	49,063	30	0,1921	0,2209
2.	58,438	30	0,2285	0,2209
3.	65,938	30	0,1915	0,2209
4.	68,125	30	0,2293	0,2209
5.	69,375	30	0,1898	0,2209
6.	78,750	30	0,2282	0,2209

a.) $Y1 = \frac{\left(49{,}063\ {}^{kg}/_{m3}\right) x\ (0{,}03\ m^3)}{(0{,}1921\ h) x\ (0{,}2209\ m^2)}$ = 34,680 kg/m^2h

b.) $Y2 = \frac{\left(58{,}438^{kg}/_{m3}\right) x\ (0{,}03\ m^3)}{(0{,}2285\ h) x\ (0{,}2209\ m^2)}$ = 34,737 kg/m^2h

c.) $Y3 = \frac{\left(65{,}938^{kg}/_{m3}\right) x\ (0{,}03\ m^3)}{(0{,}1915\ h) x\ (0{,}2209\ m^2)}$ = 46,754 kg/m^2h

d.) $Y4 = \frac{\left(68{,}125^{kg}/_{m3}\right) x\ (0{,}03\ m^3)}{(0{,}2293\ h) x\ (0{,}2209\ m^2)}$ = 40,348 kg/m^2h

e.) $Y5 = \frac{\left(69{,}375^{kg}/_{m3}\right) x\ (0{,}03\ m^3)}{(0{,}1898\ h) x\ (0{,}2209\ m^2)}$ = 49,651 kg/m^2h

f.) $Y6 = \frac{\left(78{,}750^{kg}/_{m3}\right) x\ (0{,}03\ m^3)}{(0{,}2282\ h) x\ (0{,}2209\ m^2)}$ = 46,868 kg/m^2h

B. Lampiran Foto

Gambar 8. Pengukuran lumpur baku

Gambar 9. Proses Filtrasi dengan alat Filter Press Plate and Frame

Gambar 10. Cake yang tertahan pada Filter

Gambar 11. Hasil Filtrat

Gambar 12. Cake Setelah Dioven

Gambar 13. Alat Untuk Uji Hasil Praktikum Filtrasi