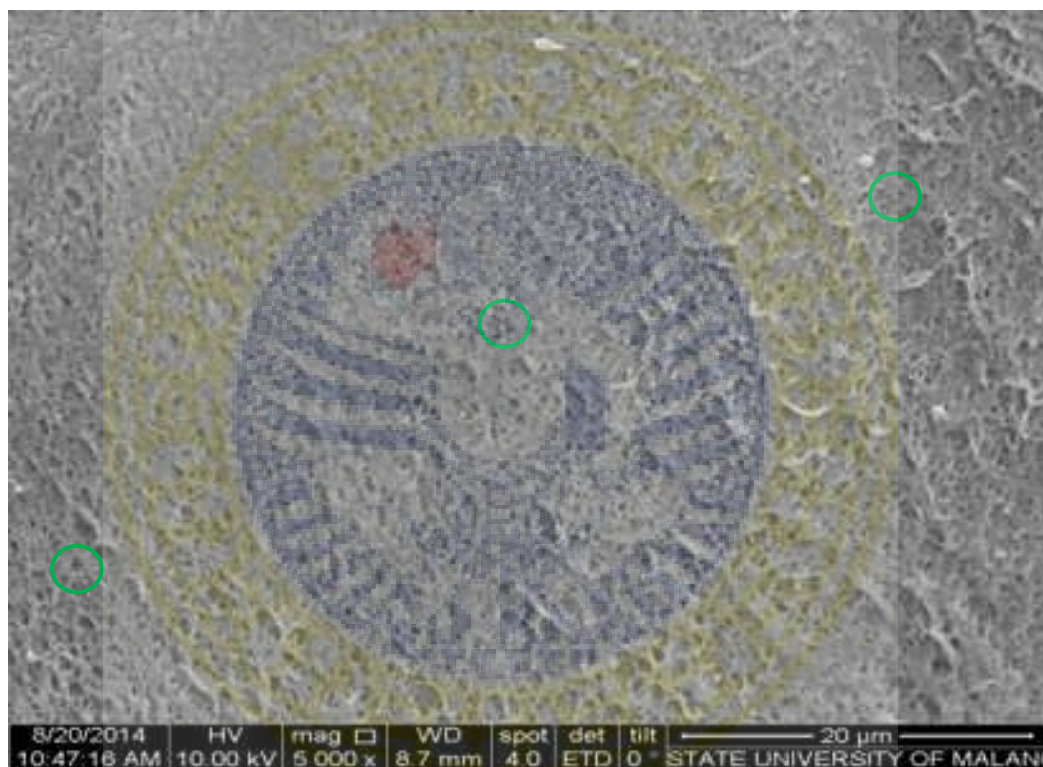


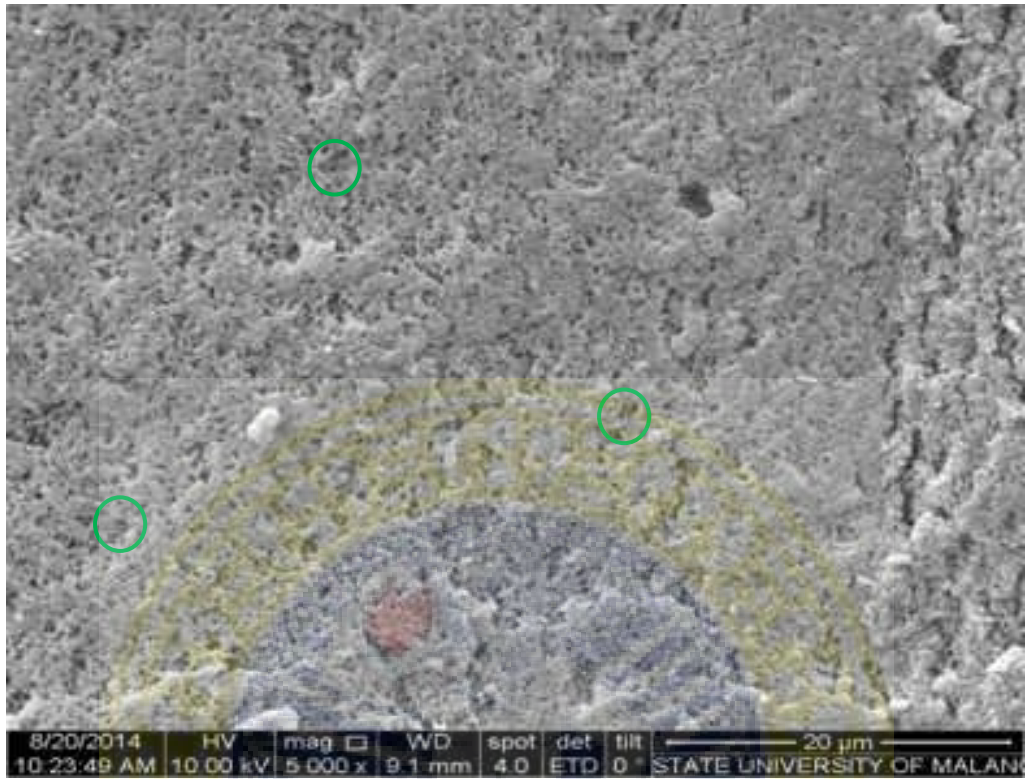
LAMPIRAN

Lampiran 1. Hasil Karakterisasi Morfologi *Hollow fiber* Selulosa Asetat – D-Glukosa Monohidrat dengan SEM(*Scanning Electron Microscope*)

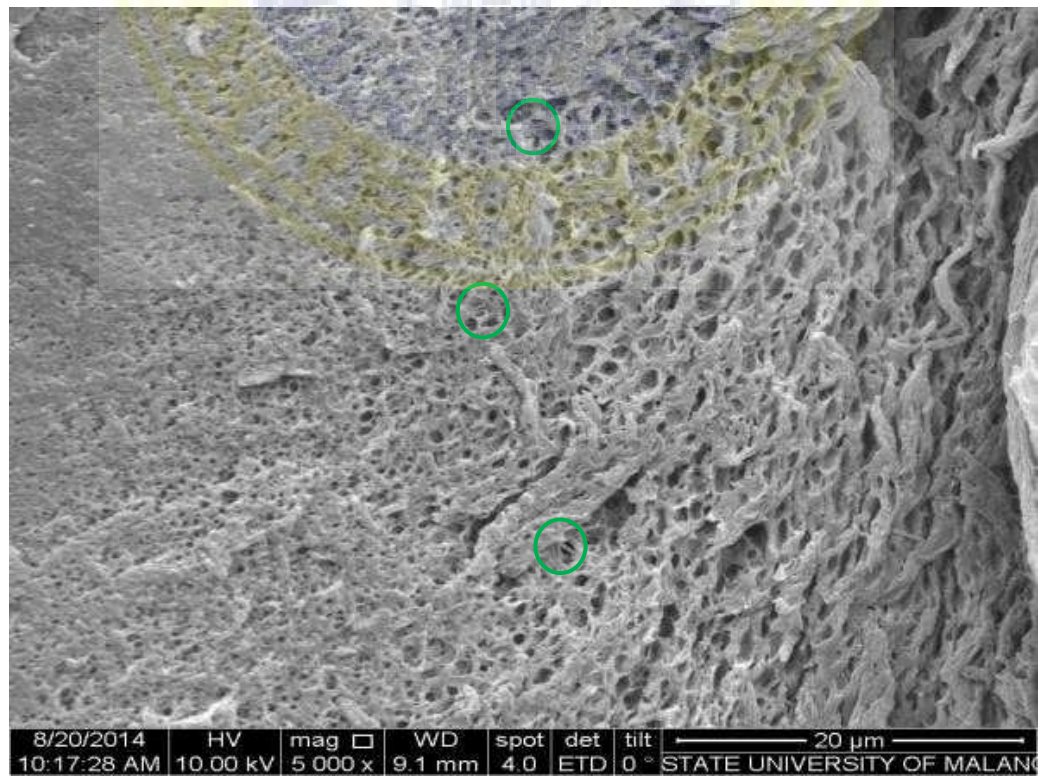
Suhu 5°C (Perbesaran 5000 kali)



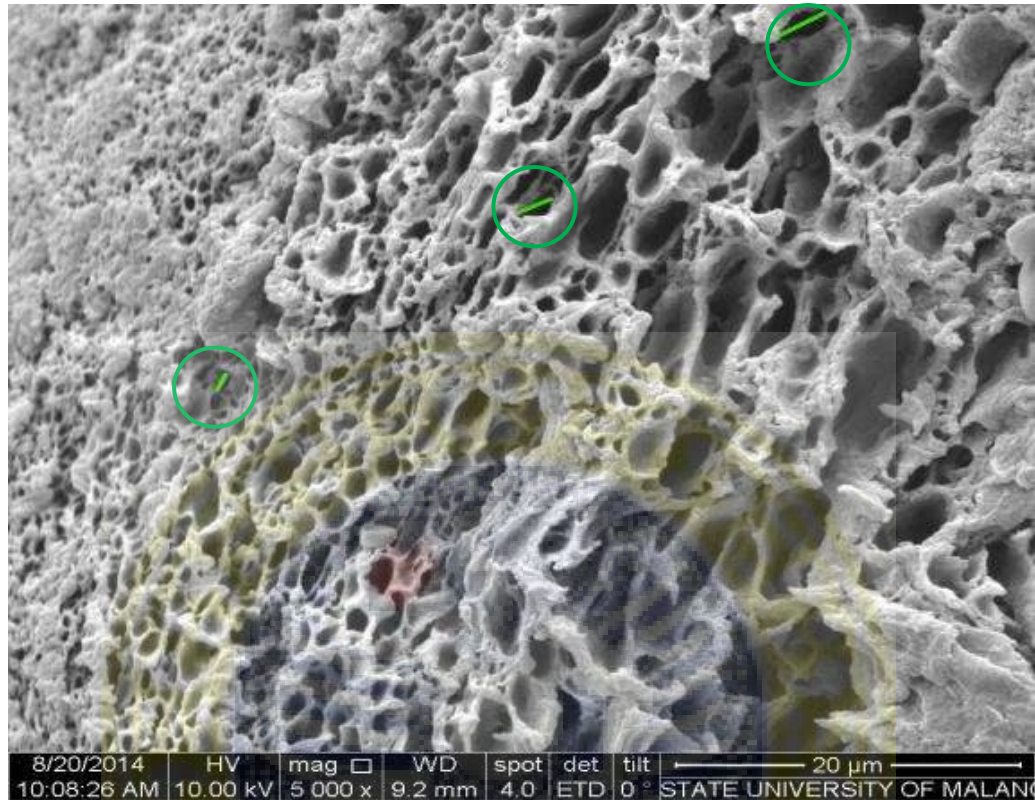
Suhu 10°C (Perbesaran 5000 kali)



Suhu 15°C (Perbesaran 5000 kali)



Suhu 20°C (Perbesaran 5000 kali)



Titik ke-	Ukuran Pori (μm)							
	5°C		10°C		15°C		20°C	
	i	i^2	i	i^2	i	i^2	i	i^2
1	0,0295	0,0009	0,0952	0,0091	0,1700	0,0289	0,1659	0,0275
2	0,0600	0,0036	0,1150	0,0132	0,1827	0,0334	0,2684	0,0720
3	0,0858	0,0074	0,1700	0,0289	0,2290	0,0524	0,2972	0,0883
Jumlah	0,1753	0,0118	0,3802	0,0512	0,5817	0,1147	0,7315	0,1879
Rata-rata	0,0584		0,1267		0,1939		0,2438	
Δ	0,0163		0,0224		0,0179		0,0398	

Perhitungan Simpangan Baku Pengukuran Ukuran Pori

1. Suhu Bak Koagulan 5°C

$$\begin{aligned}\Delta i &= \sqrt{\frac{\sum i^2 - n \cdot \bar{i}^2}{n(n-1)}} = \sqrt{\frac{0,0118 - 3(0,0584)^2}{3(3-1)}} = \sqrt{\frac{0,0118 - 3(0,0034)}{3(2)}} \\ &= \sqrt{\frac{0,0118 - 0,0102}{6}} = \sqrt{\frac{0,0016}{6}} = 0,0163 \mu m\end{aligned}$$

2. Suhu Bak Koagulan 10°C

$$\begin{aligned}\Delta i &= \sqrt{\frac{\sum i^2 - n \cdot \bar{i}^2}{n(n-1)}} = \sqrt{\frac{0,0512 - 3(0,1267)^2}{3(3-1)}} = \sqrt{\frac{0,0512 - 3(0,0161)}{3(2)}} \\ &= \sqrt{\frac{0,0512 - 0,0483}{6}} = \sqrt{\frac{0,0029}{6}} = 0,0224 \mu m\end{aligned}$$

3. Suhu Bak Koagulan 15°C

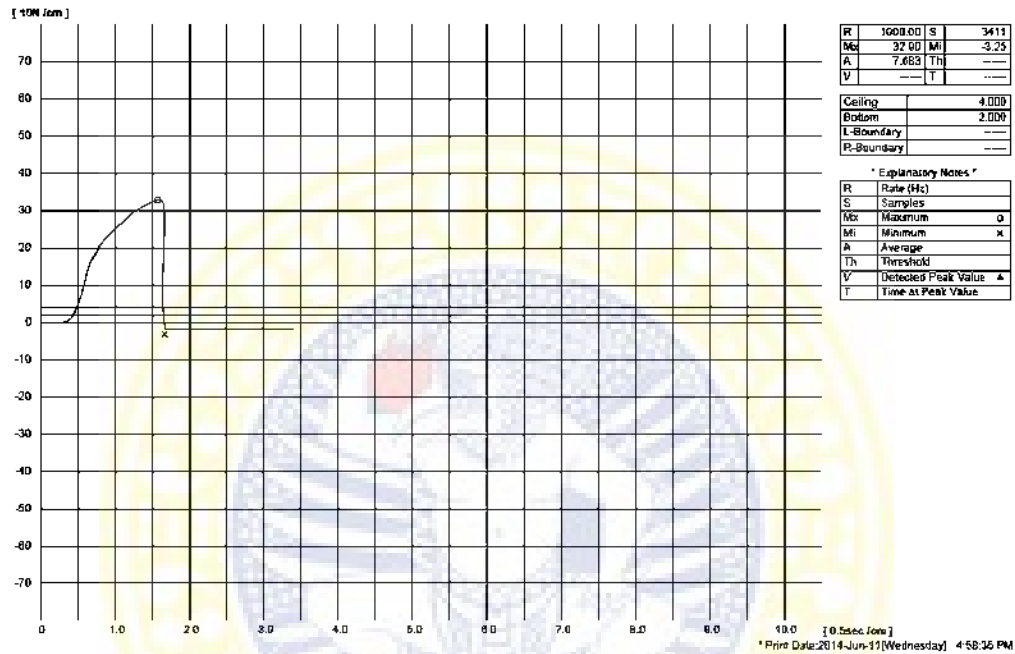
$$\begin{aligned}\Delta i &= \sqrt{\frac{\sum i^2 - n \cdot \bar{i}^2}{n(n-1)}} = \sqrt{\frac{0,1147 - 3(0,1939)^2}{3(3-1)}} = \sqrt{\frac{0,1147 - 3(0,0376)}{3(2)}} \\ &= \sqrt{\frac{0,1147 - 0,1128}{6}} = \sqrt{\frac{0,0019}{6}} = 0,0179 \mu m\end{aligned}$$

4. Suhu Bak Koagulan 20°C

$$\begin{aligned}\Delta i &= \sqrt{\frac{\sum i^2 - n \cdot \bar{i}^2}{n(n-1)}} = \sqrt{\frac{0,1879 - 3(0,2438)^2}{3(3-1)}} = \sqrt{\frac{0,1879 - 3(0,0595)}{3(2)}} \\ &= \sqrt{\frac{0,1879 - 0,1785}{6}} = \sqrt{\frac{0,0094}{6}} = 0,0398 \mu m\end{aligned}$$

Lampiran 2. Hasil Karakterisasi Sifat Mekanik (Kuat Tarik dan Derajat Elongasi) *Hollow fiber* Selulosa Asetat – D-Glukosa Monohidrat

Suhu 5°C



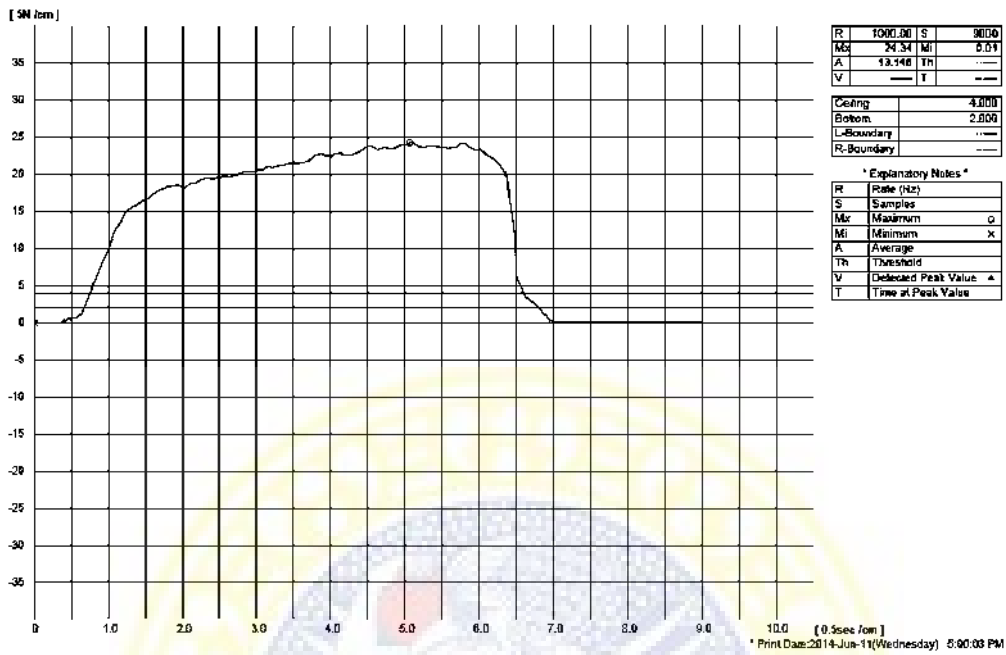
R	1000.00	S	3411
Mx	32.80	Mi	-3.25
A	7.683	Th	---
V	---	T	---

Ceiling	4.000
Bottom	2.000
L-Boundary	---
R-Boundary	---

* Explanatory Notes *

R	Rate (Hz)	
S	Samples	
Mx	Maximum	o
Mi	Minimum	x
A	Average	
Th	Threshold	
V	Detected Peak Value	▲
T	Time at Peak Value	

Suhu 10°C



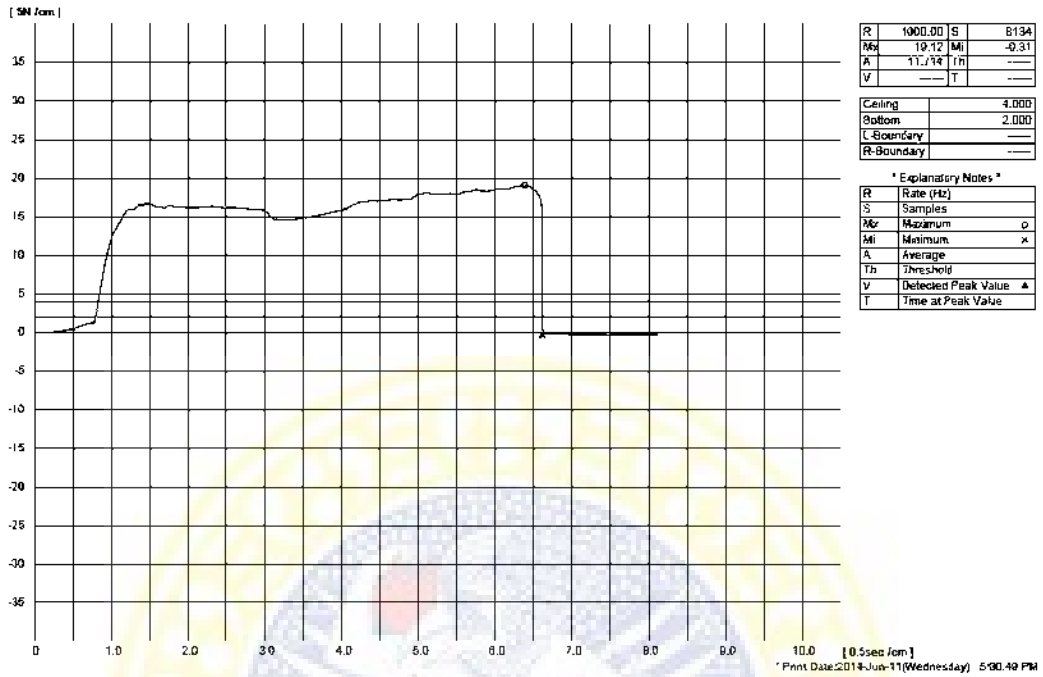
R	1000.00	S	9000
Mx	24.34	Mi	0.01
A	13.148	Th	---
V	---	T	---

Ceiling	4.000
Bottom	2.000
L-Boundary	---
R-Boundary	---

* Explanatory Notes *

R	Rate (Hz)
S	Samples
Mx	Maximum 0
Mi	Minimum x
A	Average
Th	Threshold
V	Detected Peak Value ▲
T	Time at Peak Value

Suhu 15°C



R	1000.00	S	8134
Mx	19.12	Mi	-0.31
A	11.714	Th	---
V	---	T	---

Ceiling	4.000
Bottom	2.000
L-Boundary	---
R-Boundary	---

* Explanatory Notes *

R	Rate (Hz)	
S	Samples	
Mx	Maximum	o
Mi	Minimum	x
A	Average	
Th	Threshold	
V	Detected Peak Value	▲
T	Time at Peak Value	

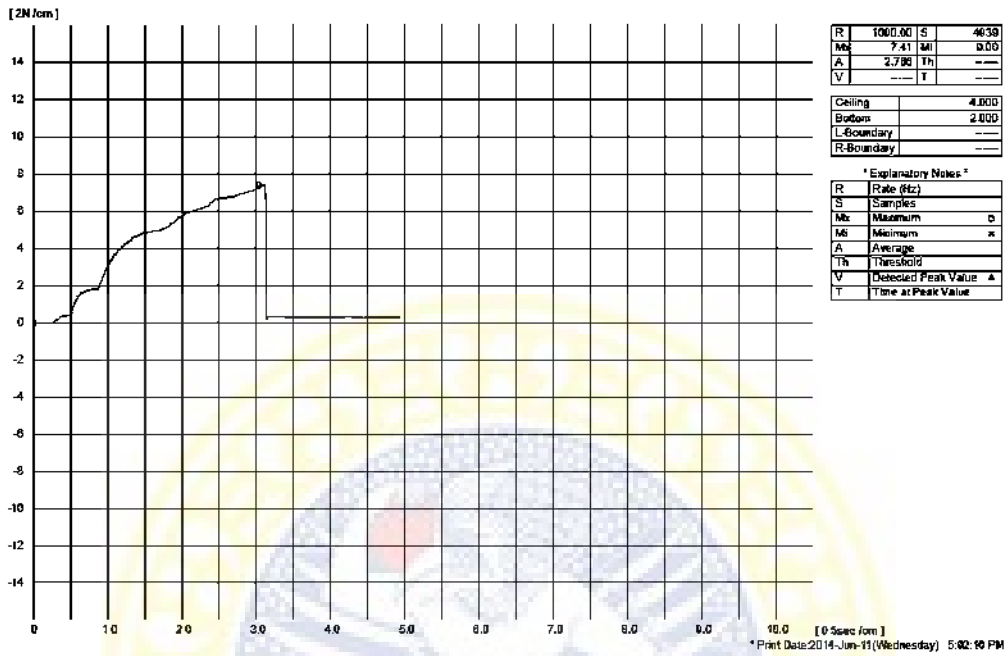
R	1000.00	S	8134
Mx	19.12	Mi	-0.31
A	11.714	Th	---
V	---	T	---

Ceiling	4.000
Bottom	2.000
L-Boundary	---
R-Boundary	---

* Explanatory Notes *

R	Rate (Hz)	
S	Samples	
Mx	Maximum	o
Mi	Minimum	x
A	Average	
Th	Threshold	
V	Detected Peak Value	▲
T	Time at Peak Value	

Suhu 20°C



R	1000.00	S	4030
Mx	7.41	Mi	0.00
A	2.768	Th	---
V	---	T	---

Ceiling	4.000
Bottom	2.000
L-Boundary	---
R-Boundary	---

* Explanatory Notes *

R	Rate (Hz)	
S	Samples	
Mx	Maximum	o
Mi	Minimum	x
A	Average	
Th	Threshold	
V	Detected Peak Value	▲
T	Time at Peak Value	

Suhu (°C)	R (mm)	r (mm)	F	σ (N/mm ²)
5	0,757	0,436	32,9	27,421
10	0,894	0,391	24,34	11,993
15	1,172	0,231	19,2	4,632
20	1,014	0,353	7,41	2,614
Membran <i>hollow fiber</i> (Wong et al, 2012)				23,1 – 33,8 N/mm²

Persamaan yang digunakan untuk menghitung besar kuat tarik *hollow fiber*

$$\sigma = \frac{F}{A}, \quad \text{dimana} \quad A = \pi(R^2 - r^2)$$

Keterangan :

- R = Jari-jari lingkaran luar *hollow fiber*
- r = Jari-jari lingkaran dalam *hollow fiber*
- F = Gaya yang dibutuhkan untuk mendeformasi *hollow fiber*
- σ = Kuat tarik *hollow fiber*
- A = Luas penampang *hollow fiber*

Suhu (°C)	L ₀ cm	L ₁ cm	ΔL	ε
5	9,00	9,40	0,40	4,44%
10	8,05	8,50	0,45	5,59%
15	8,60	9,30	0,70	8,14%
20	8,60	9,40	0,80	9,30%
Membran <i>hollow fiber</i> (Wong et al, 2012)				3,5% – 13,1%

Persamaan yang digunakan untuk menghitung derajat elongasi *hollow fiber* :

$$\varepsilon = \frac{\Delta L}{L_0} \times 100\%$$

Keterangan :

- L₀ = Panjang awal *hollow fiber*
- L₁ = Panjang akhir *hollow fiber*
- ΔL = Selisih panjang (L₁ – L₀)
- ε = Derajat elongasi *hollow fiber*

Lampiran 3. Hasil Uji Swelling Hollow fiber Selulosa Asetat – D-Glukosa Monohidrat

Suhu (°C)	Sampel	w _i (g)	w _t (g)	Derajat swelling
5	1	0,16	0,16	0,00%
	2	0,15	0,14	6,67%
	3	0,17	0,16	5,88%
10	1	0,19	0,18	5,26%
	2	0,15	0,14	6,67%
	3	0,15	0,14	6,67%
15	1	0,15	0,14	6,67%
	2	0,12	0,11	8,33%
	3	0,13	0,12	7,69%
20	1	0,13	0,12	7,69%
	2	0,10	0,09	1,00%
	3	0,12	0,11	8,33%

Persamaan yang digunakan untuk menghitung derajat swelling *hollow fiber* :

$$\text{Derajat Swelling} = \frac{w_t - w_i}{w_i} \times 100\%$$

Keterangan :

w_i = Massa awal sampel sebelum perendaman

w_t = Massa akhir sampel setelah perendaman

Sampel ke-	Derajat Swelling (%)							
	5 °C		10 °C		15 °C		20 °C	
	w _i	w _t	w _i	w _t	w _i	w _t	w _i	w _t
1	0,16	0,16	0,19	0,18	0,15	0,14	0,13	0,12
2	0,15	0,14	0,15	0,14	0,12	0,11	0,10	0,09
3	0,17	0,16	0,15	0,14	0,13	0,12	0,12	0,11
Jumlah	0,48	0,46	0,49	0,46	0,40	0,37	0,35	0,32
Rata-rata	0,16	0,15	0,16	0,15	0,13	0,12	0,12	0,11
Δ	±0,060		±0,060		±0,074		±0,086	

Perhitungan Simpangan Baku Uji Swelling :

$$\begin{aligned}\Delta\%Swelling &= \left| \frac{\partial \%swelling}{\partial w_t} \right| \Delta w_t + \left| \frac{\partial \%swelling}{\partial w_i} \right| \Delta w_i \\ &= \left| \frac{1 \cdot w_i - 0}{w_i} \right| \Delta w_t + \left| \frac{-1 \cdot w_i - (w_t - w_i) \cdot 1}{w_i^2} \right| \Delta w_i \\ &= \left| \frac{1}{w_i} \right| \Delta w_t + \left| \frac{w_t}{w_i^2} \right| \Delta w_i\end{aligned}$$

Suhu 5°C :

$$\Delta\%Swelling = \left| \frac{1}{0,16} \right| 0,005 + \left| \frac{0,15}{0,16^2} \right| 0,005 = 0,031 + 0,029 = \pm 0,060$$

Suhu 10°C :

$$\Delta\%Swelling = \left| \frac{1}{0,16} \right| 0,005 + \left| \frac{0,15}{0,16^2} \right| 0,005 = 0,031 + 0,029 = \pm 0,060$$

Suhu 15°C :

$$\Delta\%Swelling = \left| \frac{1}{0,13} \right| 0,005 + \left| \frac{0,12}{0,13^2} \right| 0,005 = 0,038 + 0,036 = \pm 0,074$$

Suhu 20°C :

$$\Delta\%Swelling = \left| \frac{1}{0,11} \right| 0,005 + \left| \frac{0,10}{0,11^2} \right| 0,005 = 0,045 + 0,041 = \pm 0,086$$

Lampiran 4. Hasil Uji *Crossflow Filtration Hollow fiber* Selulosa Asetat – D-Glukosa Monohidrat Variasi Suhu 5°C

Uji ke	V (mL)	d (cm)	l (cm)	A (cm ²)	t (menit)	Fluks (mL/cm ² menit)
1	53	0,203	7	31,2	1	1,7
2	50	0,203	7	31,2	1	1,6
3	56	0,203	7	31,2	1	1,8
4	50	0,203	7	31,2	1	1,6
Rata-rata	52,25	0,203	7	31,2	1	1,7
Δ						±0,973
Nilai Clearance Membran Dialyzer F60 Fresenius Polysulfone (<i>hollow fiber</i>) (Hoenich et al., 1996)						142 mL/menit

Persamaan yang digunakan untuk menghitung nilai fluks *hollow fiber* :

$$J = \frac{V}{A \cdot t}, \quad \text{dimana} \quad A = \pi \times d \times l \times n$$

Keterangan :

V = Volume permeat

A = Luas penampang modul *hollow fiber*

d = Diameter dalam *hollow fiber*

l = Panjang *hollow fiber*

n = Jumlah *hollow fiber* dalam 1 modul (7 *hollow fiber*)

t = Waktu filtrasi

J = Fluks

Perhitungan simpangan baku nilai fluks :

$$\begin{aligned}
 \Delta J &= \left| \frac{\partial J}{\partial V} \right| \Delta V + \left| \frac{\partial J}{\partial d} \right| \Delta V d + \left| \frac{\partial J}{\partial l} \right| \Delta l + \left| \frac{\partial J}{\partial t} \right| \Delta t \\
 &= \left| \frac{1 \cdot (\pi \cdot d \cdot l \cdot n \cdot t)}{(\pi \cdot d \cdot l \cdot n \cdot t)^2} \right| \Delta V + \left| \frac{0 - V(\pi \cdot l \cdot n \cdot t)}{(\pi \cdot d \cdot l \cdot n \cdot t)^2} \right| \Delta d + \left| \frac{0 - V(\pi \cdot d \cdot n \cdot t)}{(\pi \cdot d \cdot l \cdot n \cdot t)^2} \right| \Delta l \\
 &\quad + \left| \frac{0 - V(\pi \cdot d \cdot l \cdot n)}{(\pi \cdot d \cdot l \cdot n \cdot t)^2} \right| \Delta t \\
 &= \left| \frac{1}{\pi \cdot d \cdot l \cdot n \cdot t} \right| \Delta V + \left| \frac{V(\pi \cdot l \cdot n \cdot t)}{(\pi \cdot d \cdot l \cdot n \cdot t)^2} \right| \Delta d + \left| \frac{V(\pi \cdot d \cdot n \cdot t)}{(\pi \cdot d \cdot l \cdot n \cdot t)^2} \right| \Delta l \\
 &\quad + \left| \frac{V(\pi \cdot d \cdot l \cdot n)}{(\pi \cdot d \cdot l \cdot n \cdot t)^2} \right| \Delta t \\
 &= \left| \frac{1}{A} \right| \Delta V + \left| \frac{V(\pi \cdot l \cdot n \cdot t)}{A^2} \right| \Delta d + \left| \frac{V(\pi \cdot d \cdot n \cdot t)}{A^2} \right| \Delta l + \left| \frac{V(\pi \cdot d \cdot l \cdot n)}{A^2} \right| \Delta t \\
 &= \left| \frac{1}{31,19} \right| 0,5 + \left| \frac{(52,25)(3,14)7,7 \cdot 1}{(31,19)^2} \right| 0,0005 + \left| \frac{(52,25)(3,14)(0,203)7,1}{(31,19)^2} \right| 0,5 \\
 &\quad + \left| \frac{(52,25)(3,14)(0,203)7,7}{(31,19)^2} \right| 0,5 \\
 &= 0,016 + 4,13 \times 10^{-4} + 0,119 + 0,838 \\
 &= \pm 0,973
 \end{aligned}$$

Lampiran 5. Hasil Uji Turbidimetri *Hollow fiber* Selulosa Asetat – D-Glukosa Monohidrat Variasi Suhu 5°C

Uji ke	C _f (NTU)	C _p (NTU)	Nilai Rejeksi	Kadar Kreatinin Rentetat (mg/dL)
1	1,47	0,77	47,62%	1,19
2	1,47	0,81	44,90%	1,12
3	1,47	0,76	48,30%	1,21
4	1,47	0,88	40,14%	1,00
Rata-rata	1,47	0,81	45,24%	1,13
Kadar kreatinin normal (Ronco et al (2007))				0,7 - 1,2 mg/dL

Persamaan yang digunakan untuk menghitung nilai rejeksi *hollow fiber* :

$$R = \left(1 - \frac{C_p}{C_f}\right) \times 100\%$$

$$\text{Kadar Kreatinin Rentetat} = R \times 2,5 \text{ mg/dL}$$

Keterangan :

C_f = Konsentrasi zat terlarut dalam umpan/feed

C_p = Konsentrasi zat terlarut dalam permeat





R = Nilai koefisien rejeksi






Perhitungan simpangan baku koefisien rejeksi *hollow fiber* :

$$\begin{aligned}
 \Delta R &= \left| \frac{\partial R}{\partial C_p} \right| \Delta C_p + \left| \frac{\partial R}{\partial C_f} \right| \Delta C_f \\
 &= \left| \frac{-1 \cdot C_f - 0}{C_f^2} \right| \Delta C_p + \left| \frac{1 \cdot C_f - (C_f - C_p) \cdot 1}{C_f^2} \right| \Delta C_f \\
 &= \left| \frac{1}{C_f} \right| \Delta C_p + \left| \frac{C_p}{C_f^2} \right| \Delta C_f \\
 &= \left| \frac{1}{1,47} \right| 0,005 + \left| \frac{0,81}{1,47^2} \right| 0,5 \\
 &= 3,4 \cdot 10^{-3} + 0,187 \\
 &= \pm 0,19
 \end{aligned}$$

Lampiran 6. Dokumentasi Kegiatan Penelitian

No	Dokumentasi Kegiatan	Keterangan
1		<p>Bahan-bahan yang digunakan dalam penelitian yaitu Selulosa Asetat, asam format, D-glukosa monohidrat dan bahan-bahan <i>Simulated Body Fluid</i> (SBF)</p>
2		<p>Alat-alat yang digunakan dalam penelitian seperti plastic wrap, alumunium foil, timbangan digital, , pH meter, gelas beaker, gelas ukur, turbidimeter, alat spinning, dan lain-lain.</p>

<p>3</p>		<p>Menimbang bahan-bahan yang digunakan.</p>
<p>4</p>		<p>Pembuatan larutan dope menggunakan <i>magnetic stirrer</i></p>
<p>5</p>		<p>Pencetakan <i>hollow fiber</i> dengan spinneret</p>
<p>6</p>		<p>Hasil cetakan sampel <i>hollow fiber</i></p>

7		Alat SEM untuk uji topografi dan morfologi <i>hollow fiber</i>
8		Uji kekuatan tarik dan derajat elongasi <i>hollow fiber</i>
9		Pembuatan SBF
10		Perendaman <i>hollow fiber</i> di dalam SBF pada uji swelling
11		Modul yang digunakan dalam uji filtrasi <i>crossflow</i>

12		Uji daya rejeksi menggunakan turbidimeter
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