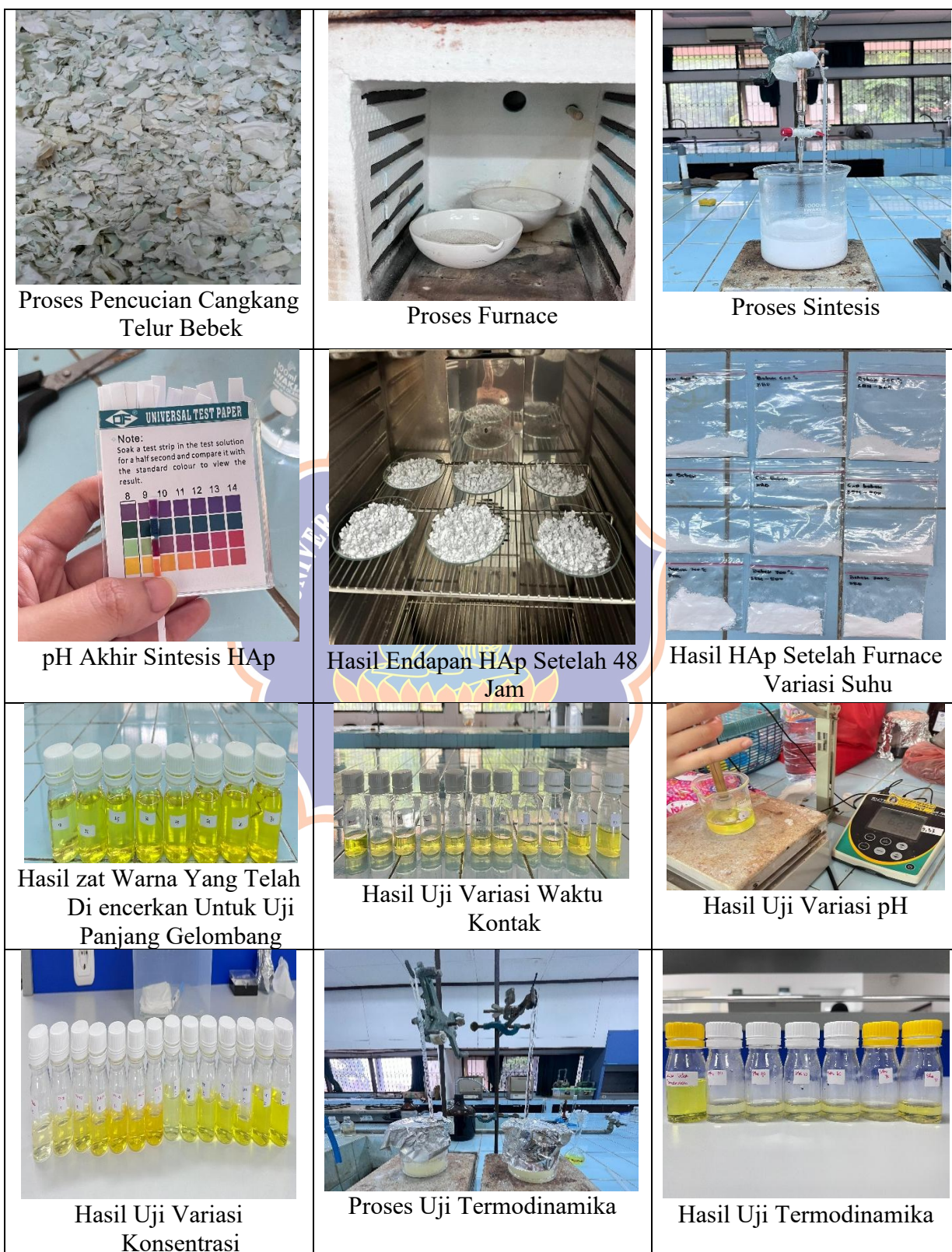


Lampiran 1. Dokumtasi Penelitian





Lampiran 2. Perhitungan dan Tabel Pembuatan Larutan Standar Zat Warna Remazol Yellow

1. Perhitungan Larutan Induk 1000 ppm

Diketahui:

$$\text{Massa zat warna} = 0,1 \text{ g} = 100 \text{ mg}$$

$$\text{Volume larutan} = 100 \text{ mL} = 0,1 \text{ L}$$

Perhitungan:

$$C = \frac{m}{V}$$

$$C = \frac{100 \text{ mg}}{0,1 \text{ L}} = 1000 \text{ mg/L}$$

Konsentrasi larutan induk = 1000 ppm

2. Perhitungan Pengenceran Menjadi 100 ppm

Diketahui:

$$M_1 = 1000 \text{ ppm}$$

$$V_1 = 10 \text{ mL}$$

$$V_2 = 100 \text{ mL}$$

Perhitungan:

$$\begin{aligned} M_1 V_1 &= M_2 V_2 \\ (1000)(10) &= M_2(100) \\ M_2 &= 100 \text{ ppm} \end{aligned}$$

3. Perhitungan Pengenceran Menjadi 20 ppm

Diketahui:

$$M_1 = 100 \text{ ppm}$$

$$V_1 = 20 \text{ mL}$$

$$V_2 = 100 \text{ mL}$$

Perhitungan:

$$\begin{aligned} M_1 V_1 &= M_2 V_2 \\ (100)(20) &= M_2(100) \\ M_2 &= 20 \text{ ppm} \end{aligned}$$

1. Tabel hasil Kurva Kalibrasi

Konsentrasi	Adsorpsi
10	0,3618
20	0,6897
30	1,0391
40	1,4027

Lampiran 3. Perhitungan Kapasitas Optimum Pada Variasi Waktu Kontak, pH, Konsentrasi dan Isoterm, Kinetika, Termodinamika

(a). Variasi Waktu Kontak

Rumus perhitungan % Efisiensi = $\frac{C_o - C_e}{C_o} \times 100\%$

120 menit

$$\%E = \frac{12,4947 - 5,75219}{12,4947} \times 100\%$$

$$\%E = 53,96\%$$

(b). Variasi pH

Rumus Perhitungan % Efisiensi = $\frac{C_o - C_e}{C_o} \times 100\%$

pH 5

$$\%E = \frac{13,8639 - 6,21574}{13,8639} \times 100\%$$

$$\%E = 55,17\%$$

(c). Variasi Konsentrasi

Rumus Perhitungan % Efisiensi = $\frac{C_o - C_e}{C_o} \times 100\%$

Konsentrasi 10ppm

$$\%E = \frac{10 - 4,773214}{10} \times 100\%$$

$$\%E = 52,28\%$$

(d). Isoterm

Persamaan regresi Isoterm Langmuir:

$$y = 0,0414x + 2,0485$$

Perhitungan Q_m

$$\frac{1}{Q_m} = 0,0414$$

$$Q_m = \frac{1}{0,0414} = 24,15 \text{ mg/g}$$

Perhitungan K_L

$$\frac{1}{Q_m K_L} = 2,0485$$

$$K_L = 0,0202 \text{ mg/L}$$

Nilai R^2

$$R^2 = 0,6327$$

Persamaan regresi Isoterm Freundlich:

$$y = 0,7852x - 0,1874$$

Perhitungan n

$$\frac{1}{n} = 0,7852$$

$$n = 1,27$$

Perhitungan Kf

$$\log K_f = -0,1874$$

$$K_f = 0,65 \text{ mg/g}$$

Nilai R²

$$R^2 = 0,9814$$

(e). Kinetika

Persamaan regresi Ordo 1:

$$y = -0,0038x - 1,3238$$

Perhitungan Q_e

$$\log Q_e = -1,3238$$

$$Q_e = 0,0381 \text{ mg/g}$$

Perhitungan k₁

$$k_1 = 2,303 \times 0,0038$$

$$k_1 = 0,0087 \text{ menit}^{-1}$$

Nilai R²

$$R^2 = 0,3643$$

Persamaan linear pseudo orde dua:

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e}$$

Persamaan regresi Orde 2:

$$y = 2,9968x + 6,6405$$

Perhitungan Q_e

Diketahui:

$$\frac{1}{q_e} = 2,9968$$

Maka:

$$q_e = \frac{1}{2,9968}$$

$$q_e = 0,3337 \text{ mg/g}$$

Perhitungan k_2

Diketahui:

$$\frac{1}{k_2 q_e^2} = 6,6405$$

$$k_2 = \frac{1}{6,6405(0,3337)^2}$$

$$k_2 = 1,35 \text{ g mg}^{-1} \text{ menit}^{-1}$$

Nilai koefisien determinasi:

$$R^2 = 0,9971$$

(f). Termodinamika

Perhitungan K_c pada 30°C

$$K_d = \frac{C_0 - C_e}{C_e}$$

$$K_d = \frac{14,8076 - 3,35471}{3,35471}$$

$$K_d = 3,4139$$

Perhitungan $\ln K_c$

$$\ln(3,4139) = 1,2278$$

Perhitungan ΔG°

$$R = 8,314 \text{ J/mol}\cdot\text{K}$$

$$T = 303 \text{ K}$$

$$\ln K_c = 1,2278$$

$$\Delta G^\circ = -RT \ln K_c$$

$$\Delta G^\circ = -(8,314)(303)(1,2278)$$

$$\Delta G^\circ = -3093,2 \text{ J/mol}$$

Persamaan Regresi Van't Hoff

$$y = 3549,2x - 10,59$$

Nilai R^2

$$R^2 = 0,9708$$

Perhitungan $-\Delta H$

$$\text{slope} = \frac{-\Delta H}{R}$$

Maka:

$$3549,2 = \frac{-\Delta H}{8,314}$$

$$\Delta H = -(3549,2)(8,314)$$

$$\Delta H = -29509,0 \text{ J/mol}$$

$$\Delta H = -29,50 \text{ kJ/mol}$$

Perhitungan ΔS

$$\text{intercept} = \frac{\Delta S}{R}$$

Maka:

$$-10,59 = \frac{\Delta S}{8,314}$$

$$\Delta S = (-10,59)(8,314)$$

$$\Delta S = -88,03 \text{ J/mol} \cdot K$$

Lampiran 4. Tabel Hasil Uji Variasi Waktu Kontak, pH dan Konsentrasi

1. Tabel Hasil Uji Waktu Kontak

Waktu kontak	C ₀ (rata-rata)	C _e (rata-rata)	C ₀ -C _e	%Efisiensi
15	12,4947	6,55491	5,939747	47,5383
30	12,4947	6,46939	6,025267	48,22275
45	12,4947	6,33042	6,164237	49,335
60	12,4947	6,36929	6,125364	49,02382
75	12,4947	6,18853	6,306122	50,47055
90	12,4947	5,87852	6,616132	52,9517
120	12,4947	5,75219	6,742468	53,96282
135	12,4947	6,09427	6,400389	51,22562
150	12,4947	6,14772	6,346939	50,7982

2. Tabel Hasil Uji pH

pH	C ₀ (rata-rata)	C _e (rata-rata)	C ₀ -C _e	%Efisiensi
3	13,8639	6,3586	7,50534	54,1357
4	13,8639	6,42954	7,4344	53,6278
5	13,8639	6,21574	7,6482	55,1661
6	13,8639	6,65695	7,2070	51,9837
7	13,8639	7,21088	6,65306	47,9882
8	13,8639	6,69388	7,17007	51,7174
9	13,8639	7,22643	6,63751	47,8761
10	13,8639	6,75705	7,1069	51,2617

3. Tabel Hasil Uji Konsentrasi

ppm	C ₀	C _e	C ₀ -C _e	$\frac{M}{a}$	Q _e	C _e /Q _e	Log Q _e	Log C _e
10	6,10301	2,91254	3,19048	0,5	0,12762	22,8221	-0,8941	0,46427
20	13,2789	7,54227	5,73664	0,5	0,22947	32,8689	-0,6393	0,8775
30	19,9067	11,4509	8,45578	0,5	0,33823	33,8553	-0,4708	1,05884
40	26,2925	14,6667	11,6259	0,5	0,46503	31,5389	-0,3325	1,16633
50	33,7697	21,0962	12,6735	0,5	0,50694	41,6149	-0,2950	1,3242
60	39,8494	23,2381	16,6113	0,5	34,9734	34,9734	-0,1775	1,3662
70	46,4577	27,9981	18,4597	0,5	37,9379	37,9179	-0,1317	1,44713

Lampiran 5. Tabel Parameter Hasil Perhitungan Model Isoterm, Pola Kinetika, Termodinamika

1. Isoterm Lngmuir

Isoterm	Parameter	Nilai
Langmuir	R ²	0,6327
	Q _m (mg/g)	24,15 (mg/g)
	KL (L/mg)	0,0202 (L/mg)

2. Isoterm Freundlich

Isoterm	Parameter	Nilai
Freundlich	R ²	0,9814
	1/n	0,7852

Kf (mg/g)	0,65
n (L/mg)	1,27

3. Kinetika Pseude Orde Satu

Kinetika	Parameter	Nilai
Pseudo Orde 1	Q _e	0,0381 mg/g
	K ₁	0,1934 menit ⁻¹
	R ²	0,3643

4. Kinetika Pseude Orde Dua

Kinetika	Parameter	Nilai
Pseudo Orde 2	Q _e	0,3337 mg/g
	K ₂	1,35 mg/g ⁻¹
	R ²	0,9971

5. Termodinamika

Suhu	C ₀ (Rata-rata)	C _e (Rata-rata)	K _c	ln K _c	Delta G	%E
30	14,8076	3,35471	3,41396	1,22787	-3,0932	77,3446
40	14,8076	5,36929	1,75783	0,56408	-1,4679	63,7396
50	14,8076	5,76385	1,56904	0,45047	-1,2097	61,0750
60	14,8076	7,0379	1,10398	0,09892	-0,2739	52,4710
80	14,8076	9,33819	0,5857	-0,5349	1,56998	36,9364

Lampiran 6. Tabel, Gambar Dan Hasil Perhitungan Derajat kristalinitas

1. HAp Variasi Suhu 700°C

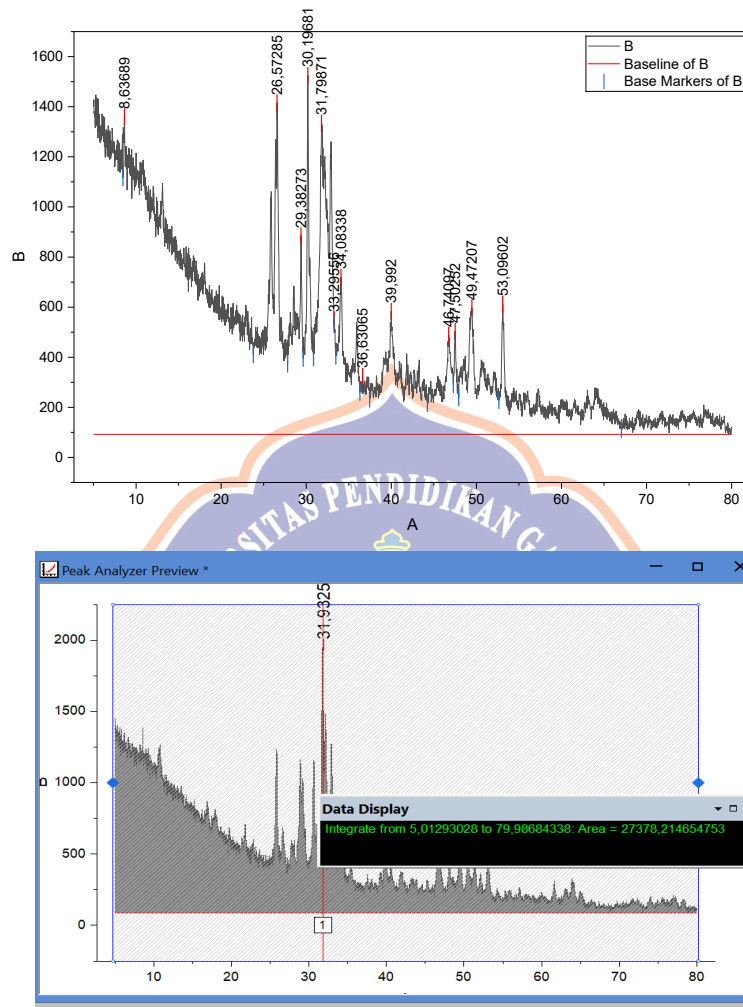
Area Kristalin (A _c)	Area Total (A _t)	Derajat Kristalinitas
22649,672	27378,214	82,728814

Dengan Perhitungan %Kristalinitas $\frac{A_c}{A_t} \times 100$

$$= \frac{22649,672}{27378,214} \times 100$$

$$= 82,72\%$$

Penentuan luas daerah kristalin HAp variasi suhu 700°C menggunakan Peak Analyzer



2. HAp Variasi Suhu 600°C

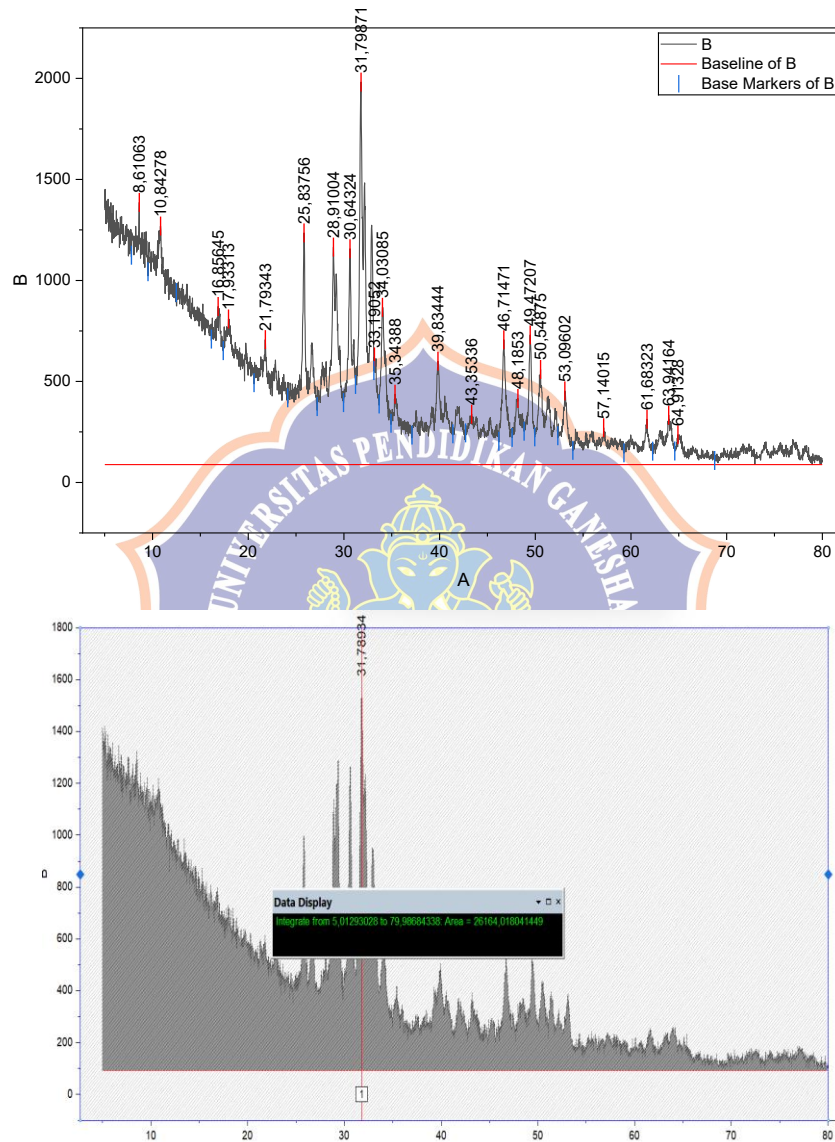
Area Kristalin (Ac)	Area Total (At)	Derajat Kristalinitas
20388,06	26106,01	78,09717

Dengan Perhitungan %Kristalinitas $\frac{A_c}{A_t} \times 100$

$$= \frac{20388,06}{26106,01} \times 100$$

$$= 78,09\%$$

Penentuan luas daerah kristalin HAp variasi suhu 600°C menggunakan Peak Analyzer



3. HAp Tanpa Variasi Suhu

Area Kristalin (Ac)	Area Total (At)	Derajat Kristalinitas
18279,17	26060,6827	70,14078

Dengan Perhitungan %Kristalinitas $\frac{A_c}{A_t} \times 100$

$$= \frac{18279,17}{26060,6827} \times 100$$

$$= 70,14\%$$

Penentuan luas daerah kristalin HAp Tanpa variasi suhu menggunakan Peak Analyzer

