

1. Uraian perhitungan

1.1 Data pengamatan

Bioinhibitor	: Ekstrak Daun Jambu Biji
Temperatur	: 31° C
Warna	: Hijau Tua
pH	: 6,07
Volume Ekstrak	: 5 mL
Media	: Pelat baja karbon
Panjang pelat	: 4 cm
Lebar pelat	: 2,6 cm
Tebal pelat	: 0,24 cm
Larutan korosif	: HCl (1M, 2M, 3M, 4M, dan 5M)
Volume Larutan	: 100 mL
Temperatur	: 28° C

1.2 Perhitungan

1.2.1 Pembuatan Larutan Media Perendaman

Diketahui :

HCl : 1,159 gr/mL

BM : 36,5 gr/mol

% : 32

Penyelesaian :

Konsentrasi HCl 32%

$$M = \frac{\rho \times \% \times 1000 \text{ mL}}{\text{BM}}$$

$$= \frac{1,159 \frac{\text{gr}}{\text{mL}} \times 0,32 \times 1000 \text{ mL}}{36,5 \text{ gr}}$$

$$M = 10,161 \text{ M}$$

Konsentrasi HCl 1M

$$V_1 M_1 = V_2 M_2$$

$$V_1 \times 10,161 \text{ M} = 100 \text{ mL} \times 2\text{M}$$

$$V_1 = \frac{100 \text{ mL} \times 2\text{M}}{10,161 \text{ M}}$$

$$= 19,6831 \text{ M}$$

Konsentrasi HCl 2M

$$V_1 M_1 = V_2 M_2$$

$$V_1 \times 10,161 \text{ M} = 100 \text{ mL} \times 1\text{M}$$

$$V_1 = \frac{100 \text{ mL} \times 1\text{M}}{10,161 \text{ M}}$$

$$V_1 = 9,8415 \text{ mL}$$

Konsentrasi HCl 3M

$$V_1 M_1 = V_2 M_2$$

$$V_1 \times 10,161 \text{ M} = 100 \text{ mL} \times 4\text{M}$$

$$V_1 = \frac{100 \text{ mL} \times 4\text{M}}{10,161 \text{ M}}$$

$$V_1 = 39,3662 \text{ mL}$$

Konsentrasi HCl 4M

$$V_1 M_1 = V_2 M_2$$

$$V_1 \times 10,161 \text{ M} = 100 \text{ mL} \times 3\text{M}$$

$$V_1 = \frac{100 \text{ mL} \times 3\text{M}}{10,161 \text{ M}}$$

$$V_1 = 29,5246 \text{ mL}$$

Konsentrasi HCl 5M

$$V_1 M_1 = V_2 M_2$$

$$V_1 \times 10,161 \text{ M} = 100 \text{ mL} \times 5\text{M}$$

$$V_1 = \frac{100 \text{ mL} \times 5\text{M}}{10,161 \text{ M}}$$

$$V_1 = 49,2077 \text{ mL}$$

1.2.2 Perhitungan Analisa Kadar Tanin

Diketahui :

Massa kristal asam oksalat : 630 mg = 6,3 gr

Volume titran KMnO_4 (standarisasi) : 27,3 mL = 0,0273 L

BM asam oksalat : 126 g/mol

A (Volume titrasi titran KMnO_4) : 16,2 mL = 0,0162 L

B (Volume titrasi blanko) : 14,3 mL = 0,0143 L

Massa sampel : 1,5 gram

Penyelesaian :

$$\begin{aligned} N \text{ KMnO}_4 &= \frac{\frac{w}{\text{BM}} \times 2 \times \frac{25}{100}}{\text{Volume titran}} \\ &= \frac{\frac{6,3 \text{ g}}{126 \text{ g/mol}} \times 2 \times \frac{25}{100}}{0,0273 \text{ L}} = 0,09157 \end{aligned}$$

Kadar tanin pada ekstrak daun jambu biji

$$\begin{aligned} \% \text{ tannin} &= \frac{10 (A-B) \times N \times 0,00416}{\text{massa sampel (gr)}} \times 100\% \\ &= \frac{10 (16,2 \text{ mL} - 14,3 \text{ mL}) \times 0,09157 \times 0,00416}{1,5 \text{ gram}} \times 100\% \\ &= 0,4283 \% \end{aligned}$$

1.2.3 Perhitungan Densitas Ekstrak Daun Jambu Biji

Diketahui :

Berat pikno kosong = 30,8642 gr

Berat pikno + ekstrak = 52,7162 gr

Volume pikno = 24,812 cm³

$$\begin{aligned} &= \frac{(\text{berat pikno+ekstrak}) - \text{berat pikno kosong}}{\text{volume pikno}} \\ &= \frac{(52,7162 - 30,8642) \text{ gr}}{24,812 \text{ cm}^3} \\ &= 0,8807 \text{ gr/cm}^3 \end{aligned}$$

1.2.4 Perhitungan Laju Korosi Dengan Inhibitor

1.2.4.1 Konsentrasi HCl 1M

Waktu perendaman 1 minggu (168 jam)

a. Massa pelat

Berat awal : 17,7789 gr

Berat akhir : 17,0763 gr

$$\begin{aligned}
 \text{Massa} &= \text{Berat awal} - \text{berat akhir} \\
 &= 16,1645 \text{ gr} - 15,8654 \text{ gr} \\
 &= 0,7626 \text{ gr}
 \end{aligned}$$

b. Luas permukaan (A)

$$\begin{aligned}
 \text{panjang} &: 4 \text{ cm} \\
 \text{lebar} &: 2,6 \text{ cm} \\
 \text{tebal} &: 0,24 \text{ cm}
 \end{aligned}$$

$$\begin{aligned}
 A &= 2 ((p \times l) + (l \times t) + (p \times t)) \\
 &= 2 ((4 \text{ cm} \times 2,6 \text{ cm}) + (2,6 \text{ cm} \times 0,24 \text{ cm}) + (4 \text{ cm} \times 0,24 \text{ cm})) \\
 &= 23,968 \text{ cm}^2
 \end{aligned}$$

c. Densitas pelat

$$\begin{aligned}
 \text{massa awal} &: 17,7789 \text{ gr} \\
 A &: 23,968 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 \rho &= \frac{\text{massa awal}}{A} \\
 &= \frac{17,7789 \text{ gr}}{23,968 \text{ cm}^2} \\
 &= 7,1229 \text{ gr/cm}^2
 \end{aligned}$$

d. Laju korosi

$$\begin{aligned}
 \text{Konstanta (K)} &= 3,45 \times 10^6 \text{ mpy} \\
 \text{Massa (w)} &= 0,2991 \text{ gr} \\
 A &= 23,968 \text{ cm}^2 \\
 \text{Densitas (D)} &= 7,1229 \text{ gr/cm}^2 \\
 \text{Waktu (T)} &= 168 \text{ jam}
 \end{aligned}$$

$$\begin{aligned}
 \text{Laju korosi} &= \frac{K \times w}{A \times T \times D} \\
 &= \frac{3,45 \times 10^6 \text{ mpy} \times 0,2991 \text{ gr}}{23,968 \text{ cm}^2 \times 168 \text{ jam} \times 7,1229 \frac{\text{gr}}{\text{cm}^2}} \\
 &= 84,5134 \text{ mpy}
 \end{aligned}$$

1.2.4.2 Konsentrasi HCl 1M

Waktu perendaman 2 minggu (336 jam)

a. Massa pelat

Berat awal : 17,7789 gr

Berat akhir : 16,4795 gr

$$\begin{aligned}\text{Massa} &= \text{Berat awal} - \text{berat akhir} \\ &= 17,7789 \text{ gr} - 16,4795 \text{ gr} \\ &= 1,3004 \text{ gr}\end{aligned}$$

b. Luas permukaan (A)

panjang : 4 cm

lebar : 2,6 cm

tebal : 0,24 cm

$$\begin{aligned}A &= 2 ((p \times l) + (l \times t) + (p \times t)) \\ &= 2 ((4 \text{ cm} \times 2,6 \text{ cm}) + (2,6 \text{ cm} \times 0,24 \text{ cm}) + (4 \text{ cm} \times 0,24 \text{ cm})) \\ &= 23,968 \text{ cm}^2\end{aligned}$$

c. Densitas pelat

massa awal : 17,7789 gr

A : 23,968 cm²

$$\begin{aligned}\rho &= \frac{\text{massa awal}}{A} \\ &= \frac{17,7789 \text{ gr}}{23,968 \text{ cm}^2} \\ &= 7,1229 \text{ gr/cm}^2\end{aligned}$$

d. Laju korosi

Konstanta (K) = 3,45 x 10⁶ mpy

Massa (w) = 1,3004 gr

A = 23,968 cm²

$$\begin{aligned}
 \text{Densitas (D)} &= 7,1229 \text{ gr/cm}^2 \\
 \text{Waktu (T)} &= 168 \text{ jam} \\
 \text{Laju korosi} &= \frac{K \times w}{A \times T \times D} \\
 &= \frac{3,45 \times 10^6 \text{ mpy} \times 1,3004 \text{ gr}}{23,968 \text{ cm}^2 \times 168 \text{ jam} \times 7,1229 \frac{\text{gr}}{\text{cm}^2}} \\
 &= 78,2104 \text{ mpy}
 \end{aligned}$$

Dengan cara perhitungan yang sama, hasil perhitungan laju korosi yang terdapat pada konsentrasi HCl 2M, 3M, 4M, dan 5M (dengan penambahan *bioinhibitor*).

Dapat dilihat pada tabel berikut :

Tabel 1. Hasil Perhitungan Laju Korosi Dengan Penambahan Inhibitor

Media Korosif	W (gr)	Konstanta	A (cm ²)	T (jam)	Densitas (gr/cm ³)	Laju Korosi (mpy)
HCl 1M	0,7026	3450000	23,968	168	7,1229	84,5134
	1,3004	3450000	23,968	336		78,2104
	1,8994	3450000	23,968	504		76,2135
	2,7626	3450000	23,968	672		83,0760
	3,6456	3450000	23,968	840		89,9456
HCl 2M	0,7839	3450000	23,968	168	7,1052	94,5277
	2,1074	3450000	23,968	336		127,0620
	4,3171	3450000	23,968	504		173,5280
	5,2357	3450000	23,968	672		157,8387
	6,1763	3450000	23,968	840		148,9557
HCl 3M	1,8584	3450000	23,968	168	7,0861	224,7018
	3,0865	3450000	23,968	336		186,5959
	4,8553	3450000	23,968	504		195,6464
	6,8847	3450000	23,968	672		208,1090
	8,3617	3450000	23,968	840		202,2043
HCl 4M	2,4	3450000	23,968	168	7,0763	290,5906
	4,1587	3450000	23,968	336		251,7665
	4,7367	3450000	23,968	504		191,1723
	5,6601	3450000	23,968	672		171,3304
	6,5516	3450000	23,968	840		158,6528
HCl 5M	3,8577	3450000	23,968	168	7,1110	464,8065
	5,5621	3450000	23,968	336		335,0831
	7,3509	3450000	23,968	504		295,2317
	8,4457	3450000	23,968	672		254,4013
	9,6456	3450000	23,968	840		232,4358

1.2.5 Perhitungan Laju Korosi Tanpa Inhibitor

1.2.5.1 Konsentrasi HCl 1M

Waktu perendaman 1 minggu (168 jam)

a. Massa pelat

Berat awal : 16,9268 gr

Berat akhir : 14,3814 gr

$$\begin{aligned}\text{Massa} &= \text{Berat awal} - \text{berat akhir} \\ &= 16,9268 \text{ gr} - 14,3814 \text{ gr} \\ &= 2,5454 \text{ gr}\end{aligned}$$

b. Luas permukaan (A)

panjang : 4 cm

lebar : 2,6 cm

tebal : 0,24 cm

$$\begin{aligned}A &= 2 ((p \times l) + (l \times t) + (p \times t)) \\ &= 2 ((4 \text{ cm} \times 2,6 \text{ cm}) + (2,6 \text{ cm} \times 0,24 \text{ cm}) + (4 \text{ cm} \times 0,24 \text{ cm})) \\ &= 23,968 \text{ cm}^2\end{aligned}$$

c. Densitas pelat

massa awal : 16,9268 gr

A : 23,968 cm²

$$\begin{aligned}\rho &= \frac{\text{massa awal}}{A} \\ &= \frac{16,9268 \text{ gr}}{23,968 \text{ cm}^2} \\ &= 6,7815 \text{ gr/cm}^2\end{aligned}$$

d. Laju korosi

Konstanta (K) = 3,45 x 10⁶ mpy

$$\begin{aligned}
\text{Massa (w)} &= 0,2991 \text{ gr} \\
A &= 23,968 \text{ cm}^2 \\
\text{Densitas (D)} &= 7,1229 \text{ gr/cm}^2 \\
\text{Waktu (T)} &= 168 \text{ jam} \\
\text{Laju korosi} &= \frac{K \times w}{A \times T \times D} \\
&= \frac{3,45 \times 10^6 \text{ mpy} \times 2,5454 \text{ gr}}{23,968 \text{ cm}^2 \times 168 \text{ jam} \times 6,7815 \frac{\text{gr}}{\text{cm}^2}} \\
&= 321,5909 \text{ mpy}
\end{aligned}$$

1.2.5.2 Konsentrasi HCl 1M

Waktu perendaman 2 minggu (336 jam)

a. Massa pelat

Berat awal : 16,9268 gr

Berat akhir : 13,8336 gr

$$\begin{aligned}
\text{Massa} &= \text{Berat awal} - \text{berat akhir} \\
&= 16,9268 \text{ gr} - 13,8336 \text{ gr} \\
&= 3,0932 \text{ gr}
\end{aligned}$$

b. Densitas pelat

massa awal : 16,9268 gr

A : 23,968 cm²

$$\begin{aligned}
\rho &= \frac{\text{massa awal}}{A} \\
&= \frac{16,9268 \text{ gr}}{23,968 \text{ cm}^2} \\
&= 6,7815 \text{ gr/cm}^2
\end{aligned}$$

c. Laju korosi

$$\begin{aligned}
\text{Massa (w)} &= 0,2991 \text{ gr} \\
A &= 23,968 \text{ cm}^2 \\
\text{Densitas (D)} &= 7,1229 \text{ gr/cm}^2 \\
\text{Waktu (T)} &= 168 \text{ jam}
\end{aligned}$$

$$\begin{aligned}
 \text{Laju korosi} &= \frac{K \times w}{A \times T \times D} \\
 &= \frac{3,45 \times 10^6 \text{ mpy} \times 3,0932 \text{ gr}}{23,968 \text{ cm}^2 \times 168 \text{ jam} \times 6,7815 \frac{\text{gr}}{\text{cm}^2}} \\
 &= 195,4005 \text{ mpy}
 \end{aligned}$$

Dengan cara perhitungan yang sama, hasil perhitungan laju korosi yang terdapat pada konsentrasi HCl 2M, 3M, 4M, dan 5M (tanpa penambahan *bioinhibitor*).

Dapat dilihat pada tabel berikut :

Tabel 2. Hasil Perhitungan Laju Korosi Tanpa Penambahan Inhibitor

Media Korosif	W (gr)	Konstanta	A (cm ²)	T (jam)	Densitas (gr/cm ³)	Laju Korosi (mpy)
HCl 1M	2,5454	3450000	23,968	168	6,7815	321,5909
	3,0932	3450000	23,968	336		195,4005
	3,5957	3450000	23,968	504		151,4293
	4,0012	3450000	23,968	672		126,3798
	4,7954	3450000	23,968	840		121,1720
HCl 2M	1,6857	3450000	23,968	168	6,9701	207,2125
	44873	3450000	23,968	336		275,7978
	5,7690	3450000	23,968	504		236,3823
	6,7302	3450000	23,968	672		206,8253
	7,3762	3450000	23,968	840		181,3420
HCl 3M	3,5423	3450000	23,968	168	6,6361	457,3492
	5,4684	3450000	23,968	336		353,0147
	7,5967	3450000	23,968	504		326,9387
	8,0448	3450000	23,968	672		259,6676
	9,4675	3450000	23,968	840		244,4173
HCl 4M	5,2519	3450000	23,968	168	6,6556	676,0892
	6,5312	3450000	23,968	336		420,3882
	7,0295	3450000	23,968	504		301,6412
	8,2777	3450000	23,968	672		266,4018
	9,1120	3450000	23,968	840		234,6017
HCl 5M	6,1843	3450000	23,968	168	6,7133	789,2729
	8,0645	3450000	23,968	336		514,6170
	9,9795	3450000	23,968	504		424,5454
	11,1035	3450000	23,968	672		354,2718
	12,2056	3450000	23,968	840		311,5486

1.2.6 Perhitungan efisiensi inhibitor

1.2.6.1 Efisiensi inhibitor pada HCl 1M

Minggu 1

X_a : 321,5909 mpy

X_b : 84,5134 mpy

$$\begin{aligned}\text{Efisiensi inhibitor} &= \frac{X_a - X_b}{X_a} \times 100\% \\ &= \frac{321,5909 \text{ mpy} - 84,5134 \text{ mpy}}{321,5909 \text{ mpy}} \times 100\% \\ &= 73,7202 \%\end{aligned}$$

Minggu 2

X_a : 195,4005 mpy

X_b : 78,2104 mpy

$$\begin{aligned}\text{Efisiensi inhibitor} &= \frac{X_a - X_b}{X_a} \times 100\% \\ &= \frac{195,4005 \text{ mpy} - 78,2104 \text{ mpy}}{195,4005 \text{ mpy}} \times 100\% \\ &= 59,4703 \%\end{aligned}$$

Dengan cara perhitungan yang sama, hasil perhitungan efisiensi inhibitor yang terdapat pada konsentrasi HCl 2M, 3M, 4M, dan 5M. Dapat dilihat pada tabel berikut :

Tabel 3. Hasil Perhitungan Efisiensi Inhibitor

Media Korosif	Laju Korosi Tanpa Inhibitor (mpy)	Laju Korosi Dengan Inhibitor (mpy)	Efisiensi (%)
HCl 1M	321,5909	84,5134	73,7202
	195,4005	78,2104	59,9743
	151,4293	76,2135	49,7075
	126,3798	83,0760	34,2675
	121,1720	89,9456	25,7703
HCl 2M	207,2125	94,5277	54,3812
	275,7978	127,0620	53,9292
	236,3823	173,5280	26,7274
	206,8253	157,8387	23,6864
	181,3420	148,9557	13,2677

	457,3492	224,7018	50,8686
	353,0147	186,5959	47,1408
HCl 3M	326,9387	195,6464	40,1458
	259,6676	208,1090	19,8556
	244,4173	202,2043	17,2708
	676,0892	290,5906	57,0188
	420,3882	251,7665	40,1109
HCl 4M	301,6412	191,1723	36,5403
	266,4018	171,3304	35,6872
	234,6017	158,6528	32,3735
	789,2729	464,8065	41,1095
	514,6170	335,0831	34,8868
HCl 5M	424,5454	295,2317	30,4710
	354,2718	254,4013	28,1903
	311,5486	232,4358	24,4304

