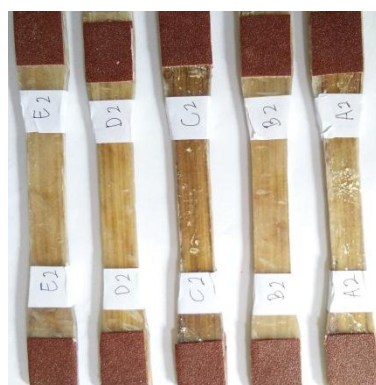
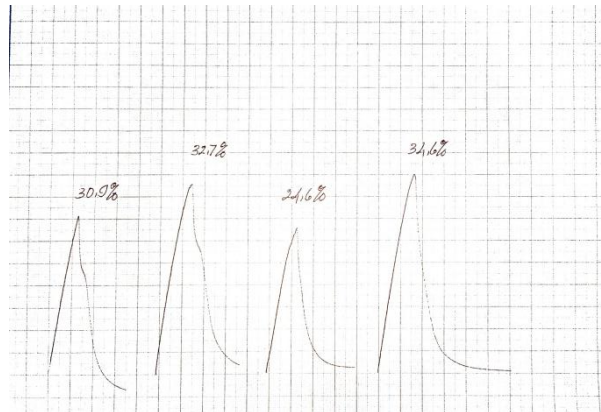
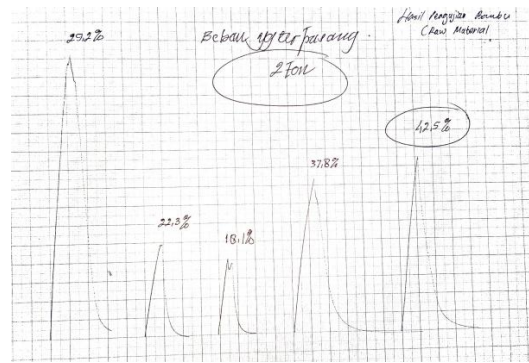
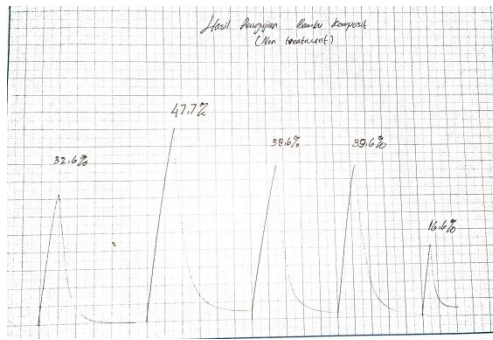


LAMPIRAN





RAW MATERIAL

No	kode spesimen	Kekuatan Tarik (Mpa)	Regangan (%)	Modulus Elastisitas (Gpa)
1.	A1	177,08	1,55	11,42
2.	B1	115,63	0,60	19,27
3.	C1	108,70	0,90	12,07
4.	D1	185,13	1,40	13,20

KOMPOSIT SANDWICH UNTREATMENT

No	kode spesimen	Kekuatan Tarik (Mpa)	Regangan (%)	Modulus Elastisitas (Gpa)
1.	A2	92,40	1,00	9,20
2.	B2	125,44	0,90	13,93
3.	C2	105,20	1,40	7,51
4.	D2	102,65	0,79	12,90

KOMPOSIT SANDWICH TREATMENT

No	kode spesimen	Kekuatan Tarik (Mpa)	Regangan (%)	Modulus Elastisitas (Gpa)
1.	A3	162,41	0,90	18,04
2.	B3	175,11	0,60	29,18
3.	C3	171,46	0,90	19,05
4.	D3	174,40	0,60	29,06

PERHITUNGAN UJI TARIK
RAW MATERIAL

A1. - $\sigma_{maks} = \frac{F}{A_0}$

$$= \frac{5723,2 \text{ N}}{32,32 \text{ mm}^2}$$
$$= 177,08 \text{ N/mm}^2$$

- $e = \frac{Li-Lo}{Lo} \times 100\%$

$$= \frac{167,15 - 165,60}{165,60} \times 100\%$$
$$= 1,55\%$$

- $E = \frac{\sigma_{maks}}{e}$

$$= \frac{177,08 \text{ N/mm}^2}{0,0155}$$
$$= 11,42 \text{ GPa}$$

B1. - $\sigma_{maks} = \frac{F}{A_0}$

$$= \frac{4370,8 \text{ N}}{37,80 \text{ mm}^3}$$
$$= 115,63 \text{ N/mm}^2$$

- $e = \frac{Li-Lo}{Lo} \times 100\%$

$$= \frac{166,05 - 165}{165} \times 100\%$$
$$= 0,6\%$$

- $E = \frac{\sigma_{maks}}{e}$

$$= \frac{115,63 \text{ N/mm}^2}{0,006}$$
$$= 19,27 \text{ GPa}$$

C1. - $\sigma_{maks} = \frac{F}{A_0}$

$$= \frac{3547,6 \text{ N}}{32,64 \text{ mm}^2}$$
$$= 108,70 \text{ N/mm}^2$$

- $e = \frac{Li-Lo}{Lo} \times 100\%$

$$= \frac{165,60 - 164}{164} \times 100\%$$
$$= 0,9\%$$

- $E = \frac{\sigma_{maks}}{e}$

$$= \frac{108,70 \text{ N/mm}^2}{0,009}$$
$$= 12,07 \text{ GPa}$$

D1. - $\sigma_{maks} = \frac{F}{A_0}$

$$= \frac{7408 \text{ N}}{40,02 \text{ mm}^2}$$
$$= 185,13 \text{ N/mm}^2$$

- $e = \frac{Li-Lo}{Lo} \times 100\%$

$$= \frac{167,45 - 165,15}{165,15} \times 100\%$$
$$= 1,4\%$$

- $E = \frac{\sigma_{maks}}{e}$

$$= \frac{185,13 \text{ N/mm}^2}{0,014}$$
$$= 13,2 \text{ GPa}$$

PERHITUNGAN UJI TARIK
KOMPOSIT SANDWICH
UNTREATMENT

$$\begin{aligned}
 \text{A2. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{6389,6 \text{ N}}{69,17 \text{ mm}^2} \\
 &= 92,40 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{166,75 - 165}{165} \times 100\% \\
 &= 1\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{92,40 \text{ N/mm}^2}{0,01} \\
 &= 9,2 \text{ GPa}
 \end{aligned}$$

$$\begin{aligned}
 \text{B2. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{9349,2 \text{ N}}{74,53 \text{ mm}^2} \\
 &= 125,44 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{166,75 - 165,10}{165,10} \times 100\% \\
 &= 0,9\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{125,44 \text{ N/mm}^2}{0,009} \\
 &= 9,2 \text{ GPa}
 \end{aligned}$$

$$\begin{aligned}
 \text{C2. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{7565,6 \text{ N}}{71,91 \text{ mm}^2} \\
 &= 105,2 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{167,80 - 165,40}{165,40} \times 100\% \\
 &= 1,4\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{105,2 \text{ N/mm}^2}{0,014} \\
 &= 7,51 \text{ GPa}
 \end{aligned}$$

$$\begin{aligned}
 \text{D2. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{7761,6 \text{ N}}{75,61 \text{ mm}^2} \\
 &= 102,65 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{166,70 - 164,40}{164,40} \times 100\% \\
 &= 0,79\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{102,65 \text{ N/mm}^2}{0,0079} \\
 &= 12,9 \text{ GPa}
 \end{aligned}$$

PERHITUNGAN UJI TARIK
KOMPOSIT SANDWICH
TREATMENT

$$\begin{aligned}
 \text{A3. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{6056,4 \text{ N}}{37,29 \text{ mm}^2} \\
 &= 162,41 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{167,5 - 166}{166} \times 100\% \\
 &= 0,9\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{162,41 \text{ N/mm}^2}{0,009} \\
 &= 18,04 \text{ GPa}
 \end{aligned}$$

$$\begin{aligned}
 \text{B3. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{6409,2 \text{ N}}{36,60 \text{ mm}^2} \\
 &= 175,11 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{167 - 166}{166} \times 100\% \\
 &= 0,6\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{175,11 \text{ N/mm}^2}{0,006}
 \end{aligned}$$

$$= 29,18 \text{ GPa}$$

$$\begin{aligned}
 \text{C3. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{4821,6 \text{ N}}{28,12 \text{ mm}^2} \\
 &= 171,46 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{168 - 166,5}{166,5} \times 100\% \\
 &= 0,9\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{171,46 \text{ N/mm}^2}{0,009} \\
 &= 19,05 \text{ GPa}
 \end{aligned}$$

$$\begin{aligned}
 \text{D3. } - \sigma_{maks} &= \frac{F}{A_0} \\
 &= \frac{6781,6 \text{ N}}{38,88 \text{ mm}^2} \\
 &= 174,4 \text{ N/mm}^2 \\
 - e &= \frac{L_i - L_0}{L_0} \times 100\% \\
 &= \frac{167 - 166}{166} \times 100\% \\
 &= 0,6\% \\
 - E &= \frac{\sigma_{maks}}{e} \\
 &= \frac{174,4 \text{ N/mm}^2}{0,006} \\
 &= 29,06 \text{ GPa}
 \end{aligned}$$

PERHITUNGAN UJI BENDING
PERHITUNGAN RAW
MATERIAL

$$\begin{aligned}\text{Ao. } - Mb &= \frac{P.Ls}{4} \\ &= \frac{366 \text{ N} \cdot 100,32 \text{ mm}}{4} \\ &= 9179,28 \text{ N} \cdot \text{m}\end{aligned}$$

$$\begin{aligned}- W &= \frac{b \cdot (h)^2}{6} = \frac{13,76 \cdot (4,92)^2}{6} \\ &= 55,50 \text{ mm}^3\end{aligned}$$

$$\begin{aligned}- \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{9179,28 \text{ N} \cdot \text{m}}{55,50 \text{ mm}^3} \\ &= 165,40 \text{ N/mm}^2\end{aligned}$$

$$\begin{aligned}\text{Bo. } - Mb &= \frac{P.Ls}{4} \\ &= \frac{374 \text{ N} \cdot 100,30 \text{ mm}}{4} \\ &= 9378,05 \text{ N} \cdot \text{m}\end{aligned}$$

$$\begin{aligned}- W &= \frac{b \cdot (h)^2}{6} = \frac{13,12 \cdot (5,88)^2}{6} \\ &= 75,60 \text{ mm}^3\end{aligned}$$

$$\begin{aligned}- \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{9378,05 \text{ N} \cdot \text{m}}{75,60 \text{ mm}^3} \\ &= 124,05 \text{ N/mm}^2\end{aligned}$$

$$\begin{aligned}\text{Co. } - Mb &= \frac{P.Ls}{4} \\ &= \frac{426 \text{ N} \cdot 100,50 \text{ mm}}{4} \\ &= 10703,25 \text{ N} \cdot \text{m}\end{aligned}$$

$$\begin{aligned}- W &= \frac{b \cdot (h)^2}{6} = \frac{13,28 \cdot (5,54)^2}{6} \\ &= 67,95 \text{ mm}^3\end{aligned}$$

$$\begin{aligned}- \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{10703,25 \text{ N} \cdot \text{m}}{67,95 \text{ mm}^3} \\ &= 157,51 \text{ N/mm}^2\end{aligned}$$

$$\begin{aligned}\text{Do. } - Mb &= \frac{P.Ls}{4} \\ &= \frac{540 \text{ N} \cdot 100,20 \text{ mm}}{4} \\ &= 13527 \text{ N} \cdot \text{m}\end{aligned}$$

$$\begin{aligned}- W &= \frac{b \cdot (h)^2}{6} = \frac{13,86 \cdot (6,28)^2}{6} \\ &= 91,10 \text{ mm}^3\end{aligned}$$

$$\begin{aligned}- \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{13527 \text{ N} \cdot \text{m}}{91,10 \text{ mm}^3} \\ &= 148,50 \text{ N/mm}^2\end{aligned}$$

PERHITUNGAN KOMPOSIT
SANDWICH UNTREATMENT

$$\begin{aligned} \mathbf{A1. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{576 N \cdot 100,10 mm}{4} \end{aligned}$$

$$= 14558,4 N.m$$

$$\begin{aligned} - W &= \frac{b.(h)^2}{6} = \frac{14,20 \cdot (7,34)^2}{6} \\ &= 127,50 mm^3 \end{aligned}$$

$$\begin{aligned} - \sigma Bending &= \frac{Mb}{W} \\ &= \frac{14558,4 N.m}{127,50 mm^3} \\ &= 114,18 N/mm^2 \end{aligned}$$

$$\begin{aligned} \mathbf{B1. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{770 N \cdot 100,20 mm}{4} \end{aligned}$$

$$= 19481 N.m$$

$$\begin{aligned} - W &= \frac{b.(h)^2}{6} = \frac{15,30 \cdot (7,72)^2}{6} \\ &= 151,98 mm^3 \end{aligned}$$

$$\begin{aligned} - \sigma Bending &= \frac{Mb}{W} \\ &= \frac{19481 N.m}{151,98 mm^3} \\ &= 128,18 N/mm^2 \end{aligned}$$

$$\begin{aligned} \mathbf{C1. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{672 N \cdot 100,20 mm}{4} \end{aligned}$$

$$= 17001,6 N.m$$

$$\begin{aligned} - W &= \frac{b.(h)^2}{6} = \frac{14,32 \cdot (8,28)^2}{6} \\ &= 163,63 mm^3 \end{aligned}$$

$$\begin{aligned} - \sigma Bending &= \frac{Mb}{W} \\ &= \frac{17001,6 N.m}{163,63 mm^3} \\ &= 103,90 N/mm^2 \end{aligned}$$

$$\begin{aligned} \mathbf{D1. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{714 N \cdot 100,40 mm}{4} \end{aligned}$$

$$= 18099,9 N.m$$

$$\begin{aligned} - W &= \frac{b.(h)^2}{6} = \frac{14,66 \cdot (8,90)^2}{6} \\ &= 193,53 mm^3 \end{aligned}$$

$$\begin{aligned} - \sigma Bending &= \frac{Mb}{W} \\ &= \frac{18099,9 N.m}{193,53 mm^3} \\ &= 93,52 N/mm^2 \end{aligned}$$

PERHITUNGAN KOMPOSIT
SANDWICH TREATMENT

$$\begin{aligned} \mathbf{A2. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{784 \text{ N} \cdot 100,38 \text{ mm}}{4} \end{aligned}$$

$$= 19870,48 \text{ N} \cdot \text{m}$$

$$\begin{aligned} - W &= \frac{b \cdot (h)^2}{6} = \frac{13,50 \cdot (7,20)^2}{6} \\ &= 116,64 \text{ mm}^3 \end{aligned}$$

$$\begin{aligned} - \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{19870,48 \text{ N} \cdot \text{m}}{116,64 \text{ mm}^3} \\ &= 170,36 \text{ N/mm}^2 \end{aligned}$$

$$\begin{aligned} \mathbf{B2. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{794 \text{ N} \cdot 100,50 \text{ mm}}{4} \end{aligned}$$

$$= 19949,25 \text{ N} \cdot \text{m}$$

$$\begin{aligned} - W &= \frac{b \cdot (h)^2}{6} = \frac{13,70 \cdot (7,20)^2}{6} \\ &= 118,37 \text{ mm}^3 \end{aligned}$$

$$\begin{aligned} - \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{19949,25 \text{ N} \cdot \text{m}}{118,37 \text{ mm}^3} \\ &= 168,53 \text{ N/mm}^2 \end{aligned}$$

$$\begin{aligned} \mathbf{C2. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{640 \text{ N} \cdot 101 \text{ mm}}{4} \end{aligned}$$

$$= 16160 \text{ N} \cdot \text{m}$$

$$\begin{aligned} - W &= \frac{b \cdot (h)^2}{6} = \frac{13,48 \cdot (6,34)^2}{6} \\ &= 90,31 \text{ mm}^3 \end{aligned}$$

$$\begin{aligned} - \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{16160 \text{ N} \cdot \text{m}}{90,31 \text{ mm}^3} \\ &= 178,94 \text{ N/mm}^2 \end{aligned}$$

$$\begin{aligned} \mathbf{D2. - Mb} &= \frac{P.Ls}{4} \\ &= \frac{624 \text{ N} \cdot 101,40 \text{ mm}}{4} \end{aligned}$$

$$= 15818,4 \text{ N} \cdot \text{m}$$

$$\begin{aligned} - W &= \frac{b \cdot (h)^2}{6} = \frac{13,02 \cdot (6,44)^2}{6} \\ &= 89,99 \text{ mm}^3 \end{aligned}$$

$$\begin{aligned} - \sigma \text{Bending} &= \frac{Mb}{W} \\ &= \frac{15818,4 \text{ N} \cdot \text{m}}{89,99 \text{ mm}^3} \\ &= 175,78 \text{ N/mm}^2 \end{aligned}$$

**PERHITUNGAN PROSES
ALKALI (NaOH)**

Konsentrasi NaOH 2,5%

Berat molekul = 39,99 (40 gr/mol)

Densitas = 2,13 gr/cm³

Kemurnian larutan 48,24%

$$M1 \text{ 2,5\% NaOH} = \frac{10 \times 2,5 \times 2,13}{40}$$
$$= \frac{53,25}{40}$$

$$M2 = 1,33$$

$$M1 \text{ 48,24\%} = \frac{10 \times 48,24 \times 2,13}{40}$$
$$= \frac{1027,51}{40}$$

$$M2 = 25,70$$

$$M1 \cdot V1 = M2 \cdot V2$$

$$25,70 \cdot V1 = 1,33 \cdot 1000$$

$$V1 = \frac{1330}{25,70}$$

$$V1 = 51,75 \text{ ml (52 ml)}$$

**PERHITUNGAN PROSES
BLEACHING**

NaOH = 0,25%

Kemurnian = 48,24%

$$M2 = \frac{10 \times 0,25 \times 2,13}{40}$$

$$= \frac{5,32}{40}$$

$$= 0,13$$

$$M1 = \frac{10 \times 48,24 \times 2,13}{40}$$

$$= \frac{1027,51}{40}$$

$$= 25,70$$

$$M1 \cdot V1 = M2 \cdot V2$$

$$25,70 \cdot V1 = 0,13 \cdot 200 \text{ ml}$$

$$V1 = \frac{26}{25,70}$$

$$= 1,01 \text{ ml}$$

$$V1 = 2 \text{ ml NaOH : 400 ml air}$$

H₂O₂

Konsentrasi H₂O₂ = 1,5%

Densitas = 1,45 gr/cm³

Berat molekul = 34 gr/mol

$$M1 = \frac{10 \times 50 \times 1,45}{34}$$

$$= \mathbf{21,32}$$

$$M2 = \frac{10 \times 1,5 \times 1,45}{34}$$

$$= \frac{21,75}{34}$$

$$= \mathbf{0,64}$$

$$\mathbf{M1 \cdot V1 = M2 \cdot V2}$$

$$21,32 \cdot V1 = 0,64 \cdot 200 \text{ ml}$$

$$V1 = \frac{128}{21,32}$$

$$V1 = \mathbf{6 \text{ ml}}$$

$$\mathbf{400 \text{ ml} = 12 \text{ ml} : 400 \text{ ml}}$$