

LAMPIRAN 1

**PERHITUNGAN FRAKSI VOLUME SERAT
KOMPOSIT HIBRIDA KENAF-*E GLASS* DENGAN MATRIKS
*POLYPROPYLENE***

Sebelum proses pencetakan dimulai maka dilakukan perhitungan terlebih dahulu, yaitu perhitungan terhadap massa serat, dan massa matriks. Fraksi volume serat hibrida (kenaf dan *E-glass*) dengan matriks *polypropylene* adalah 30%: 20%. Sedangkan fraksi volume serat kenaf dan *E-glass* yang digunakan adalah 10%: 20%, 15%:15%, dan 20%:10%. Adapun perhitungannya sebagai berikut :

Diketahui :

$$\text{Massa jenis serat kenaf} = 1.45 \text{ gr/cm}^3$$

$$\text{Massa jenis serat } E\text{-Glass} = 2.42 \text{ gr/cm}^3$$

$$\text{Massa jenis } polypropylene = 0.92 \text{ gr/cm}^3$$

$$\text{Dimensi cetakan : panjang (p)} = 17 \text{ cm}$$

$$\text{lebar (l)} = 2 \text{ cm}$$

$$\text{tebal (t)} = 0.4 \text{ cm}$$

Perbandingan fraksi volume serat dan matriks 30:70

➤ **Fraksi volume serat kenaf/*E-Glass* dengan perbandingan 10:20**

$$\begin{aligned} \text{Volume cetakan, } V_c &= p \times l \times t \\ &= 17 \text{ cm} \times 2 \text{ cm} \times 0.4 \text{ cm} \\ &= 13.6 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Volume Matriks, } V_m &= \frac{vm}{100} \times V_c \\ &= \frac{70}{100} \times 13.6 \text{ cm}^3 \\ &= 9.52 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Volume serat, } V_f &= \frac{vf}{100} \times V_c \\ &= \frac{30}{100} \times 13.6 \text{ cm}^3 \\ &= 4.08 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Volume serat kenaf, } V_{kenaf} &= \frac{10}{100} \times 13.6 \text{ cm}^3 \\ &= 1.36 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned}
\text{Volume serat } E\text{-Glass, } V_{E\text{-Glass}} &= \frac{20}{100} \times 13.6 \text{ cm}^3 \\
&= 2.72 \text{ cm}^3 \\
\text{Massa matriks, } m_m &= V_m \times \rho_m \\
&= 9.52 \text{ cm}^3 \times 0.92 \text{ gr/cm}^3 \\
&= 8.76 \text{ gr} \\
\text{Massa serat kenaf, } m_{kenaf} &= V_{kenaf} \times \rho_{kenaf} \\
&= 1.36 \text{ cm}^3 \times 1.45 \text{ gr/cm}^3 \\
&= 1.97 \text{ gr} \\
\text{Massa serat } E\text{-Glass, } m_{E\text{-Glass}} &= V_{E\text{-Glass}} \times \rho_{E\text{-Glass}} \\
&= 2.72 \text{ cm}^3 \times 2.42 \text{ gr/cm}^3 \\
&= 6.58 \text{ gr}
\end{aligned}$$

➤ **Fraksi volume serat kenaf/E-Glass dengan perbandingan 15:15**

$$\begin{aligned}
\text{Volume cetakan, } V_c &= p \times l \times t \\
&= 17 \text{ cm} \times 2 \text{ cm} \times 0.4 \text{ cm} \\
&= 13.6 \text{ cm}^3 \\
\text{Volume Matriks, } V_m &= \frac{70}{100} \times 13.6 \text{ cm}^3 \\
&= 9.52 \text{ cm}^3 \\
\text{Volume serat, } V_f &= \frac{30}{100} \times 13.6 \text{ cm}^3 \\
&= 4.08 \text{ cm}^3 \\
\text{Volume serat kenaf, } V_{kenaf} &= \frac{15}{100} \times 13.6 \text{ cm}^3 \\
&= 2.04 \text{ cm}^3 \\
\text{Volume serat } E\text{-Glass, } V_{E\text{-Glass}} &= \frac{15}{100} \times 13.6 \text{ cm}^3 \\
&= 2.04 \text{ cm}^3 \\
\text{Massa matriks, } m_m &= V_m \times \rho_m \\
&= 9.52 \text{ cm}^3 \times 0.92 \text{ gr/cm}^3 \\
&= 8.76 \text{ gr} \\
\text{Massa serat kenaf, } m_{kenaf} &= V_{kenaf} \times \rho_{kenaf} \\
&= 2.04 \text{ cm}^3 \times 1.45 \text{ gr/cm}^3
\end{aligned}$$

$$\begin{aligned}
&= 2.96 \text{ gr} \\
\text{Massa serat } E\text{-Glass, } m_{E\text{-Glass}} &= V_{E\text{-Glass}} \times \rho_{E\text{-Glass}} \\
&= 2.04 \text{ cm}^3 \times 2.42 \text{ gr/cm}^3 \\
&= 4.94 \text{ gr}
\end{aligned}$$

➤ **Fraaksi volume serat kenaf/E-Glass dengan perbandingan 20:10**

$$\begin{aligned}
\text{Volume cetakan, } V_c &= p \times l \times t \\
&= 17 \text{ cm} \times 2 \text{ cm} \times 0.4 \text{ cm} \\
&= 13.6 \text{ cm}^3
\end{aligned}$$

$$\begin{aligned}
\text{Volume Matriks, } V_m &= \frac{70}{100} \times 13.6 \text{ cm}^3 \\
&= 9.52 \text{ cm}^3
\end{aligned}$$

$$\begin{aligned}
\text{Volume serat, } V_f &= \frac{30}{100} \times 13.6 \text{ cm}^3 \\
&= 4.08 \text{ cm}^3
\end{aligned}$$

$$\begin{aligned}
\text{Volume serat kenaf, } V_{kenaf} &= \frac{20}{100} \times 13.6 \text{ cm}^3 \\
&= 2.72 \text{ cm}^3
\end{aligned}$$

$$\begin{aligned}
\text{Volume serat } E\text{-Glass, } V_{E\text{-Glass}} &= \frac{10}{100} \times 13.6 \text{ cm}^3 \\
&= 1.36 \text{ cm}^3
\end{aligned}$$

$$\begin{aligned}
\text{Massa matriks, } m_m &= V_m \times \rho_m \\
&= 9.52 \text{ cm}^3 \times 0.92 \text{ gr/cm}^3 \\
&= 8.76 \text{ gr}
\end{aligned}$$

$$\begin{aligned}
\text{Massa serat kenaf, } m_{kenaf} &= V_{kenaf} \times \rho_{kenaf} \\
&= 2.72 \text{ cm}^3 \times 1.45 \text{ gr/cm}^3 \\
&= 3.94 \text{ gr}
\end{aligned}$$

$$\begin{aligned}
\text{Massa serat } E\text{-Glass, } m_{E\text{-Glass}} &= V_{E\text{-Glass}} \times \rho_{E\text{-Glass}} \\
&= 1.36 \text{ cm}^3 \times 2.42 \text{ gr/cm}^3 \\
&= 3.29 \text{ gr}
\end{aligned}$$

LAMPIRAN 2

HASIL PENGUJIAN SERAT TUNGGAL KENAF

Kenaf	Diameter (μm)			Rata-rata		Luas Area (mm^2)	F (Kgf)
	1	2	3	(μm)	(mm)		
1	88.12	88.12	99.13	91.79	0.0918	0.006618739	0.155
2	110.15	143.19	132.18	128.507	0.1285	0.012968691	0.234
4	143.19	88.12	154.21	128.507	0.1285	0.012968691	0.235
5	110.15	154.21	110.15	124.837	0.1248	0.012232608	0.254
7	121.16	132.18	99.13	117.49	0.1175	0.010843403	0.198
8	154.21	88.12	99.13	113.82	0.1138	0.010171252	0.235
9	132.18	88.12	143.19	121.163	0.1212	0.011537059	0.262











F (N)	σ Tarik (Mpa)	(L) Standar ASTM (mm)	Measurement travel end / Δ L (mm)	ϵ (Tarik)	E (Mpa)
1.521	229.73	50.00	0.606	0.0121	18955
2.296	177.01	50.00	0.616	0.0123	14367.4
2.305	177.76	50.00	0.77	0.0154	11543
2.492	203.70	50.00	0.84	0.0168	12124.8
1.942	179.13	50.00	0.67	0.0134	13367.9
2.305	226.65	50.00	0.88	0.0176	12878
2.570	222.78	50.00	0.74	0.0148	15052.7
Rata - rata	202.39			0.0146	14041.26
Standar Deviasi	24.31			0.0021	2483.08
<i>Coefficient of Variation (%)</i>	12.01			14.58	17.68

Serat Tunggal (serat kenaf)

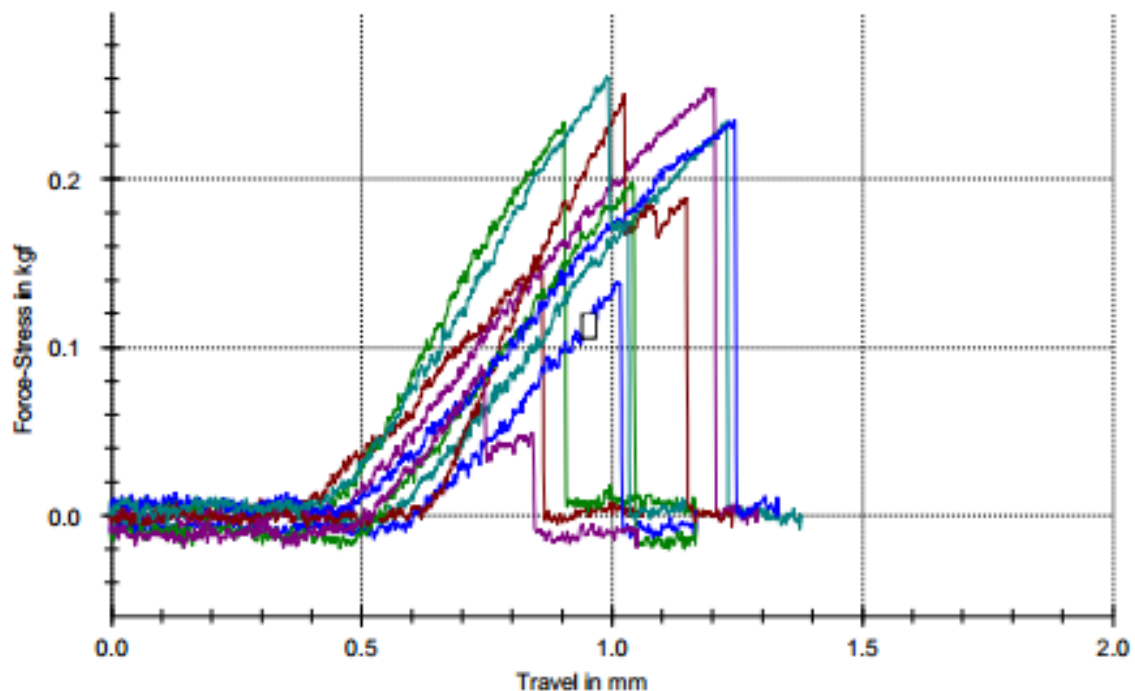
Parameter table:

Headline	: Serat Tunggal (serat kenaf)	Evaluat. method	: M (Automatic A, B or C)
Customer	: 923/LUPKPP-SERAT/IV/17	Specimen ID	: A1-A10
Tester	: Aprial	Specimen holders:	
Material	: Serat Tunggal	Extensometer	:
Test standard	: ASTM D 3379	Load cell	:

Results:

Legends	Nr	Fmax Lm kgf	Measurement travel end mm
	1	0.155	1.06
	2	0.234	1.16
	3	0.139	1.17
	4	0.235	1.37
	5	0.254	1.29
	6	0.251	1.24
	7	0.198	1.17
	8	0.235	1.33
	9	0.262	1.14
	10	0.089	1.05

Series graph:



PROPERTIS *POLYPROPYLENE* (Callister, 2007)

<i>Material</i>	<i>Modulus of Elasticity</i>	
	<i>GPa</i>	<i>10⁶psi</i>
Polyethylene		
• Low density (LDPE)	0.172–0.282	0.025–0.041
• High density (HDPE)	1.08	0.157
• Ultrahigh molecular weight (UHMWPE)	0.69	0.100
Poly(ethylene terephthalate) (PET)	2.76–4.14	0.40–0.60
Poly(methyl methacrylate) (PMMA)	2.24–3.24	0.325–0.470
Polypropylene (PP)	1.14–1.55	0.165–0.225
Polystyrene (PS)	2.28–3.28	0.330–0.475
Poly(tetrafluoroethylene) (PTFE)	0.40–0.55	0.058–0.080
Poly(vinyl chloride) (PVC)	2.41–4.14	0.35–0.60

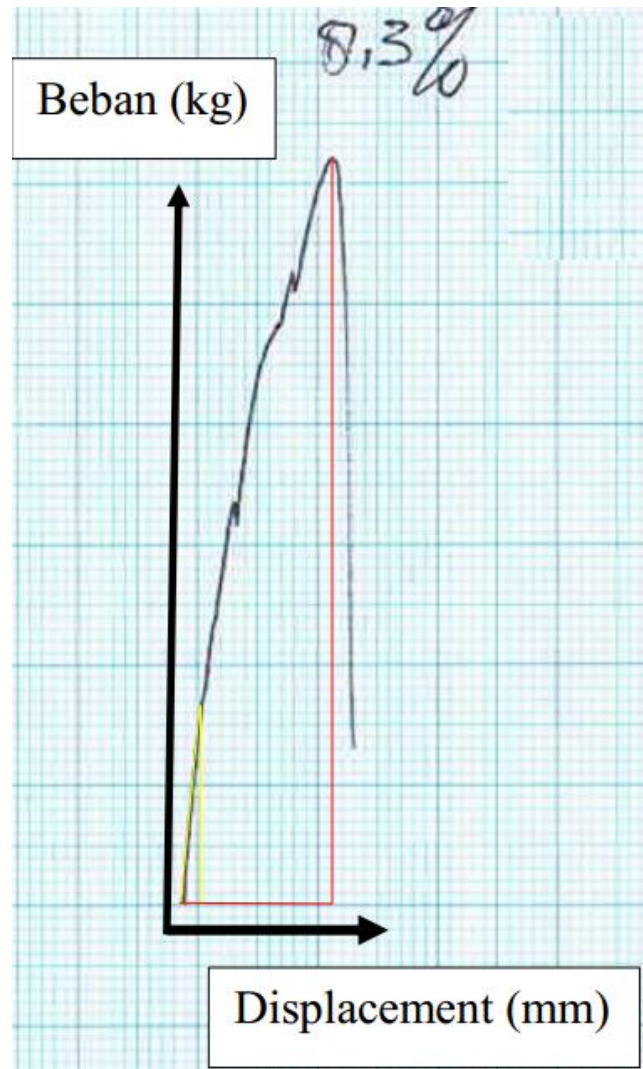
LAMPIRAN 3

**TABEL HASIL PERHITUNGAN PENGUJIAN TARIK KOMPOSIT HIBRIDA KENAF/E-GLASS DENGAN MATRIKS
POLYPROPYLENE**

Fraksi Volume Serat dan Matriks 30% : 70%	Nama Spesimen	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max load (Kg)	Beban Max Komposit (Kg)	Kekuatan Tarik σ (MPa)	Regangan Tarik (ε)	Modulus Elastisitas (MPa)
10% Serat Kenaf 20% Serat E-Glass	KF10/GF20/01	13	3.770	49.010	9.81	57	4.62	8.30	2000	166	33.227	0.081	842.12
	KF10/GF20/02	13	3.850	50.050	9.81	57	4.50	8.60	2000	172	33.713	0.079	661.61
	KF10/GF20/03	13	3.770	49.010	9.81	57	4.60	7.50	2000	150	30.024	0.081	623.80
	KF10/GF20/04	13	3.920	50.960	9.81	57	5.30	9.10	2000	182	35.036	0.093	637.37
	KF10/GF20/05	13	3.920	50.960	9.81	57	5.75	7.50	2000	150	28.876	0.101	470.57
Rata - rata (\bar{x})			3.846	49.998			4.95	8.20			32.175	0.087	647.09
Standar Deviasi											2.606	0.010	132.33
Coefesiensi of faration (%)											8.100	11.039	20.45
15% Serat Kenaf 15% Serat E-Glass	KF15/GF15/01	13	3.680	47.840	9.81	57	5.75	10.90	2000	218	44.703	0.101	609.72
	KF15/GF15/02	13	3.730	48.490	9.81	57	5.70	10.10	2000	202	40.867	0.100	717.38
	KF15/GF15/03	13	3.820	49.660	9.81	57	5.45	8.90	2000	178	35.163	0.096	482.03
	KF15/GF15/04	13	4.080	53.040	9.81	57	3.80	11.40	2000	228	42.170	0.067	1253.97
	KF15/GF15/05	13	3.820	49.660	9.81	57	4.85	10.20	2000	204	40.299	0.085	670.84
Rata - rata (\bar{x})			3.826								40.640	0.090	746.79
Standar Deviasi											3.501	0.014	296.96
Coefesiensi of faration (%)											8.613	15.949	39.77
20% Serat Kenaf 10% Serat E-Glass	KF20/GF10/01	13	3.920	50.960	9.81	57	5.35	12.40	2000	248	47.741	0.094	657.64
	KF20/GF10/02	13	3.870	50.310	9.81	57	5.20	12.40	2000	248	48.358	0.091	741.01
	KF20/GF10/03	13	3.900	50.700	9.81	57	5.50	11.80	2000	236	45.664	0.096	779.74
	KF20/GF10/04	13	3.820	49.660	9.81	57	5.10	12.10	2000	242	47.805	0.089	808.90
	KF20/GF10/05	13	3.950	51.350	9.81	57	5.00	11.60	2000	232	44.322	0.088	787.24
Rata - rata (\bar{x})											46.778	0.092	754.90
Standar Deviasi											1.714	0.003	59.65
Coefesiensi of faration (%)											3.664	3.800	7.90

GRAFIK PENGUJIAN TARIK KOMPOSIT HIBRIDA

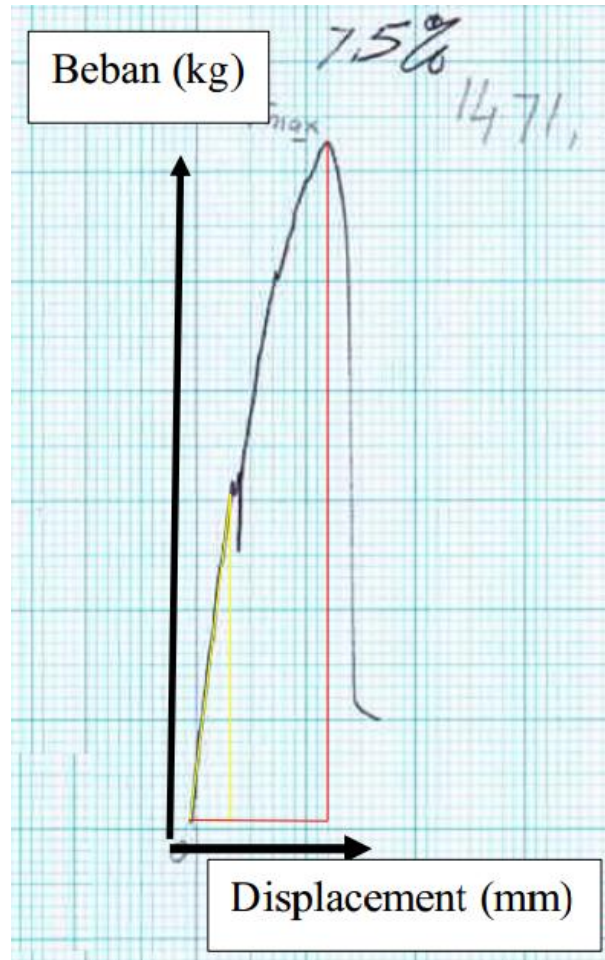
➤ VARIASI SERAT KENAF/E-GLASS 10:20



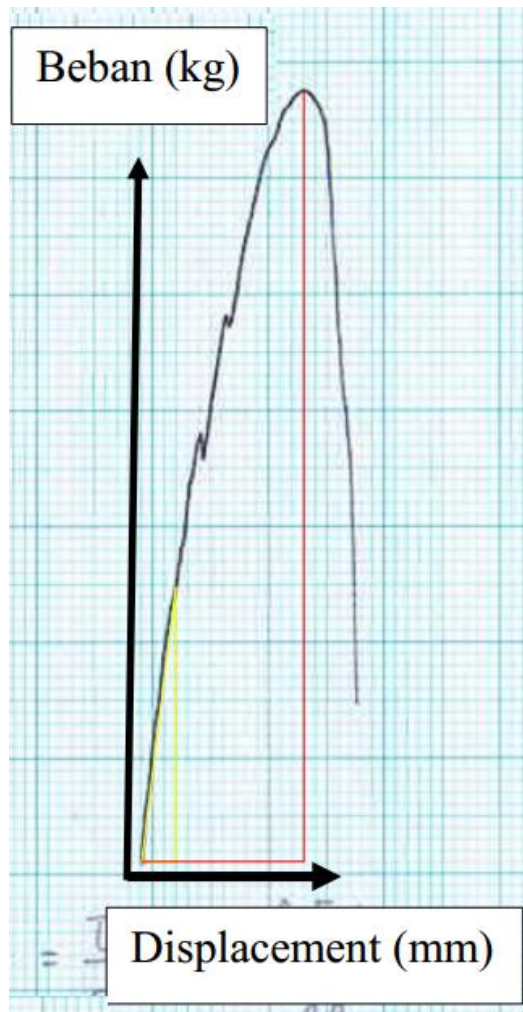
No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
1	13	3.770	49.010	9.81	57	4.62	8.30	166	2000



No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
2	13	3.850	50.050	9.81	57	4.50	8.60	172	2000



No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
3	13	3.770	49.010	9.81	57	4.60	7.50	150	2000

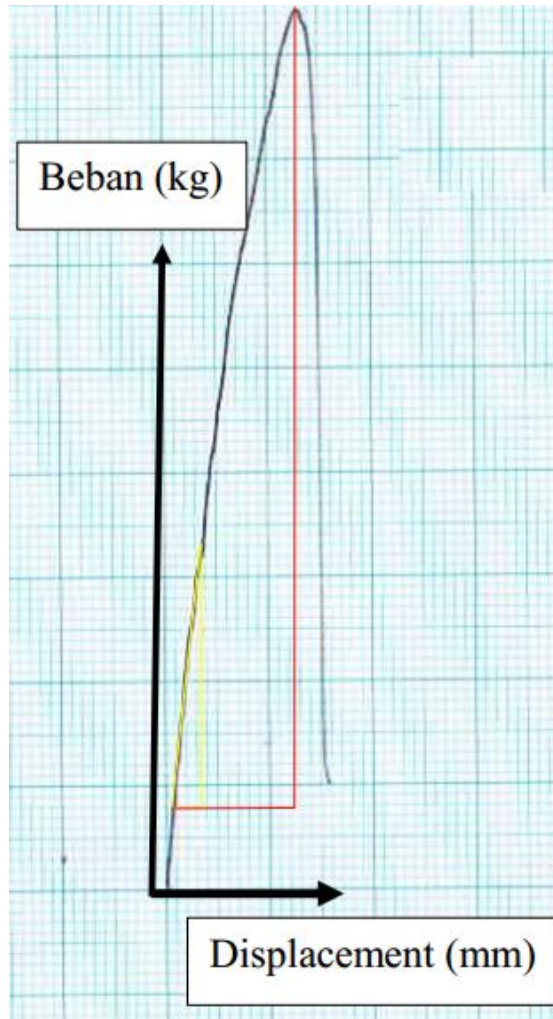


No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
4	13	3.920	50.960	9.81	57	5.30	9.10	182	2000.00

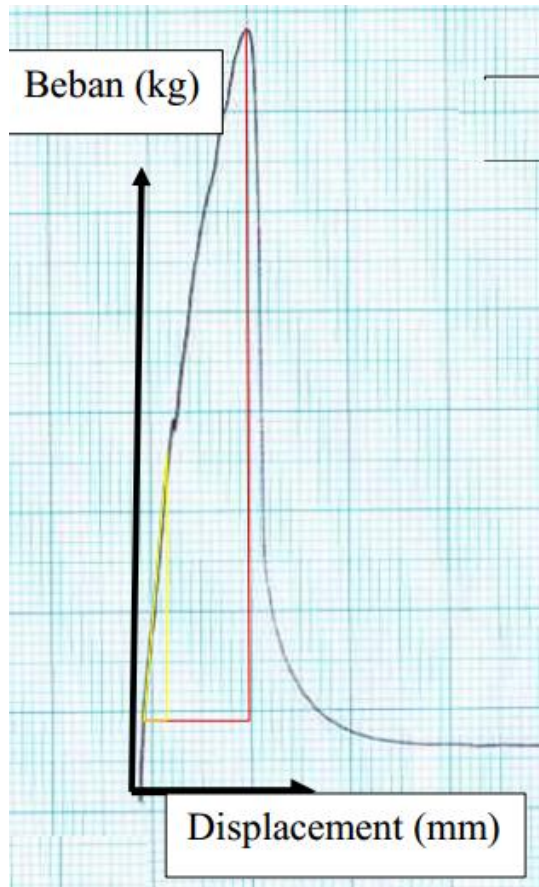


No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
5	13	3.920	50.960	9.81	57	5.75	7.50	150	2000

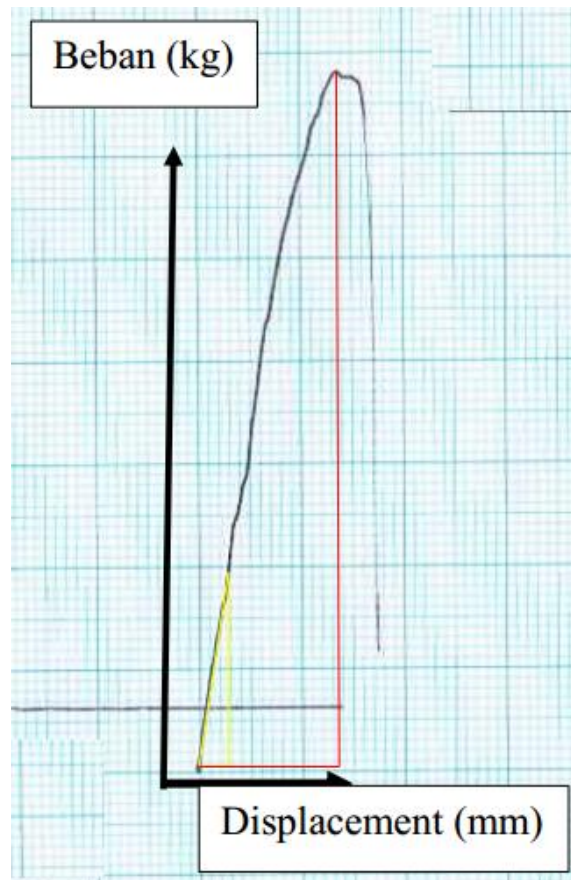
➤ VARIASI SERAT KENAF/E-GLASS 15:15



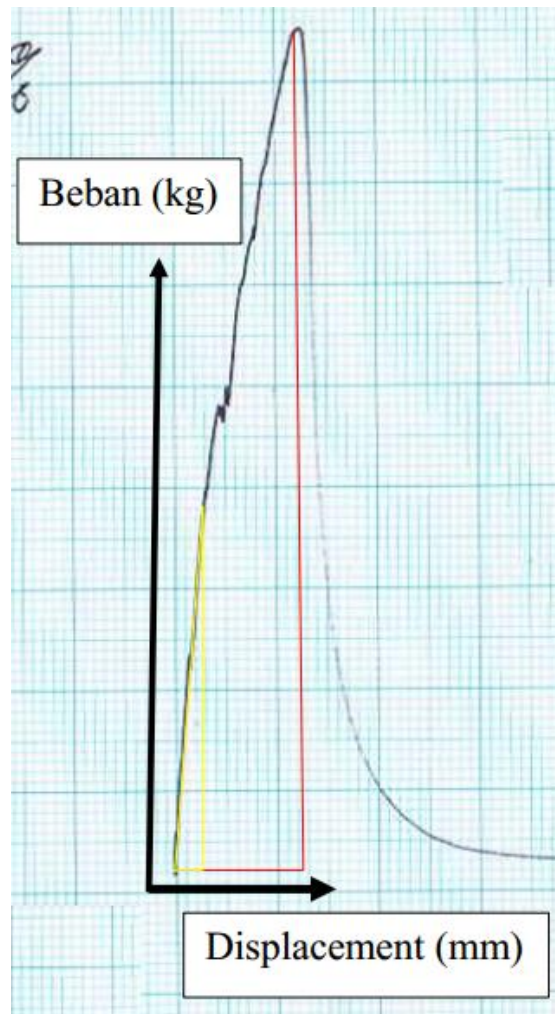
No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
1	13	3.680	47.840	9.81	57	5.75	10.90	218	2000



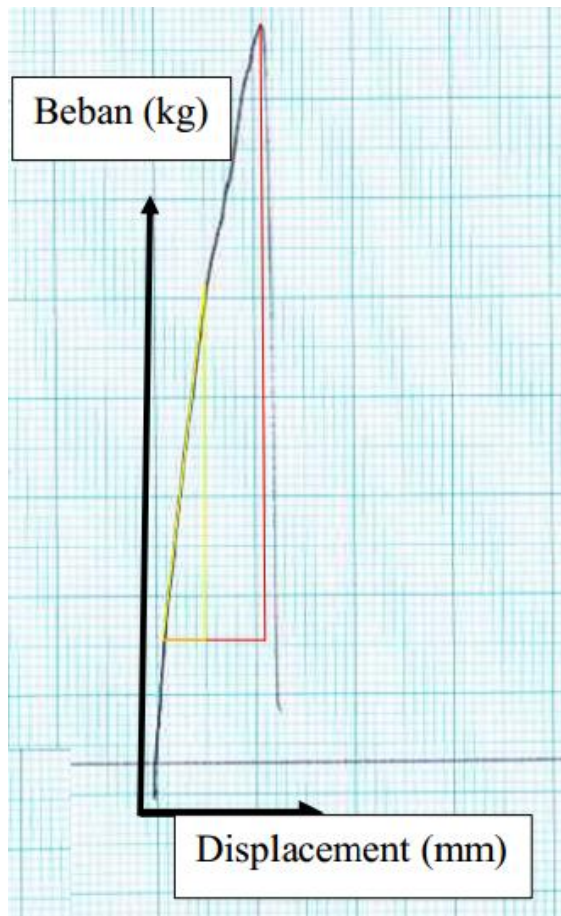
No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
2	13	3.730	48.490	9.81	57	5.70	10.10	202	2000



No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
3	13	3.820	49.660	9.81	57	5.45	8.90	178	2000

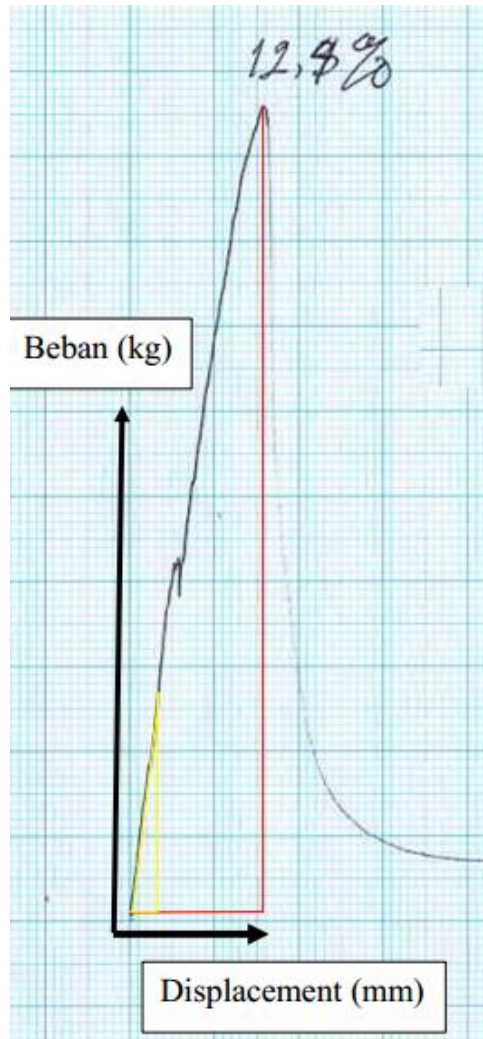


No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
4	13	4.080	53.040	9.81	57	3.80	11.40	228	2000

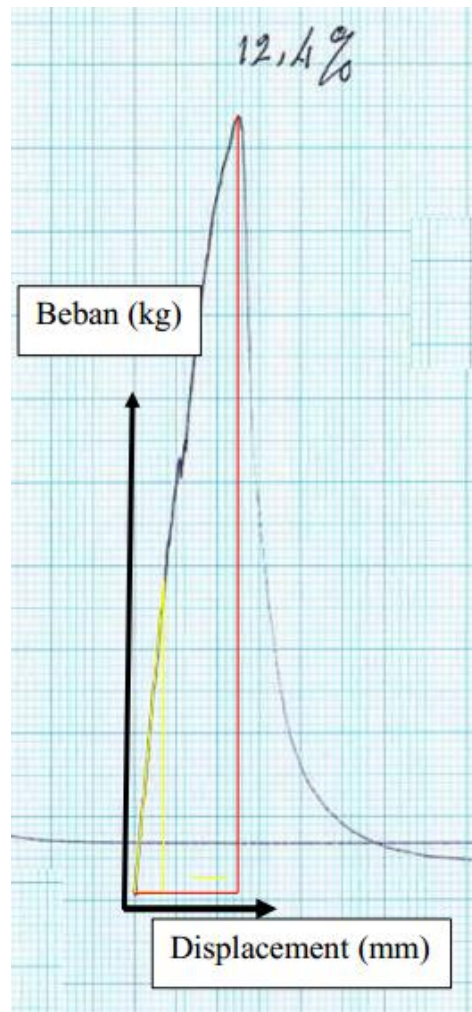


No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
5	13	3.820	49.660	9.81	57	4.85	10.20	204	2000

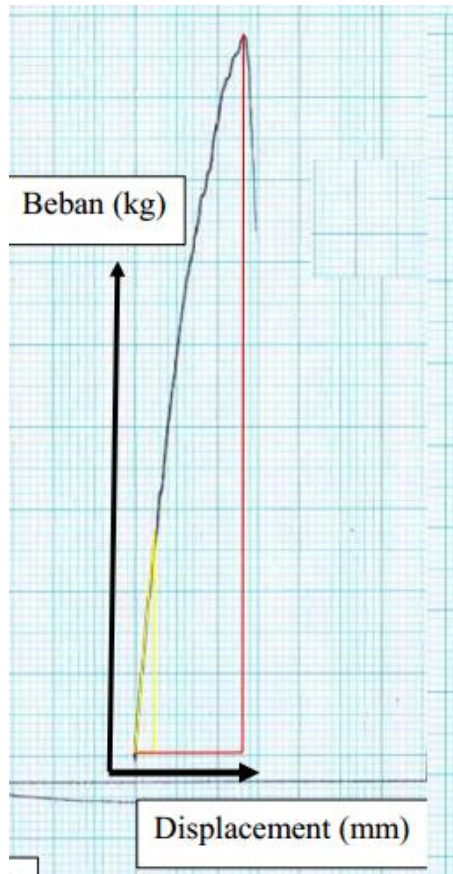
➤ VARIASI SERAT KENAF/E-GLASS 20:10



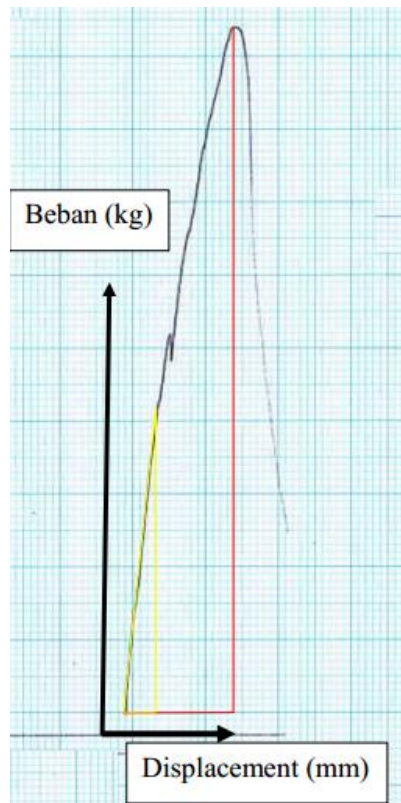
No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
1	13	3.920	50.960	9.81	57	5.35	12.40	248	2000



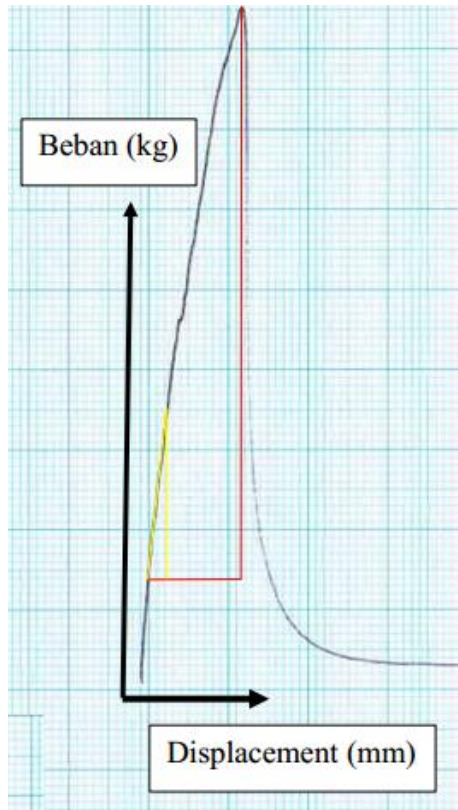
No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
2	13	3.870	50.310	9.81	57	5.20	12.40	248	2000



No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
3	13	3.900	50.700	9.81	57	5.50	11.80	236	2000



No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
4	13	3.820	49.660	9.81	57	5.10	12.10	242	2000



No.	Lebar (mm)	Tebal (mm)	Luas Penampang (mm ²)	g	(L) Standar ASTM D638-02 (mm)	ΔL (mm)	Beban yang Diterima (%)	Beban Max Komposit (Kg)	Beban Max load (Kg)
5	13	3.950	51.350	9.81	57	5.00	11.60	232	2000