

LAMPIRAN A
PERHITUNGAN

Lampiran A. Perhitungan

A.1 Perhitungan Fraksi Volume Serat

- Uji Tarik

Diketahui :

$$\begin{aligned}\text{Volume sampel uji tarik} &= p \times l \times t \\ &= 25\text{cm} \times 2,5\text{cm} \times 0,3\text{cm} \\ &= 18,75 \text{ cm}^3\end{aligned}$$

$$\rho \text{ serat daun nanas} = 1,5 \text{ g/cm}^3$$

$$\rho \text{ resin vinil ester} = 1,12 \text{ g/cm}^3$$

$$\rho \text{ resin epoksi} = 1,19 \text{ g/cm}^3$$

$$\rho \text{ resin polyester} = 1,13 \text{ g/cm}^3$$

$$\% \text{Volume serat} = 15\%$$

$$\begin{aligned}\text{Berat serat yang digunakan} &= V_{\text{serat}} \times \rho_{\text{serat}} \\ &= (\%V_{\text{serat}} \times V_{\text{sampel}}) \times \rho_{\text{serat}} \\ &= 15\% \times 18,75 \text{ cm}^3 \times 1,5 \text{ g/cm}^3 \\ &= 4,2 \text{ gram}\end{aligned}$$

$$\begin{aligned}\text{Berat total resin vinil ester} &= V_{\text{resin}} \times \rho_{\text{resin}} \\ &= (\%V_{\text{resin}} \times V_{\text{sampel}}) \times \rho_{\text{resin}} \\ &= 100\% - \%V_{\text{serat}} (V_{\text{sampel}} \times \rho_{\text{resin}}) \\ &= 85\% \times 18,75 \text{ cm}^3 \times 1,12 \text{ g/cm}^3 \\ &= 17,85 \text{ gram}\end{aligned}$$

$$\text{Persentase katalis} = \text{resin} : \text{katalis 1} : \text{katalis 2} = 100 : 3 : 1$$

$$\text{Berat resin} = \frac{100}{104} \times 17,85 \text{ g}$$

$$= 17,16 \text{ g}$$

$$\text{Berat katalis 1} = \frac{3}{104} \times 17,85 \text{ g}$$

$$= 0,51 \text{ g}$$

$$\text{Berat katalis 2} = \frac{1}{104} \times 17,85 \text{ g}$$

$$= 0,17 \text{ g}$$

$$\text{Berat total resin epoksi} = V_{\text{resin}} \times \rho_{\text{resin}}$$

$$= (\%V_{\text{resin}} \times V_{\text{sampel}}) \times \rho_{\text{resin}}$$

$$= 100\% - \%V_{\text{serat}} (V_{\text{sampel}} \times \rho_{\text{resin}})$$

$$= 85\% \times 18,75 \text{ cm}^3 \times 1,19 \text{ g/cm}^3$$

$$= 18,96 \text{ gram}$$

$$\text{Persentase katalis} = \text{resin} : \text{katalis} = 3 : 1$$

$$\text{Berat resin} = \frac{3}{4} \times 18,96 \text{ g}$$

$$= 14,22 \text{ g}$$

$$\text{Berat katalis} = \frac{1}{4} \times 18,96 \text{ g}$$

$$= 4,74 \text{ g}$$

$$\text{Berat total resin polyester} = V_{\text{resin}} \times \rho_{\text{resin}}$$

$$= (\%V_{\text{resin}} \times V_{\text{sampel}}) \times \rho_{\text{resin}}$$

$$= 100\% - \%V_{\text{serat}} (V_{\text{sampel}} \times \rho_{\text{resin}})$$

$$= 85\% \times 18,75 \text{ cm}^3 \times 1,13 \text{ g/cm}^3$$

$$= 17,91 \text{ gram}$$

Persentase katalis = resin : katalis = 100 : 1

Berat resin = $\frac{100}{101} \times 17,91 \text{ g}$

$$= 17,73 \text{ g}$$

Berat katalis = $\frac{1}{101} \times 17,91 \text{ g}$

$$= 0,18 \text{ g}$$

- Uji Lentur

Diketahui :

Volume sampel uji tarik = $p \times l \times t$

$$= 12,5\text{cm} \times 1,27\text{cm} \times 0,32\text{cm}$$

$$= 5,08 \text{ cm}^3$$

ρ serat daun nanas = $1,5 \text{ g/cm}^3$

ρ resin vinil ester = $1,12 \text{ g/cm}^3$

ρ resin epoksi = $1,19 \text{ g/cm}^3$

ρ resin polyester = $1,13 \text{ g/cm}^3$

%Volume serat = 15%

Berat serat yang digunakan = $V_{\text{serat}} \times \rho_{\text{serat}}$

$$= (\%V_{\text{serat}} \times V_{\text{sampel}}) \times \rho_{\text{serat}}$$

$$= 15\% \times 5,08 \text{ cm}^3 \times 1,5 \text{ g/cm}^3$$

$$= 1,14 \text{ gram}$$

Berat total resin vinil ester = $V_{\text{resin}} \times \rho_{\text{resin}}$

$$= (\%V_{\text{resin}} \times V_{\text{sampel}}) \times \rho_{\text{resin}}$$

$$\begin{aligned}
&= 100\% - \%V_{\text{serat}} (V_{\text{sampel}} \times \rho_{\text{resin}}) \\
&= 85\% \times 5,08 \text{ cm}^3 \times 1,12 \text{ g/cm}^3 \\
&= 4,8 \text{ gram} \\
\text{Persentase katalis} &= \text{resin} : \text{katalis 1} : \text{katalis 2} = 100 : 3 : 1 \\
\text{Berat resin} &= \frac{100}{104} \times 4,8 \text{ g} \\
&= 4,61 \text{ g} \\
\text{Berat katalis 1} &= \frac{3}{104} \times 4,8 \text{ g} \\
&= 0,14 \text{ g} \\
\text{Berat katalis 2} &= \frac{1}{104} \times 4,8 \text{ g} \\
&= 0,05 \text{ g} \\
\text{Berat total resin epoksi} &= V_{\text{resin}} \times \rho_{\text{resin}} \\
&= (\%V_{\text{resin}} \times V_{\text{sampel}}) \times \rho_{\text{resin}} \\
&= 100\% - \%V_{\text{serat}} (V_{\text{sampel}} \times \rho_{\text{resin}}) \\
&= 85\% \times 5,08 \text{ cm}^3 \times 1,19 \text{ g/cm}^3 \\
&= 5,1 \text{ gram} \\
\text{Persentase katalis} &= \text{resin} : \text{katalis} = 3 : 1 \\
\text{Berat resin} &= \frac{3}{4} \times 5,1 \text{ g} \\
&= 3,83 \text{ g} \\
\text{Berat katalis} &= \frac{1}{4} \times 5,1 \text{ g} \\
&= 1,27 \text{ g} \\
\text{Berat total resin polyester} &= V_{\text{resin}} \times \rho_{\text{resin}}
\end{aligned}$$

$$\begin{aligned}
&= (\%V_{\text{resin}} \times V_{\text{sampel}}) \times \rho_{\text{resin}} \\
&= 100\% - \%V_{\text{serat}} (V_{\text{sampel}} \times \rho_{\text{resin}}) \\
&= 85\% \times 5,08 \text{ cm}^3 \times 1,13 \text{ g/cm}^3 \\
&= 4,9 \text{ gram}
\end{aligned}$$

Persentase katalis $= \text{resin} : \text{katalis} = 100 : 1$

Berat resin $= \frac{100}{101} \times 4,9 \text{ g}$

$$= 4,85 \text{ g}$$

Berat katalis $= \frac{1}{101} \times 4,9 \text{ g}$

$$= 0,05 \text{ g}$$

LAMPIRAN B
GAMBAR ALAT DAN BAHAN

Lampiran B. Gambar Alat dan Bahan



Gambar B.1 Alas Cetakan



Gambar B.2 Alat Pengaduk



Gambar B.3 Bagging Film



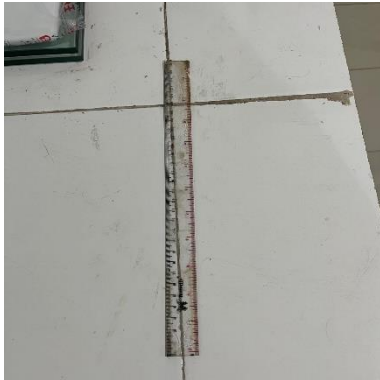
Gambar B.4 Baki



Gambar B.5 Cetakan



Gambar B.6 Gunting



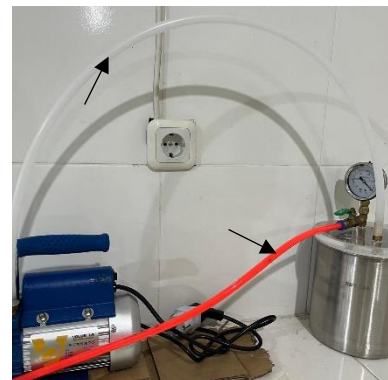
Gambar B.7 Penggaris



Gambar B.8 Pompa Vakum



Gambar B.9 Sarung Tangan



Gambar B.10 Selang



Gambar B.11 *Silent Tape*



Gambar B.12 Wadah



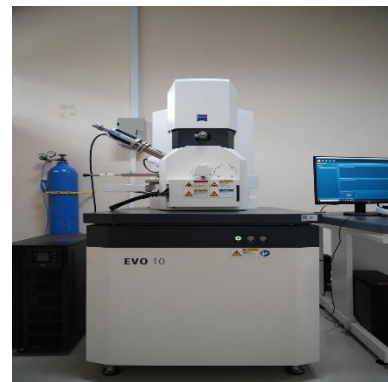
Gambar B.13 Tabung *Reservior*



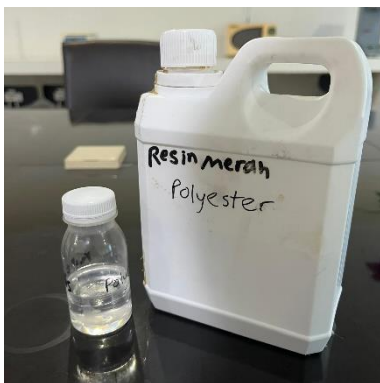
Gambar B.14 Serat Nanas



Gambar B.15 Timbangan Digital



Gambar B.16 Alat SEM



Gambar B.17 Resin Poliester



Gambar B.18 Resin Epoksi



Gambar B.18 Resin Vinyl Ester



Gambar B.20 Larutan NaOH 5%

LAMPIRAN C
DATA DAN HASIL PENELITIAN

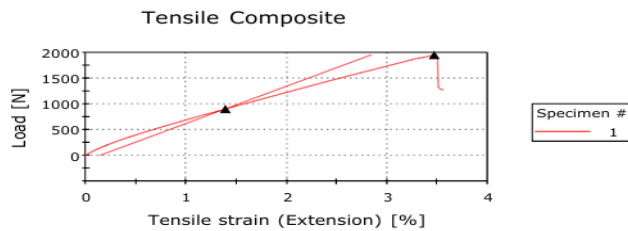
Lampiran C. Data dan Hasil Penelitian


INSTRON
 LAPORAN PENGUJIAN

Report Number	026/EXT/UNT/06/24
Operator Name	AF
Material	Composite
Test Method	ASTM D3039
Humidity	67. %
Temperature	26. C
Rate	2.00 mm/min

Last test date: Wednesday, June 05, 2024

Graph 1



	Width [mm]	Thickness [mm]	Max Load [N]	Tensile stress [MPa]	Tensile stress at Yield [MPa]	Tensile strain (Extension) at Break (Automatic load drop) [%]	Modulus (Automatic Young's) [GPa]	Code
1	25.00	3.00	1949.31	24.03	11.16	3.55	0.89	Polyester HLU
Mean	25.00	3.00	1949.31	24.03	11.16	3.55	0.89	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	25.00	3.00	1949.31	24.03	11.16	3.55	0.89	

Note: The result just for this test

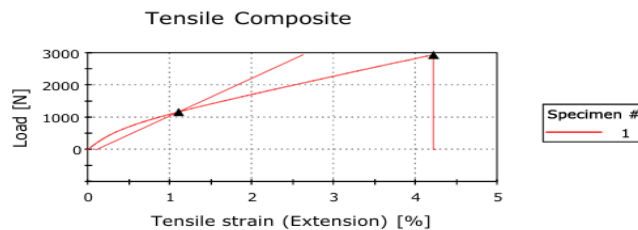
Gambar C.1 Hasil Uji Tarik *Hand Lay-up* Poliester


INSTRON
 LAPORAN PENGUJIAN

Report Number	030/EXT/UNT/06/24
Operator Name	AF
Material	Composite
Test Method	ASTM D3039
Humidity	67. %
Temperature	26. C
Rate	2.00 mm/min

Last test date: Wednesday, June 05, 2024

Graph 1



	Width [mm]	Thickness [mm]	Max Load [N]	Tensile stress [MPa]	Tensile stress at Yield [MPa]	Tensile strain (Extension) at Break (Automatic load drop) [%]	Modulus (Automatic Young's) [GPa]	Code
1	25.00	3.00	2941.06	38.00	15.16	4.21	1.51	Epoxy HLU
Mean	25.00	3.00	2941.06	38.00	15.16	4.21	1.51	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	25.00	3.00	2941.06	38.00	15.16	4.21	1.51	

Note: The result just for this test

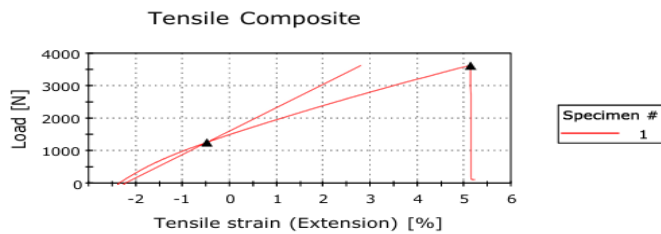
Gambar C.2 Hasil Uji Tarik *Hand Lay-up* Epoksi


INSTRON
LAPORAN PENGUJIAN

Report Number	027/EXT/UNT/06/24
Operator Name	AF
Material	Composite
Test Method	ASTM D3039
Humidity	67. %
Temperature	26. C
Rate	2.00 mm/min

Last test date: Wednesday, June 05, 2024

Graph 1



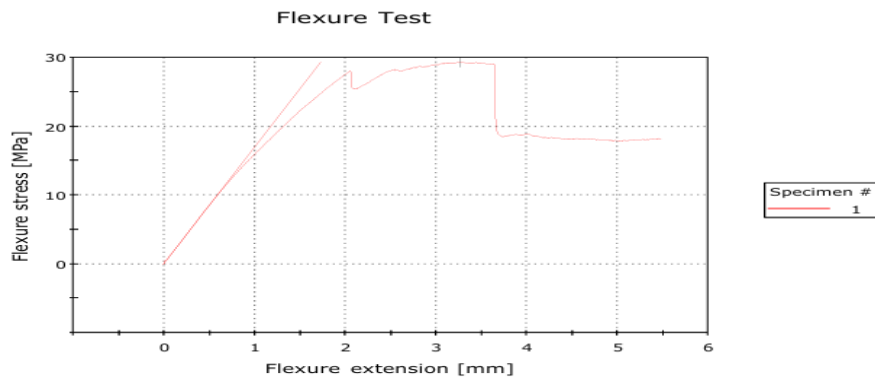
	Width [mm]	Thickness [mm]	Max Load [N]	Tensile stress [MPa]	Tensile stress at Yield [MPa]	Tensile strain (Extension) at Break (Automatic load drop) [%]	Modulus (Automatic Young's) [GPa]	Code
1	25.00	3.00	3624.47	51.38	18.02	5.12	1.02	HLU Vinyl
Mean	25.00	3.00	3624.47	51.38	18.02	5.12	1.02	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	25.00	3.00	3624.47	51.38	18.02	5.12	1.02	

Note: The result just for this test

Gambar C.3 Hasil Uji Tarik *Hand Lay-up* Vinyl Ester


INSTRON
LAPORAN PENGUJIAN

Report No	042/EXT/UNT/06/24
Material	Komposit
Material specification	Polyester HLU
Test Method	ASTM D790
Rate	5.00 mm/min



	Width [mm]	Thickness [mm]	Support span [mm]	Maximum Load [N]	Maximum Flexure stress [MPa]	Flexure strain (Extension) gauge length [mm]	Modulus of elasticity E [GPa]	Code
1	12.7	3.2	20.00	150.18	29.28	18.89	0.0293	Polyester HLU
Mean	12.7	3.2	20.00	150.18	29.28	18.89	0.0293	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	12.7	3.2	20.00	150.18	29.28	18.89	0.0293	

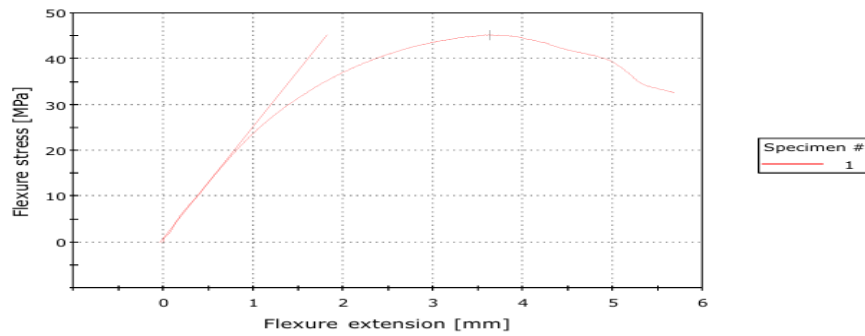
Gambar C.4 Hasil Uji Lentur *Hand Lay-up* Poliester



LAPORAN PENGUJIAN

Report No	045/EXT/UNT/06/24
Material	Komposit
Material specification	Polyester Epoxy HLU
Test Method	ASTM D790
Rate	5.00 mm/min

Flexure Test



	Width [mm]	Thickness s [mm]	Support span [mm]	Maximum Load [N]	Maximum Flexure stress [MPa]	Flexure strain (Extension) gauge length [mm]	Modulus of elasticity E [GPa]	Code
1	12.7	3.2	20.00	158.76	45.19	22.83	0.0452	Vacuum HLU
Mean	12.7	3.2	20.00	158.76	45.19	22.83	0.0452	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	12.7	3.2	20.00	158.76	45.19	22.83	0.0452	

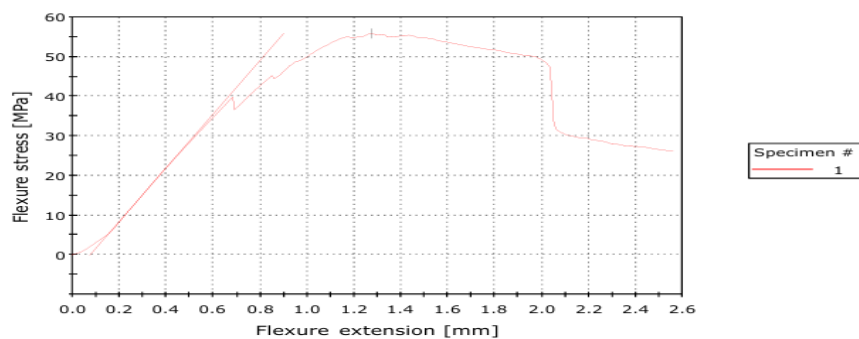
Gambar C.5 Hasil Uji Lentur *Hand Lay-up* Epoksi



LAPORAN PENGUJIAN

Report No	044/EXT/UNT/06/24
Material	Komposit
Material specification	Polyester HLU Vynil
Test Method	ASTM D790
Rate	5.00 mm/min

Flexure Test



	Width [mm]	Thickness s [mm]	Support span [mm]	Maximum Load [N]	Maximum Flexure stress [MPa]	Flexure strain (Extension) gauge length [mm]	Modulus of elasticity E [GPa]	Code
1	12.29	3.2	20.00	169.17	55.82	24.51	0.0558	HLU Vynil
Mean	12.29	3.2	20.00	169.17	55.82	24.51	0.0558	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	12.29	3.2	20.00	169.17	55.82	24.51	0.0558	

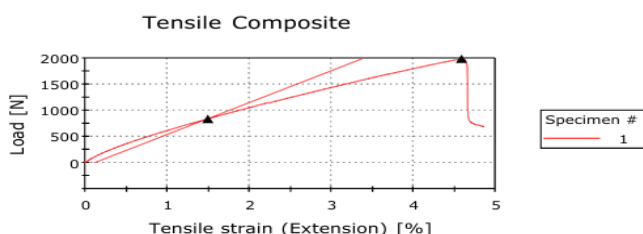
Gambar C.6 Hasil Uji Lentur *Hand Lay-up* Vinil Ester


INSTRON
LAPORAN PENGUJIAN

Report Number	025/EXT/UNT/06/24
Operator Name	AF
Material	Composite
Test Method	ASTM D3039
Humidity	67. %
Temperature	26. C
Rate	2.00 mm/min

Last test date: Wednesday, June 05, 2024

Graph 1



	Width [mm]	Thickness [mm]	Max Load [N]	Tensile stress [MPa]	Tensile stress at Yield [MPa]	Tensile strain (Extension) at Break (Automatic load drop) [%]	Modulus (Automatic Young's) [GPa]	Code
1	25.00	3.00	1980.74	28.18	11.94	4.85	0.86	Polyester Vacuum
Mean	25.00	3.00	1980.74	28.18	11.94	4.85	0.86	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	25.00	3.00	1980.74	28.18	11.94	4.85	0.86	

Note: The result just for this test

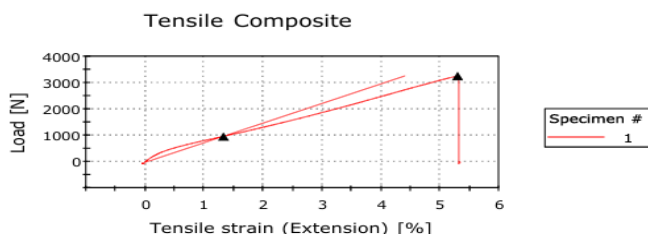
Gambar C.7 Hasil Uji Tarik Vacuum Bag Poliester


INSTRON
LAPORAN PENGUJIAN

Report Number	029/EXT/UNT/06/24
Operator Name	AF
Material	Composite
Test Method	ASTM D3039
Humidity	67. %
Temperature	26. C
Rate	2.00 mm/min

Last test date: Wednesday, June 05, 2024

Graph 1



	Width [mm]	Thickness [mm]	Max Load [N]	Tensile stress [MPa]	Tensile stress at Yield [MPa]	Tensile strain (Extension) at Break (Automatic load drop) [%]	Modulus (Automatic Young's) [GPa]	Code
1	25.00	3.00	3246.24	46.12	13.78	5.31	1.05	Vacuum Epoxy
Mean	25.00	3.00	3246.24	46.12	13.78	5.31	1.05	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	25.00	3.00	3246.24	46.12	13.78	5.31	1.05	

Note: The result just for this test

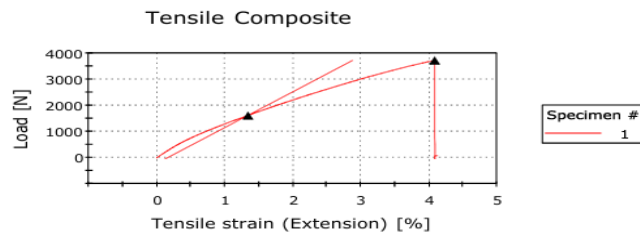
Gambar C.8 Hasil Uji Tarik Vacuum Bag Epoksi


INSTRON
LAPORAN PENGUJIAN

Report Number	028/EXT/UNT/06/24
Operator Name	AF
Material	Composite
Test Method	ASTM D3039
Humidity	67. %
Temperature	26. C
Rate	2.00 mm/min

Last test date: Wednesday, June 05, 2024

Graph 1



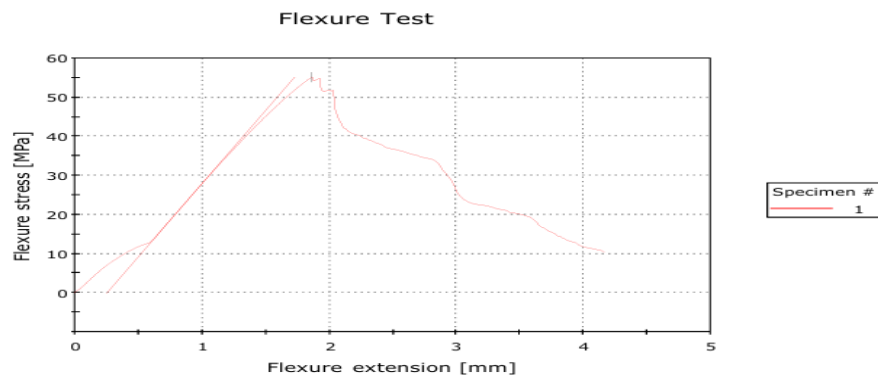
	Width [mm]	Thickness [mm]	Max Load [N]	Tensile stress [MPa]	Tensile stress at Yield [MPa]	Tensile strain (Extension) at Break (Automatic load drop) (%)	Modulus (Automatic Young's) [GPa]	Code
1	25.00	3.00	3710.59	58.37	25.50	4.08	2.15	Vacuum Vinyl
Mean	25.00	3.00	3710.59	58.37	25.50	4.08	2.15	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	25.00	3.00	3710.59	58.37	25.50	4.08	2.15	

Note: The result just for this test

Gambar C.9 Hasil Uji Tarik Vacuum Bag Vinyl Ester


INSTRON
LAPORAN PENGUJIAN

Report No	041/EXT/UNT/06/24
Material specification	Polyester Vacuum
Test Method	ASTM D790
Rate	5.00 mm/min

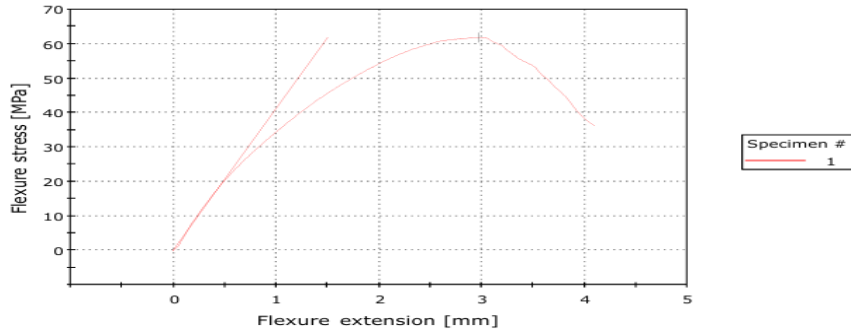


	Width [mm]	Thickness [mm]	Support span [mm]	Maximum Load [N]	Maximum Flexure stress [MPa]	Flexure strain (Extension) gauge length [mm]	Modulus of elasticity E [GPa]	Code
1	12.7	3.2	20.00	265.36	55.09	19.61	0.0551	Polyester Vacuum
Mean	12.7	3.2	20.00	265.36	55.09	19.61	0.0551	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	12.7	3.2	20.00	265.36	55.09	19.61	0.0551	

Gambar C.10 Hasil Uji Lentur Vacuum Bag Poliester

Report No	046/EXT/UNT/06/24
Material	Komposit
Material specification	Polyester Epoxy Vacuum
Test Method	ASTM D790
Rate	5.00 mm/min

Flexure Test

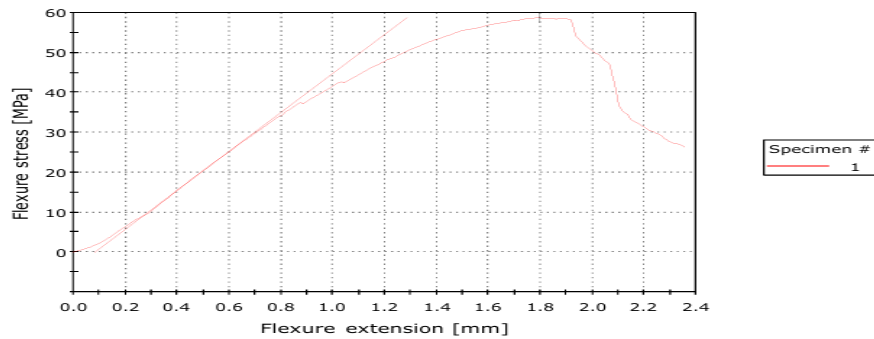


	Width [mm]	Thickness [mm]	Support span [mm]	Maximum Load [N]	Maximum Flexure stress [MPa]	Flexure strain (Extension) gauge length [mm]	Modulus of elasticity E [GPa]	Code
1	12.7	3.2	20.00	203.46	61.81	23.56	0.0618	Epoxy Vacuum
Mean	12.7	3.2	20.00	203.46	61.81	23.56	0.0618	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	12.7	3.2	20.00	203.46	61.81	23.56	0.0618	

Gambar C.11 Hasil Uji Lentur *Vacuum Bag* Epoksi

Report No	043/EXT/UNT/06/24
Material	Komposit
Material specification	Polyester Vacuum Vynil
Test Method	ASTM D790
Rate	5.00 mm/min

Flexure Test



	Width [mm]	Thickness [mm]	Support span [mm]	Maximum Load [N]	Maximum Flexure stress [MPa]	Flexure strain (Extension) gauge length [mm]	Modulus of elasticity E [GPa]	Code
1	12.7	3.2	20.00	177.22	58.64	24.78	0.0586	Vacuum Vinyl
Mean	12.7	3.2	20.00	177.22	58.64	24.78	0.0586	
Standard deviation	-----	-----	-----	-----	-----	-----	-----	
Minimum	12.7	3.2	20.00	177.22	58.64	24.78	0.0586	

Gambar C.12 Hasil Uji Lentur *Vacuum Bag* Vinil Ester