LAMPIRAN

LAMPIRAN 1. Perhitungan Uji Tarik

I. Plastik Murni Non Paduan

1. Perhitungan Tegangan Tarik

Rumus Tegangan Tarik:

$$\sigma = \frac{F}{A}$$

Keterangan:

σ = Tegangan tarik (MPa)

F = Gaya tarik yang diberikan (N)

A = Luas penampang awal material (mm^2)

Menghitung luas penampang

A = Luas penampang spesimen

A = Tebal x Lebar

= 3.2 x 13

= 41.6 mm^2 = 41.6 x 10^{-6} m^2

a. LDPE (*Low Density Polyethylene*) Murni Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{910.4}{41.6\ x\ 10^{-6}} = 21884615\ \text{Pa}$$

$$= 21.88\ \text{MPa.}$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{893.8}{41.6\ x\ 10^{-6}} = 21485576\ \text{Pa}$$

$$= 21.49\ \text{MPa.}$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{961.1}{41.6\ x\ 10^{-6}} = 23103365\ \text{Pa}$$

$$= 23.11\ \text{MPa.}$$

`

b. LDPE (*Low Density Polyethylene*) Murni Temperatur 200°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{746.6}{41.6\ x\ 10^{-6}} = 17947115\text{Pa}$$

$$= 17.95\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{627.3}{41.6\ x\ 10^{-6}} = 15079326\ \text{Pa}$$

$$= 15.08\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{698}{41.6\ x\ 10^{-6}} = 16778846\ \text{Pa}$$

$$= 16.78\ \text{MPa}.$$

c. HDPE (*High Density Polyethylene*) Murni Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1733.6}{41.6\ x\ 10^{-6}} = 41673076\ \text{Pa}$$

$$= 41.67\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1682.8}{41.6\ x\ 10^{-6}} = 40451923\ \text{Pa}$$

$$= 40.45\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1281.5}{41.6\ x\ 10^{-6}} = 30805288\ \text{Pa}$$

$$= 30.81\ \text{MPa}.$$

`

d. HDPE (*High Density Polyethylene*) Murni Temperatur 200°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1384.8}{41.6\ x\ 10^{-6}} = 33288461\ \text{Pa}$$

$$= 33.29\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1416.1}{41.6\ x\ 10^{-6}} = 34040865\ \text{Pa}$$

$$= 34.04\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1369.3}{41.6\ x\ 10^{-6}} = 32915865\text{Pa}$$

$$= 32.92\ \text{MPa}.$$

e. PP (*Polypropylene*) Murni Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1387.8}{41.6\ x\ 10^{-6}} = 33360576\ \text{Pa}$$

$$= 33.36\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1329.3}{41.6\ x\ 10^{-6}} = 31954326\ \text{Pa}$$

$$= 31.95\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1221.7}{41.6\ x\ 10^{-6}} = 29367788\ \text{Pa}$$

$$= 29.37\ \text{MPa}.$$

`

f. PP (*Polypropylene*) Murni Temperatur 200°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{690.1}{41.6\ x\ 10^{-6}} = 1659892\ \text{Pa}$$

$$= 16.59\text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{994.4}{41.6\ x\ 10^{-6}} = 23903846\ \text{Pa}$$

$$= 23.9\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{918.9}{41.6\ x\ 10^{-6}} = 22098942\ \text{Pa}$$

$$= 22.09\ \text{MPa}.$$

2. Perhitungan Regangan

Rumus Regangan:

$$\varepsilon = \frac{\Delta L}{L0} \times 100$$

Keterangan:

ε = Regangan Tarik (Strain)

ΔL = Pertambahan Panjang spesimen

$L0$ = Panjang awal spesimen

a. LDPE (*Low Density Polyethylene*) Murni Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{33}{57} \times 100$$

$$= 57.89\ \%$$

Spesimen 2

$$\varepsilon = \frac{24}{57} \times 100$$

$$= 42.11\ \%$$

Spesimen 3

$$\varepsilon = \frac{26}{57} \times 100$$
$$= 45.61\ \%$$

b. LDPE (*Low Density Polyethylene*) Murni Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{17}{57} \times 100$$
$$= 29.82\ \%$$

Spesimen 2

$$\varepsilon = \frac{17}{57} \times 100$$
$$= 29.82\ \%$$

Spesimen 3

$$\varepsilon = \frac{17}{57} \times 100$$
$$= 29.82\ \%$$

c. HDPE (*High Density Polyethylene*) Murni Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{48}{57} \times 100$$
$$= 84\ \%$$

Spesimen 2

$$\varepsilon = \frac{50}{57} \times 100$$
$$= 87\ \%$$

Spesimen 3

$$\varepsilon = \frac{48}{57} \times 100$$
$$= 84\ \%$$

d. HDPE (*High Density Polyethylene*) Murni Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{39}{57} \times 100$$
$$= 68.42\ \%$$

Spesimen 2

$$\varepsilon = \frac{63}{57} \times 100$$
$$= 110.53\ \%$$

Spesimen 3

`

$$\varepsilon = \frac{24}{57} \times 100$$
$$= 73.69\ \%$$

e. PP (*Polypropylene*) Murni Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{12}{57} \times 100$$
$$= 21.05\ \%$$

Spesimen 2

$$\varepsilon = \frac{12}{57} \times 100$$
$$= 21.05\ \%$$

Spesimen 3

$$\varepsilon = \frac{12}{57} \times 100$$
$$= 21.05\ \%$$

f. PP (*Polypropylene*) Murni Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

Spesimen 2

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

Spesimen 3

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

3. Perhitungan Modulus Elastisitas

Rumus Modulus Elastisitas:

$$E = \frac{\sigma}{\varepsilon}$$

Keterangan:

E = Modulus Elastisitas (MPa)

σ = Tegangan (MPa)

ε = Regangan (%)

`

a. LDPE (*Low Density Polyethylene*) Murni Temperatur 190°C

Spesimen 1

$$E = \frac{14.38}{22.81}$$
$$= 63.06\ \text{Mpa}$$

Spesimen 2

$$E = \frac{17.16}{19.30}$$
$$= 88.93\ \text{Mpa}$$

Spesimen 3

$$E = \frac{19.15}{22.81}$$
$$= 83.95\ \text{Mpa}$$

b. LDPE (*Low Density Polyethylene*) Murni Temperatur 200°C

Spesimen 1

$$E = \frac{13.92}{8.77}$$
$$= 158.64\ \text{Mpa}$$

Spesimen 2

$$E = \frac{10.06}{8.77}$$
$$= 114.69\ \text{Mpa}$$

Spesimen 3

$$E = \frac{13.78}{10.53}$$
$$= 130.92\ \text{Mpa}$$

c. HDPE (*High Density Polyethylene*) Murni Temperatur 190°C

Spesimen 1

$$E = \frac{33.12}{25.56}$$
$$= 134.9\ \text{Mpa}$$

Spesimen 2

$$E = \frac{37.89}{21.05}$$
$$= 180\ \text{Mpa}$$

Spesimen 3

$$E = \frac{26.38}{22.81}$$
$$= 115.64\ \text{Mpa}$$

`

d. HDPE (*High Density Polyethylene*) Murni Temperatur 200°C

Spesimen 1

$$E = \frac{27.09}{8.77}$$
$$= 308.87 \text{ Mpa}$$

Spesimen 2

$$E = \frac{26.66}{8.77}$$
$$= 303.94 \text{ Mpa}$$

Spesimen 3

$$E = \frac{24.28}{10.53}$$
$$= 230.69 \text{ Mpa}$$

e. PP (*Polypropylene*) Murni Temperatur 190°C

Spesimen 1

$$E = \frac{23.77}{10.53}$$
$$= 225.81 \text{ Mpa}$$

Spesimen 2

$$E = \frac{23.72}{8.77}$$
$$= 270.45 \text{ Mpa}$$

Spesimen 3

$$E = \frac{26.12}{14.04}$$
$$= 186.07 \text{ Mpa}$$

f. PP (*Polypropylene*) Murni Temperatur 200°C

Spesimen 1

$$E = \frac{16.59}{8.77}$$
$$= 210.22$$

Spesimen 2

$$E = \frac{23.90}{8.77}$$
$$= 272.50 \text{ Mpa}$$

Spesimen 3

$$E = \frac{22.09}{8.77}$$
$$= 251.81 \text{ Mpa}$$

`

II. Plastik Daur Ulang Non Paduan

1. Perhitungan Tegangan Tarik

Rumus Tegangan Tarik:

$$\sigma = \frac{F}{A}$$

Keterangan:

σ = Tegangan tarik (MPa)

F = Gaya tarik yang diberikan (N)

A = Luas penampang awal material (mm^2)

Menghitung luas penampang

A = Luas penampang spesimen

A = Tebal x Lebar

= 3.2 x 13

= 41.6 mm^2 = 41.6 x 10^{-6} m^2

a. LDPE (*Low Density Polyethylene*) Daur Ulang Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{783.5}{41.6\ x\ 10^{-6}} = 18834134\ \text{Pa}$$

= 18.83 MPa.

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{650.5}{41.6\ x\ 10^{-6}} = 15637019\ \text{Pa}$$

= 15.64 MPa.

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{468.8}{41.6\ x\ 10^{-6}} = 11269230\ \text{Pa}$$

= 11.27 MPa.

b. LDPE (*Low Density Polyethylene*) Daur Ulang Temperatur 200°C

Spesimen 1

`

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{549.3}{41.6\ x\ 10^{-6}} = 13204329\ \text{Pa}$$

$$= 13.20\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{413.7}{41.6\ x\ 10^{-6}} = 9944711\ \text{Pa}$$

$$= 9.94\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{571.8}{41.6\ x\ 10^{-6}} = 13745192\ \text{Pa}$$

$$= 13.75\ \text{MPa}.$$

c. HDPE (*High Density Polyethylene*) Daur Ulang Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1028.2}{41.6\ x\ 10^{-6}} = 24726346\ \text{Pa}$$

$$= 24.72\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1489.1}{41.6\ x\ 10^{-6}} = 35895673\ \text{Pa}$$

$$= 35.8\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1588.9}{41.6\ x\ 10^{-6}} = 38194711\ \text{Pa}$$

$$= 38.19\ \text{MPa}.$$

d. HDPE (*High Density Polyethylene*) Daur Ulang Temperatur 200°C

Spesimen 1

`

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1386.8}{41.6\ x\ 10^{-6}} = 33336538\ \text{Pa}$$

$$= 33.34\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1254}{41.6\ x\ 10^{-6}} = 30144230\ \text{Pa}$$

$$= 30.14\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1276.6}{41.6\ x\ 10^{-6}} = 30687500\ \text{Pa}$$

$$= 30.69\ \text{MPa}.$$

e. PP (*Polypropylene*) Daur Ulang Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1145.5}{41.6\ x\ 10^{-6}} = 27546057\ \text{Pa}$$

$$= 27.54\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1079.4}{41.6\ x\ 10^{-6}} = 25957115\ \text{Pa}$$

$$= 25.95\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1174.6}{41.6\ x\ 10^{-6}} = 28245576\ \text{Pa}$$

$$= 28.24\ \text{MPa}.$$

f. PP (*Polypropylene*) Daur Ulang Temperatur 200°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$= \frac{947}{41.6\ x\ 10^{-6}} = 22764423$ Pa

$= 22.76$ MPa.

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$= \frac{777.2}{41.6\ x\ 10^{-6}} = 18682692$ Pa

$= 18.68$ MPa.

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$= \frac{828.2}{41.6\ x\ 10^{-6}} = 19908653$ Pa

$= 19.9$ MPa.

2. Perhitungan Regangan

Rumus Regangan:

$$\varepsilon = \frac{\Delta L}{L0} \times 100$$

Keterangan:

ε = Regangan Tarik (Strain)

ΔL = Pertambahan Panjang spesimen

$L0$ = Panjang awal spesimen

a. LDPE (*Low Density Polyethylene*)) Daur Ulang Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{29}{57} \times 100$$

$= 50.88\ \%$

Spesimen 2

$$\varepsilon = \frac{11}{57} \times 100$$

$= 19.30\ \%$

Spesimen 3

$$\varepsilon = \frac{8}{57} \times 100$$

`

$= 14.04\,\%$

b. LDPE (*Low Density Polyethylene*) Daur Ulang Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{11}{57} \times 100$$

$$= 19.30\,\%$$

Spesimen 2

$$\varepsilon = \frac{6}{57} \times 100$$

$$= 10.53\ \%$$

Spesimen 3

$$\varepsilon = \frac{10}{57} \times 100$$

$$= 17.54\ \%$$

c. HDPE (*High Density Polyethylene*) Daur Ulang Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{12}{57} \times 100$$

$$= 21.05\ \%$$

Spesimen 2

$$\varepsilon = \frac{52}{57} \times 100$$

$$= 91.23\,\%$$

Spesimen 3

$$\varepsilon = \frac{30}{57} \times 100$$

$$= 52{,}63\ \%$$

d. HDPE (*High Density Polyethylene*) Daur Ulang Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{42}{57} \times 100$$

$$= 73.68\ \%$$

Spesimen 2

$$\varepsilon = \frac{42}{57} \times 100$$

$$= 73.68\ \%$$

Spesimen 3

$$\varepsilon = \frac{42}{57} \times 100$$

`

$= 73.68\ \%$

e. PP (*Polypropylene*) Daur Ulang Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{9}{57} \times 100$$

$$= 15{,}79\ \%$$

Spesimen 2

$$\varepsilon = \frac{9}{57} \times 100$$

$$= 15{,}79\ \%$$

Spesimen 3

$$\varepsilon = \frac{9}{57} \times 100$$

$$= 15{,}79\ \%$$

f. PP (*Polypropylene*) Daur Ulang Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{6}{57} \times 100$$

$$= 10.53\ \%$$

Spesimen 2

$$\varepsilon = \frac{6}{57} \times 100$$

$$= 10.53\ \%$$

Spesimen 3

$$\varepsilon = \frac{6}{57} \times 100$$

$$= 10.53\ \%$$

3. Perhitungan Modulus Elastisitas

Rumus Modulus Elastisitas:

$$E = \frac{\sigma}{\varepsilon}$$

Keterangan:

E = Modulus Elastisitas (MPa)

σ = Tegangan (MPa)

ε = Regangan (%)

a. LDPE (*Low Density Polyethylene*) Daur Ulang Temperatur 190°C

Spesimen 1

`

$$E = \frac{16.51}{17.54}$$

$$= 94.12 \text{ Mpa}$$

Spesimen 2

$$E = \frac{12.90}{12.28}$$

$$= 105.05 \text{ Mpa}$$

Spesimen 3

$$E = \frac{9.30}{8.77}$$

$$= 106.03 \text{ Mpa}$$

b. LDPE (*Low Density Polyethylene*) Daur Ulang Temperatur 200°C

Spesimen 1

$$E = \frac{9.46}{8.77}$$

$$= 107.83 \text{ Mpa}$$

Spesimen 2

$$E = \frac{8.85}{7.02}$$

$$= 126.16 \text{ Mpa}$$

Spesimen 3

$$E = \frac{8.40}{7.02}$$

$$= 119.72 \text{ Mpa}$$

c. HDPE (*High Density Polyethylene*) Daur Ulang Temperatur 190°C

Spesimen 1

$$E = \frac{22.16}{15.79}$$

$$= 140.34 \text{ Mpa}$$

Spesimen 2

$$E = \frac{22.70}{17.54}$$

$$= 155.04 \text{ Mpa}$$

Spesimen 3

$$E = \frac{32.12}{24.56}$$

$$= 130.77 \text{ Mpa}$$

d. HDPE (*High Density Polyethylene*) Daur Ulang Temperatur 200°C

Spesimen 1

`

$$E = \frac{16.51}{8.77}$$

$$= 188.18 \text{ Mpa}$$

Spesimen 2

$$E = \frac{23.70}{14.04}$$

$$= 168.88 \text{ Mpa}$$

Spesimen 3

$$E = \frac{22.67}{14.04}$$

$$= 161.49 \text{ Mpa}$$

e. **PP (*Polypropylene*) Daur Ulang Temperatur 190°C**

Spesimen 1

$$E = \frac{23.46}{10.53}$$

$$= 222.86 \text{ Mpa}$$

Spesimen 2

$$E = \frac{22.31}{10.53}$$

$$= 212.54 \text{ Mpa}$$

Spesimen 3

$$E = \frac{23.05}{10.53}$$

$$= 218.96 \text{ Mpa}$$

f. PP (*Polypropylene*) Daur Ulang Temperatur 200°C

Spesimen 1

$$E = \frac{19.35}{7.02}$$

$$= 275.68 \text{ Mpa}$$

Spesimen 2

$$E = \frac{18.68}{8.77}$$

$$= 212.98 \text{ Mpa}$$

Spesimen 3

$$E = \frac{19.91}{8.77}$$

$$= 226.96 \text{ Mpa}$$

`

III. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP)

1. Perhitungan Tegangan Tarik

Rumus Tegangan Tarik:

$$\sigma = \frac{F}{A}$$

Keterangan:

σ = Tegangan tarik (MPa)

F = Gaya tarik yang diberikan (N)

A = Luas penampang awal material (mm^2)

Menghitung luas penampang

A= Luas penampang spesimen

A= Tebal x Lebar

= 3.2 x 13

= 41.6 mm^2 = 41.6 x 10^{-6} m^2

a. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP) Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{799.9}{41.6\ x\ 10^{-6}} = 19238365.3\ \text{Pa}$$

= 19.23 MPa.

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{684.6}{41.6\ x\ 10^{-6}} = 1646730{,}7\ \text{Pa}$$

= 16.46 MPa.

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{639.8}{41.6\ x\ 10^{-6}} = 15389807.6\ \text{Pa}$$

= 15.38 MPa.

b. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

`

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{838.6}{41.6\ x\ 10^{-6}} = 20168653\ \text{Pa}$$

$$= 19.23\ \text{MPa}.$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{843.6}{41.6\ x\ 10^{-6}} = 20288846.1\ \text{Pa}$$

$$= 20.28\ \text{MPa}.$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{783.8}{41.6\ x\ 10^{-6}} = 18841346.1\ \text{Pa}$$

$$= 18.84\ \text{MPa}.$$

2. Perhitungan Regangan

Rumus Regangan:

$$\varepsilon = \frac{\Delta L}{L0} \times 100$$

Keterangan:

ε = Regangan Tarik (Strain)

ΔL = Pertambahan Panjang spesimen

$L0$ = Panjang awal spesimen

a. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP) Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{6}{57} \times 100$$

$$= 10.53\ \%$$

Spesimen 2

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

Spesimen 3

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

b. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

Spesimen 2

$$\varepsilon = \frac{7}{57} \times 100$$
$$= 12.28\ \%$$

Spesimen 3

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

3. Perhitungan Modulus Elastisitas

Rumus Modulus Elastisitas:

$$E = \frac{\sigma}{\varepsilon}$$

Keterangan:

E = Modulus Elastisitas (MPa)

σ = Tegangan (MPa)

ε = Regangan (%)

a. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP) Temperatur 190°C

Spesimen 1

$$E = \frac{12.04}{7.02}$$
$$= 171.62\ \text{Mpa}$$

Spesimen 2

`

$$E = \frac{16.46}{8.77}$$

$$= 187.61 \text{ Mpa}$$

Spesimen 3

$$E = \frac{15.38}{8.77}$$

$$= 175.33 \text{ Mpa}$$

b. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

Spesimen 1

$$E = \frac{11.72}{7.02}$$

$$= 166.99 \text{ Mpa}$$

Spesimen 2

$$E = \frac{17.68}{8.77}$$

$$= 201.53 \text{ Mpa}$$

Spesimen 3

$$E = \frac{18.84}{8.77}$$

$$= 214.79 \text{ Mpa}$$

IV. Plastik Murni Paduan (LDPE, HDPE, dan PP)

1. Perhitungan Tegangan Tarik

Rumus Tegangan Tarik:

$$\sigma = \frac{F}{A}$$

Keterangan:

σ = Tegangan tarik (MPa)

F = Gaya tarik yang diberikan (N)

A = Luas penampang awal material (mm^2)

Menghitung luas penampang

A= Luas penampang spesimen

A= Tebal x Lebar

= 3.2 x 13

= 41.6 mm^2 = 41.6 x 10^{-6} m^2

`

a. Plastik Murni Paduan (LDPE, HDPE, dan PP) Temperatur 190°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{864.4}{41.6\ x\ 10^{-6}} = 207877746.1\ \text{Pa}$$

$$= 20.78\ \text{MPa.}$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{898.9}{41.6\ x\ 10^{-6}} = 21608173.0\ \text{Pa}$$

$$= 21.61\ \text{MPa.}$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{993.1}{41.6\ x\ 10^{-6}} = 23872596.1\ \text{Pa}$$

$$= 23.87\ \text{MPa.}$$

b. Plastik Murni Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

Spesimen 1

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{953.6}{41.6\ x\ 10^{-6}} = 22923076.9\ \text{Pa}$$

$$= 22.92\ \text{MPa.}$$

Spesimen 2

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{968.4}{41.6\ x\ 10^{-6}} = 23288846.1\ \text{Pa}$$

$$= 23.28\ \text{MPa.}$$

Spesimen 3

$$\sigma = \frac{beban\ (N)}{A\ (mm^2)}$$

$$= \frac{1032.3}{41.6\ x\ 10^{-6}} = 24814903.8\ \text{Pa}$$

$$= 24.81\ \text{MPa.}$$

`

2. Perhitungan Regangan

Rumus Regangan:

$$\varepsilon = \frac{\Delta L}{L0} \times 100$$

Keterangan:

ε = Regangan Tarik (Strain)

ΔL = Pertambahan Panjang spesimen

$L0$ = Panjang awal spesimen

a. Plastik Murni Paduan (LDPE, HDPE, dan PP) Temperatur 190°C

Spesimen 1

$$\varepsilon = \frac{6}{57} \times 100$$
$$= 10.53\ \%$$

Spesimen 2

$$\varepsilon = \frac{7}{57} \times 100$$
$$= 12.28\ \%$$

Spesimen 3

$$\varepsilon = \frac{8}{57} \times 100$$
$$= 14.04\ \%$$

b. Plastik Murni Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

Spesimen 1

$$\varepsilon = \frac{8}{57} \times 100$$
$$= 14.04\ \%$$

Spesimen 2

$$\varepsilon = \frac{7}{57} \times 100$$
$$= 12.28\ \%$$

Spesimen 3

$$\varepsilon = \frac{9}{57} \times 100$$
$$= 15.79\ \%$$

3. Perhitungan Modulus Elastisitas

Rumus Modulus Elastisitas:

`

$$E = \frac{\sigma}{\varepsilon}$$

Keterangan:

E = Modulus Elastisitas (MPa)

σ = Tegangan (MPa)

ε = Regangan (%)

a. Plastik Murni Paduan (LDPE, HDPE, dan PP) Temperatur 190°C

Spesimen 1

$$E = \frac{20.78}{8.77}$$

$$= 236.88 \text{ Mpa}$$

Spesimen 2

$$E = \frac{21.61}{10.53}$$

$$= 205.00 \text{ Mpa}$$

Spesimen 3

$$E = \frac{23.87}{12.28}$$

$$= 194.39 \text{ Mpa}$$

b. Plastik Murni Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

Spesimen 1

$$E = \frac{22.92}{12.28}$$

$$= 198.20 \text{ Mpa}$$

Spesimen 2

$$E = \frac{23.28}{10.53}$$

$$= 205 \text{ Mpa}$$

Spesimen 3

$$E = \frac{23.75}{12.28}$$

$$= 193.43 \text{ Mpa}$$

Lampiran 2. Perhitung Uji Impak

Perhitungan Luas Penampang

$$A = b\ x\ (h - a)$$

$$= 12{,}7\ x\ (12.7 - 2.54)$$

`

$= 12{,}7\ x\ 10.16$

$= 129.03\ mm^2$

Rumus Mencari Nilai Impak:

$$Nilai\ Impak = \frac{Energi\ diserap\ (Joule)}{Luas\ Penampang\ (mm^2)}$$

1. Plastik Murni

a. Plastik Murni HDPE (*High-Density Polyethylene*) Temperatur 190°C

Spesimen 1

$$Nilai\ Impak = \frac{126\ J}{129{,}03\ (mm^2)} = 0{,}977\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{130\ J}{129{,}03\ (mm^2)} = 1{,}008\ J/mm^2$$

Spesimen 3

$$Nilai\ Impak = \frac{125\ J}{129{,}03\ (mm^2)} = 0{,}969\ J/mm^2$$

b. Plastik Murni LDPE (*Low-Density Polyethylene*) Temperatur 190°C

Spesimen 1

$$Nilai\ Impak = \frac{135\ J}{129{,}03\ (mm^2)} = 1{,}046\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{136\ J}{129{,}03\ (mm^2)} = 1{,}054\ J/mm^2$$

Spesimen 3

$$Nilai\ Impak = \frac{133\ J}{129{,}03\ (mm^2)} = 1{,}031\ J/mm^2$$

c. Plastik Murni PP (Polypropylene) Temperatur 190°C

Spesimen 1

$$Nilai\ Impak = \frac{120\ J}{129{,}03\ (mm^2)} = 0{,}930\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{119\ J}{129{,}03\ (mm^2)} = 0{,}922 J/mm^2$$

Spesimen 3

`

$$Nilai\ Impak = \frac{114\ J}{129{,}03\ (mm^2)} = 0{,}884\ J/mm^2$$

2. Plastik Daur Ulang

a. Plastik Daur Ulang HDPE (*High-Density Polyethylene*) Temperatur 190°C

Spesimen 1

$$Nilai\ Impak = \frac{122\ J}{129{,}03\ (mm^2)} = 0{,}946\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{119\ J}{129{,}03\ (mm^2)} = 0{,}922\ J/mm^2$$

Spesimen 3

$$Nilai\ Impak = \frac{124\ J}{129{,}03\ (mm^2)} = 0{,}961\ J/mm^2$$

b. Plastik Daur Ulang LDPE (*Low-Density Polyethylene*) Temperatur 190°C

Spesimen 1

$$Nilai\ Impak = \frac{114\ J}{129{,}03\ (mm^2)} = 0{,}884\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{112\ J}{129{,}03\ (mm^2)} = 0{,}868\ J/mm^2$$

Spesimen 3

$$Nilai\ Impak = \frac{114\ J}{129{,}03\ (mm^2)} = 0{,}844\ J/mm^2$$

c. Plastik Daur Ulang PP (Polypropylene) Temperatur 190°C

Spesimen 1

$$Nilai\ Impak = \frac{114\ J}{129{,}03\ (mm^2)} = 0{,}844\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{114\ J}{129{,}03\ (mm^2)} = 0{,}844\ \ J/mm^2$$

Spesimen 3

`

$$Nilai\ Impak = \frac{112\ J}{129{,}03\ (mm^2)} = 0{,}868\ J/mm^2$$

3. Plastik Paduan Murni

a. Plastik Murni Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

Spesimen 1

$$Nilai\ Impak = \frac{137\ J}{129{,}03\ (mm^2)} = 1{,}062\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{140\ J}{129{,}03\ (mm^2)} = 1{,}085\ J/mm^2$$

Spesimen 3

$$Nilai\ Impak = \frac{140\ J}{129{,}03\ (mm^2)} = 1{,}085\ J/mm^2$$

4. Plastik Paduan Daur Ulang

a. Plastik Daur Ulang Paduan (LDPE, HDPE, dan PP) Temperatur 200°C

Spesimen 1

$$Nilai\ Impak = \frac{132\ J}{129{,}03\ (mm^2)} = 1{,}023\ J/mm^2$$

Spesimen 2

$$Nilai\ Impak = \frac{124\ J}{129{,}03\ (mm^2)} = 0{,}961\ J/mm^2$$

Spesimen 3

$$Nilai\ Impak = \frac{136\ J}{129{,}03\ (mm^2)} = 1{,}054\ J/mm^2$$

`

Lampiran 2 . Dokumentasi *Sampel* Uji Tarik

1. Plastik PP Murni Temeperatur 190°C

Spesimen 1		
Tegangan Tarik = 33,36 Mpa	Regangan = 21,05%	Modulus Elastisitas = 225,8 MPa

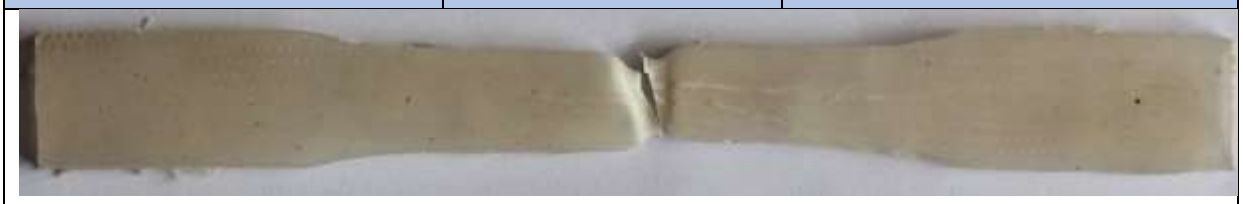
Spesimen 2		
Tegangan Tarik = 31,95 Mpa	Regangan = 21,05%	Modulus Elastisitas = 270,5 MPa

Spesimen 3		
Tegangan Tarik = 29,37 Mpa	Regangan = 21,05%	Modulus Elastisitas = 186,1 MPa

`

2. Plastik PP Murni Temeperatur 200°C

Spesimen 1		
Tegangan Tarik = 16.59 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 210.22 MPa



Spesimen 2		
Tegangan Tarik = 23.9 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 272.50 MPa

Spesimen 3		
Tegangan Tarik = 22.0 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 271.40 MPa

`

3. Plastik HDPE Murni Temeperatur 190°C

Spesimen 1		
Tegangan Tarik = 41,67 Mpa	Regangan = 68,42%	Modulus Elastisitas = 134,9 MPa

Spesimen 2		
Tegangan Tarik = 40,45 Mpa	Regangan = 110,5%	Modulus Elastisitas = 180 MPa

Spesimen 3		
Tegangan Tarik = 30,81 Mpa	Regangan = 42,11%	Modulus Elastisitas = 115,64 MPa

`

4. Plastik HDPE Murni Temperatur 200 °C

Spesimen 1		
Tegangan Tarik = 33.29 Mpa	Regangan = 68.42 %	Modulus Elastisitas = 308.87 MPa

Spesimen 2		
Tegangan Tarik = 34.04 Mpa	Regangan = 68.42 %	Modulus Elastisitas = 303.94 MPa

Spesimen 3		
Tegangan Tarik = 32.92 Mpa	Regangan = 68.42 %	Modulus Elastisitas = 230.69 MPa

`

5. Plastik LDPE Murni Temeperatur 190°C

Spesimen 1		
Tegangan Tarik = 21,88 Mpa	Regangan = 57,89%	Modulus Elastisitas = 63,1 MPa

Spesimen 2		
Tegangan Tarik = 21,49 Mpa	Regangan = 42,11%	Modulus Elastisitas = 88,93 MPa

Spesimen 3		
Tegangan Tarik = 23,11 Mpa	Regangan = 45,61%	Modulus Elastisitas = 83,95 MPa

`

6. Plastik LDPE Murni Temperatur 200 °C

Spesimen 1		
Tegangan Tarik = 17.95 Mpa	Regangan = 29.82 %	Modulus Elastisitas =158.64 MPa

Spesimen 2		
Tegangan Tarik = 15.08 Mpa	Regangan = 29.82 %	Modulus Elastisitas = 114.69 MPa

Spesimen 3		
Tegangan Tarik = 16.78 Mpa	Regangan = 29.82 %	Modulus Elastisitas = 130.92 MPa

`

7. Plastik PP Daur Ulang Temeperatur 190°C

Spesimen 1		
Tegangan Tarik = 27,54 Mpa	Regangan = 15,79%	Modulus Elastisitas = 222,86 MPa

Spesimen 2		
Tegangan Tarik = 25,95 Mpa	Regangan = 15,79%	Modulus Elastisitas = 212,54 MPa

Spesimen 3		
Tegangan Tarik = 28,24 Mpa	Regangan = 15,79%	Modulus Elastisitas = 218,96 MPa

`

8. Plastik PP Daur Ulang Temeperatur 200°C

Spesimen 1		
Tegangan Tarik = 22.76 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 275.68 MPa

Spesimen 2		
Tegangan Tarik = 18.68 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 212.98 MPa

Spesimen 3		
Tegangan Tarik = 19.91 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 226.96 MPa

`

9. Plastik HDPE Daur Ulang Temeperatur 190°C

Spesimen 1		
Tegangan Tarik = 24,72 Mpa	Regangan = 21,05%	Modulus Elastisitas = 140,34 MPa

Spesimen 2		
Tegangan Tarik = 35,8 Mpa	Regangan = 91,23%	Modulus Elastisitas = 154,91 MPa

Spesimen 3		
Tegangan Tarik = 38,19 Mpa	Regangan = 52,63%	Modulus Elastisitas = 130,77 MPa

`

10. Plastik HDPE Daur Ulang Temeperatur 200°C

1. Spesimen 1		
Tegangan Tarik = 33.34 Mpa	Regangan = 73.68 %	Modulus Elastisitas =188.18 MPa

Spesimen 2		
Tegangan Tarik = 30.14 Mpa	Regangan = 73.68 %	Modulus Elastisitas = 168.88 MPa

Spesimen 3		
Tegangan Tarik = 30.69 Mpa	Regangan = 73.68 %	Modulus Elastisitas = 161.49 MPa

`

11. Plastik LDPE Daur Ulang Temeperatur 190°C

Spesimen 1		
Tegangan Tarik = 18,83 Mpa	Regangan = 50,88%	Modulus Elastisitas = 94,12 MPa

Spesimen 2		
Tegangan Tarik = 15,64 Mpa	Regangan = 19,30%	Modulus Elastisitas = 105,05 MPa

Spesimen 3		
Tegangan Tarik = 11,27 Mpa	Regangan = 14,04%	Modulus Elastisitas = 106,03 MPa

`

12. Plastik LDPE Daur Ulang Temeperatur 200°C

Spesimen 1		
Tegangan Tarik = 13.2 Mpa	Regangan = 19.30 %	Modulus Elastisitas = 107.83 MPa

Spesimen 2		
Tegangan Tarik = 9.94 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 126.16 MPa

Spesimen 3		
Tegangan Tarik = 13.75 Mpa	Regangan = 17.54 %	Modulus Elastisitas = 119.72 MPa

`

13. Plastik Paduan Murni Temperatur 190°C

Spesimen 1		
Tegangan Tarik = 19.23 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 171.62 MPa

Spesimen 2		
Tegangan Tarik = 16.46 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 187.61 MPa

Spesimen 3		
Tegangan Tarik = 15.38 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 175.33 MPa

`

14. Plastik Paduan Murni Temperatur 200°C

Spesimen 1		
Tegangan Tarik = 20.16 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 166.99 MPa

Spesimen 2		
Tegangan Tarik = 20.28 Mpa	Regangan = 12.28 %	Modulus Elastisitas = 201.53 MPa

Spesimen 3		
Tegangan Tarik = 18.84 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 214.79 MPa

`

15. Plastik Paduan Daur Ulang Temperatur 190°C

Spesimen 1		
Tegangan Tarik = 13.2 Mpa	Regangan = 19.30 %	Modulus Elastisitas = 107.83 MPa

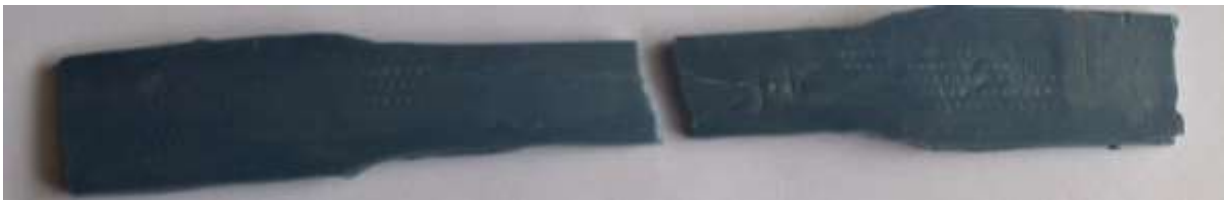
Spesimen 2		
Tegangan Tarik = 9.94 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 126.16 MPa

Spesimen 3		
Tegangan Tarik = 13.75 Mpa	Regangan = 17.54 %	Modulus Elastisitas = 119.72 MPa

`

16. Plastik Paduan Daur Ulang Temperatur 200°C

Spesimen 1		
Tegangan Tarik = 13.2 Mpa	Regangan = 19.30 %	Modulus Elastisitas = 107.83 MPa



Spesimen 2		
Tegangan Tarik = 9.94 Mpa	Regangan = 10.53 %	Modulus Elastisitas = 126.16 MPa

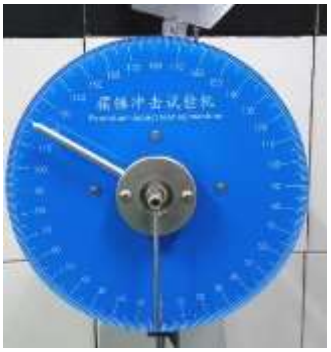
Spesimen 3		
Tegangan Tarik = 13.75 Mpa	Regangan = 17.54 %	Modulus Elastisitas = 119.72 MPa

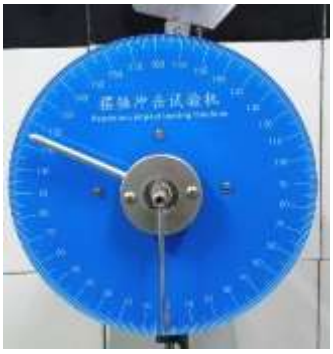
`

Lampiran 3. Dokumentasi Uji Impak

1. Plastik PP Murni

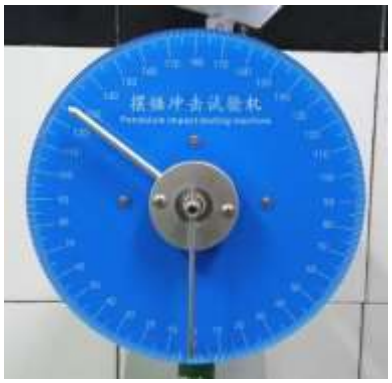
Spesimen 1	
Energi impak yang diserap = 120 Joule	Dokumentasi patahan spesimen uji
	

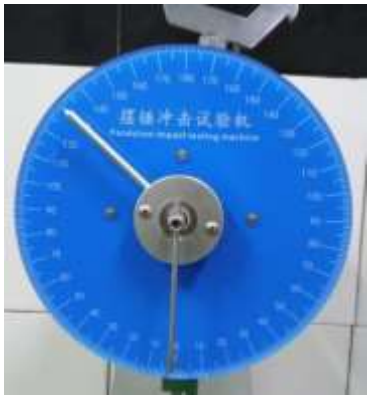
Spesimen 2	
Energi impak yang diserap = 119 Joule	Dokumentasi patahan spesimen uji
	

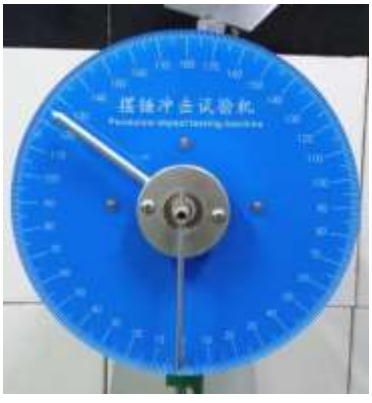
Spesimen 3	
Energi impak yang diserap = 114 Joule	Dokumentasi patahan spesimen uji
	

`

2. Plastik HDPE Murni

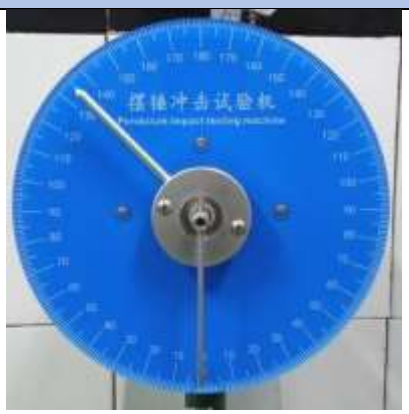
Spesimen 1	
Energi impak yang diserap = 126 Joule	Dokumentasi patahan spesimen uji
	

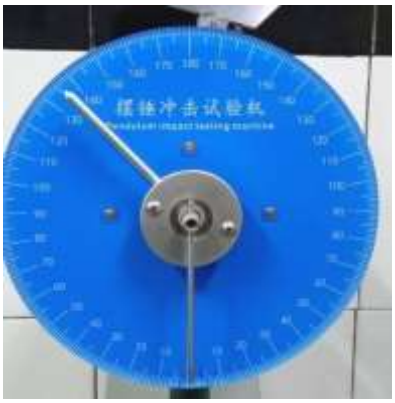
Spesimen 2	
Energi impak yang diserap = 130 Joule	Dokumentasi patahan spesimen uji
	

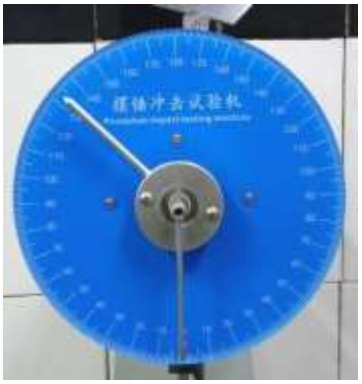
Spesimen 3	
Energi impak yang diserap = 125 Joule	Dokumentasi patahan spesimen uji
	

`

3. Plastik LDPE Murni

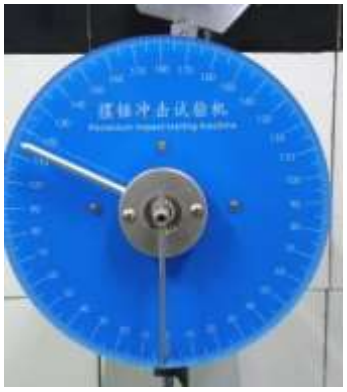
Spesimen 1	
Energi impak yang diserap = 135 Joule	Dokumentasi patahan spesimen uji
	

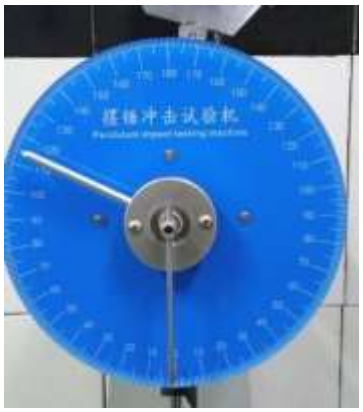
Spesimen 2	
Energi impak yang diserap = 136 Joule	Dokumentasi patahan spesimen uji
	

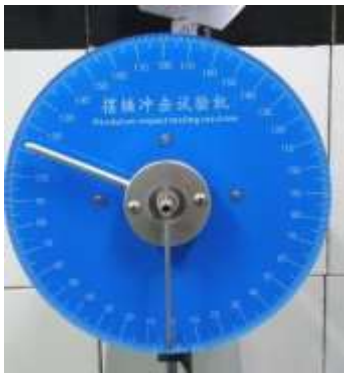
Spesimen 3	
Energi impak yang diserap = 133 Joule	Dokumentasi patahan spesimen uji
	

`

4. Plastik PP Daur Ulang

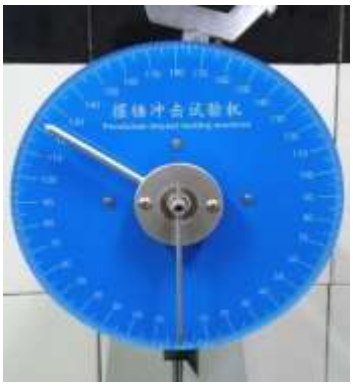
Spesimen 1	
Energi impak yang diserap = 114 Joule	Dokumentasi patahan spesimen uji
	

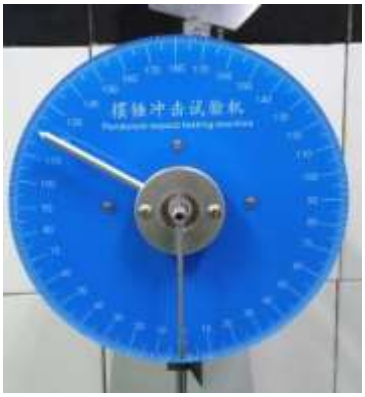
Spesimen 2	
Energi impak yang diserap = 114 Joule	Dokumentasi patahan spesimen uji
	

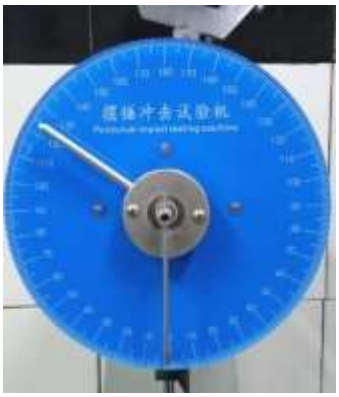
Spesimen 3	
Energi impak yang diserap = 112 Joule	Dokumentasi patahan spesimen uji
	

`

5. Plastik HDPE Daur Ulang

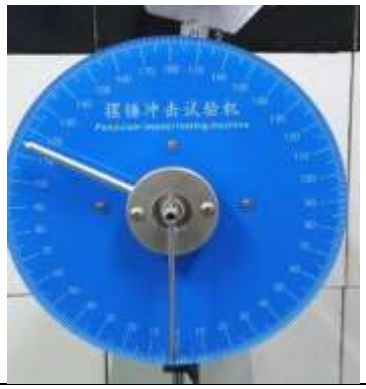
Spesimen 1	
Energi impak yang diserap = 122 Joule	Dokumentasi patahan spesimen uji
	

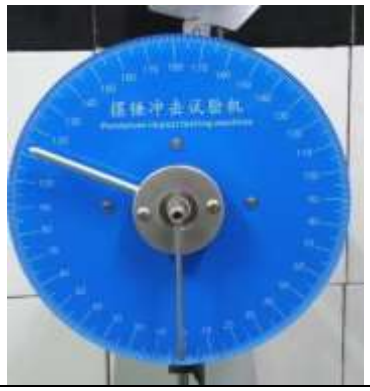
Spesimen 2	
Energi impak yang diserap = 119 Joule	Dokumentasi patahan spesimen uji
	

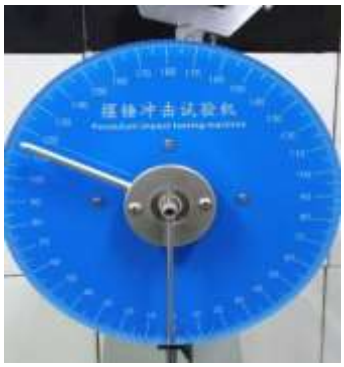
Spesimen 3	
Energi impak yang diserap = 124 Joule	Dokumentasi patahan spesimen uji
	

`

6. Plastik LDPE Daur Ulang

Spesimen 1	
Energi impak yang diserap = 114 Joule	Dokumentasi patahan spesimen uji
	

Spesimen 2	
Energi impak yang diserap = 112 Joule	Dokumentasi patahan spesimen uji
	

Spesimen 3	
Energi impak yang diserap = 114 Joule	Dokumentasi patahan spesimen uji
	

`

7. Plastik Murni Paduan LDPE, HDPE, PP

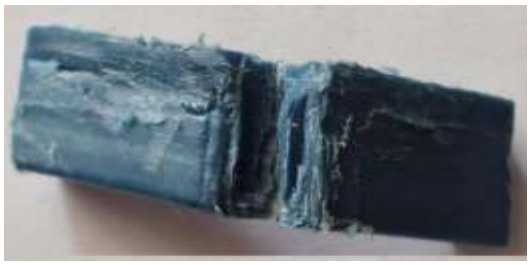
Spesimen 1	
Energi impak yang diserap = 137 Joule	Dokumentasi patahan spesimen uji
	

Spesimen 2	
Energi impak yang diserap = 140 Joule	Dokumentasi patahan spesimen uji
	

Spesimen 3	
Energi impak yang diserap = 140 Joule	Dokumentasi patahan spesimen uji
	

`

8. Plastik Daur Ulang Paduan LDPE, HDPE, PP

Spesimen 1	
Energi impak yang diserap = 132 Joule	Dokumentasi patahan spesimen uji
	

Spesimen 2	
Energi impak yang diserap = 124 Joule	Dokumentasi patahan spesimen uji
	

Spesimen 3	
Energi impak yang diserap = 136 Joule	Dokumentasi patahan spesimen uji
	

`