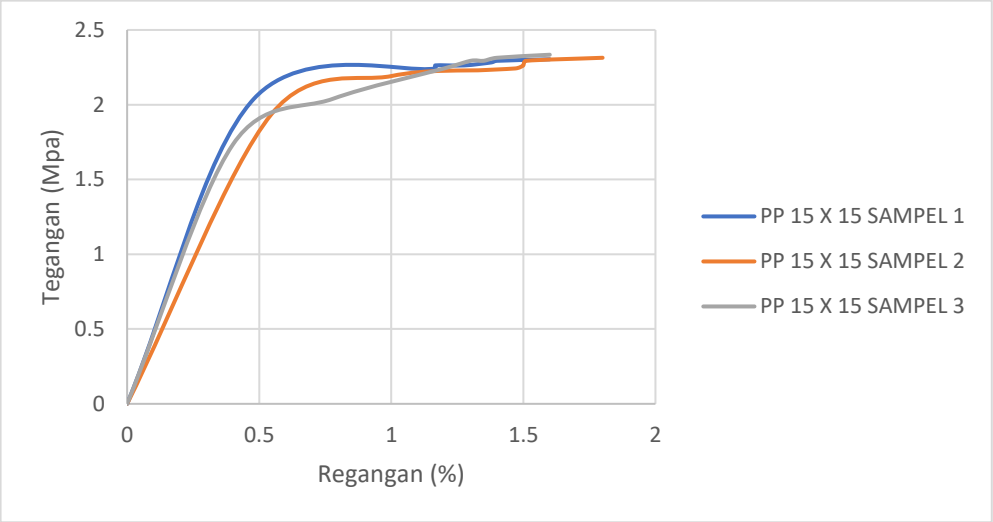
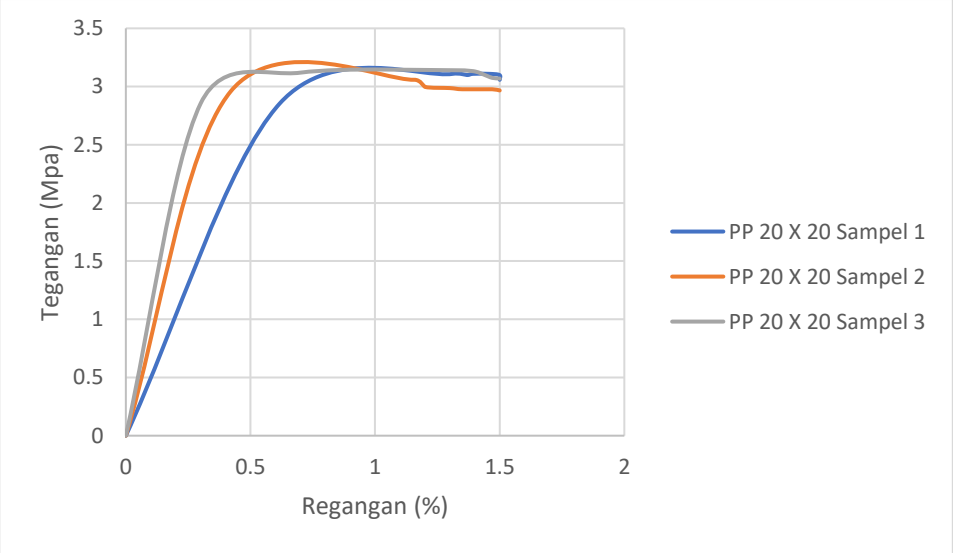
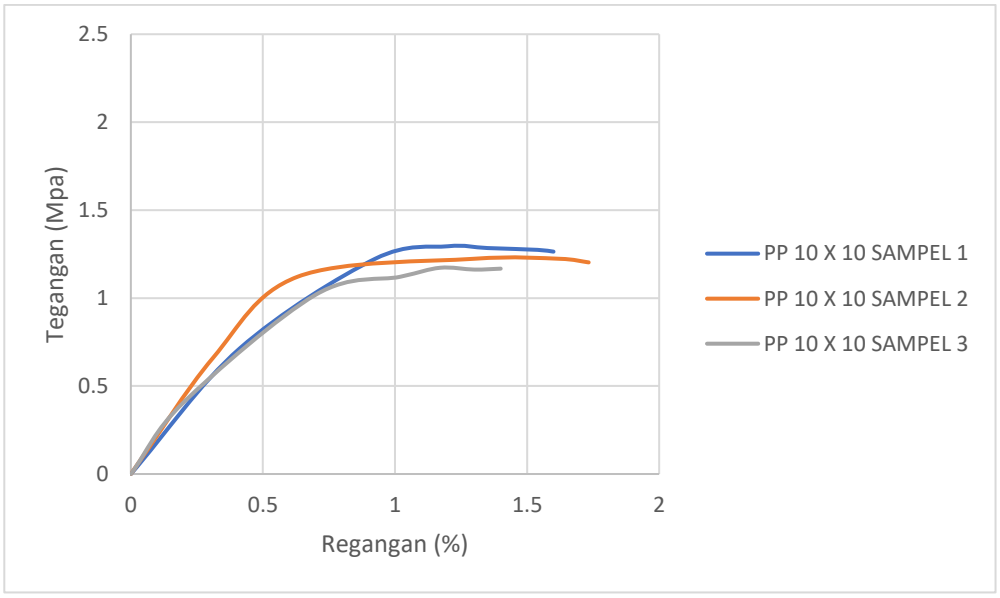
# LAMPIRAN

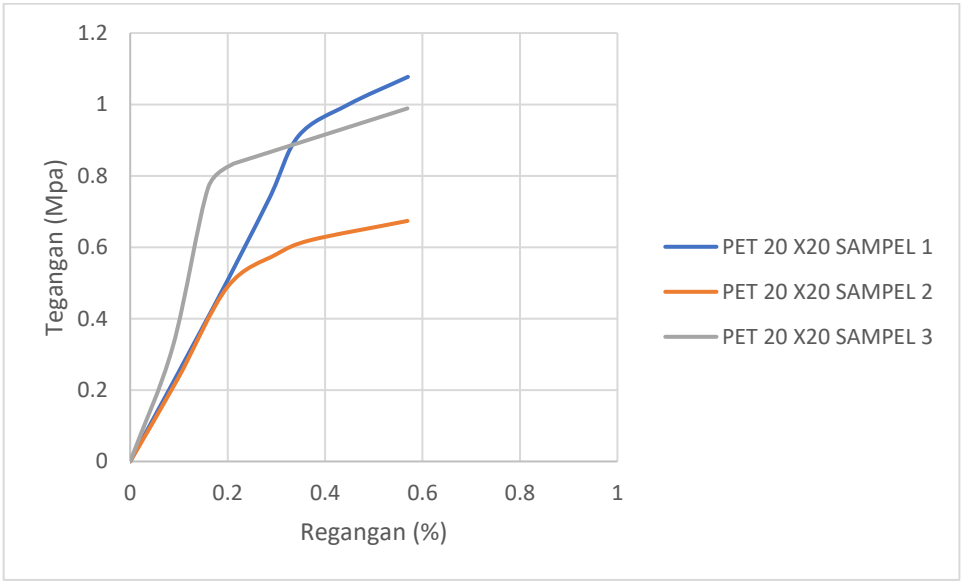
## A.Gambar Grafik Tegangan Regangan Pengujian Tarik Plastik *Polypropylen* (PP)

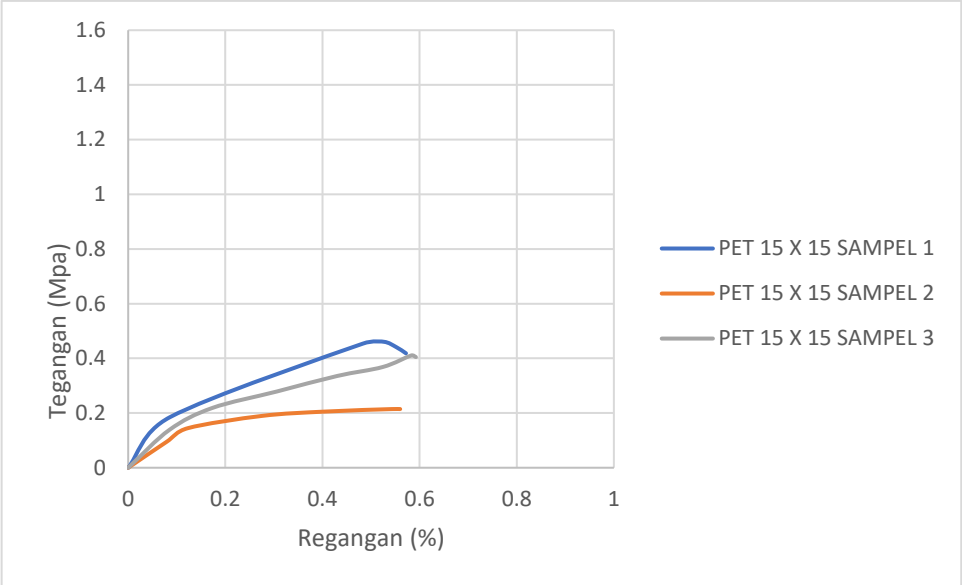


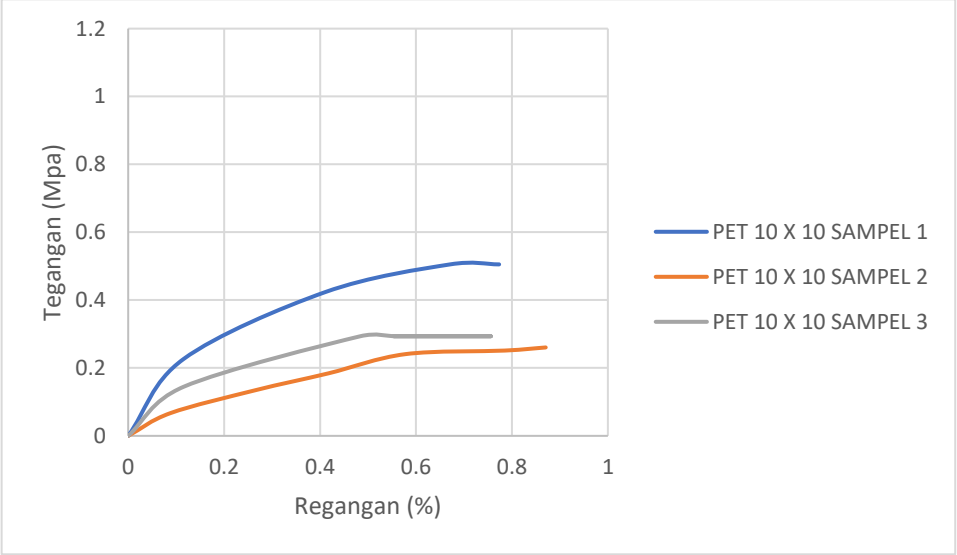






**B.Gambar Grafik Tegangan Regangan Pengujian Tarik Plastik *Polyetylene* (PET)**






## C. PERHITUNGAN

### I.Perhitungan Spesimen Uji Material Plastik *Polypropylene* 20 x 20 mm

1. menghitung Luas Penampang

A = Luas Penampang Spesimen

A = Tebal x Lebar

= 4 x 13

= 52 $mm^2$ = 52 x $10^{-6}$ $m^2$

2. Menghitung Tegangan Tarik

Spesimen 1

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

$$= \frac{164.1\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 3155769.231\ \mathrm{Pa}$$

$$= 3.16\ \mathrm{MPa}$$

Spesimen 2

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

$$= \frac{163\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 3140384.615\ \mathrm{Pa}$$

$$= 3.14\ \mathrm{MPa}$$

Spesimen 3

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

$$= \frac{142\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 3115384.615\ \mathrm{Pa}$$

$$= 3.12\ \mathrm{MPa}$$

**II.Perhitungan Spesimen Uji Material Plastik *Polypropylene* 15 x 15 mm**

1. menghitung Luas Penampang

A = Luas Penampang Spesimen

A = Tebal x Lebar

= 4 x 19

= 52 $mm^2$ = 52 x $10^{-6}$ $m^2$

2. Menghitung Tegangan Tarik

Spesimen 1

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

$$= \frac{117.7\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 2263461.538\ \mathrm{Pa}$$

$$= 2.26\mathrm{MPa}$$

Spesimen 2

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

$$= \frac{118.1\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 2271153.846\ \mathrm{Pa}$$

$$= 2.27\ \mathrm{MPa}$$

Spesimen 3

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

$$= \frac{120.9\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 2325000\ \mathrm{Pa}$$

$$= 2.33\mathrm{MPa}$$

**III.Perhitungan Spesimen Uji Material Plastik *Polypropylene* 10 x 10 mm**

1. menghitung Luas Penampang

A = Luas Penampang Spesimen

A = Tebal x Lebar

= 4 x 19

= 52 $mm^2$ = 52 x $10^{-6}$ $m^2$

2. Menghitung Tegangan Tarik

Spesimen 1

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

$$= \frac{59.4\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 1142307.692\ \mathrm{Pa}$$

$$= 1.14\ \mathrm{MPa}$$

Spesimen 2

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

$$= \frac{93.6\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 1126923.077\ \mathrm{Pa}$$

$$= 1.13\ \mathrm{MPa}$$

Spesimen 3

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

$$= \frac{57.1\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 1098076.923\ \mathrm{Pa}$$

$$= 1.10\ \mathrm{MPa}$$

**IV.Perhitungan Spesimen Uji Material Plastik *Polyethylene* 20 x 20 mm**

1. menghitung Luas Penampang

A = Luas Penampang Spesimen

A = Tebal x Lebar

= 4 x 19

= 52 $mm^2$ = 52 x $10^{-6}$ $m^2$

2. Menghitung Tegangan Tarik

Spesimen 1

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

$$= \frac{83.5\ (N)}{52\ x\ 10^{-6}\ m^2} = 1605769.231\ Pa$$

$$= 1.61\ MPa$$

Spesimen 2

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

$$= \frac{81.6\ (N)}{52\ x\ 10^{-6}\ m^2} = 1569230.769\ Pa$$

$$= 1.57\ MPa$$

Spesimen 3

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

$$= \frac{80.8\ (N)}{52\ x\ 10^{-6}\ m^2} = 1553846.154\ Pa$$

$$= 1.55\ MPa$$

**V.Perhitungan Spesimen Uji Material Plastik *Polypropylene* 15 x 15 mm**

1. menghitung Luas Penampang

A = Luas Penampang Spesimen

A = Tebal x Lebar

= 4 x 19

=52 $mm^2$ = 52 x $10^{-6}$ $m^2$

2. Menghitung Tegangan Tarik

Spesimen 1

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

$$= \frac{35.4\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 680769.2308\mathrm{Pa}$$

$$= 0.68\ \mathrm{MPa}$$

Spesimen 2

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

$$= \frac{36.2\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 696153.8462\ \mathrm{Pa}$$

$$= 0.70\ \mathrm{MPa}$$

Spesimen 3

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

$$= \frac{38.4\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 738461.5385\ \mathrm{Pa}$$

$$= 0.74\ \mathrm{MPa}$$

**VI.Perhitungan Spesimen Uji Material Plastik *Polyethylene* 10 x 10 mm**

1. menghitung Luas Penampang

A = Luas Penampang Spesimen

A = Tebal x Lebar

= 4 x 19

=52 $mm^2$ = 52 x $10^{-6}$ $m^2$

2. Menghitung Tegangan Tarik

Spesimen 1

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

$$= \frac{26.3\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 505769.2308\ \mathrm{Pa}$$

$$= 0.51\ \mathrm{MPa}$$

Spesimen 2

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

$$= \frac{25.3\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 486538.4615\ \mathrm{Pa}$$

$$= 0.49\ \mathrm{MPa}$$

Spesimen 3

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

$$= \frac{24.3\ (N)}{52\ x\ 10^{-6}\ \mathrm{m}^2} = 467307.6923\ \mathrm{Pa}$$

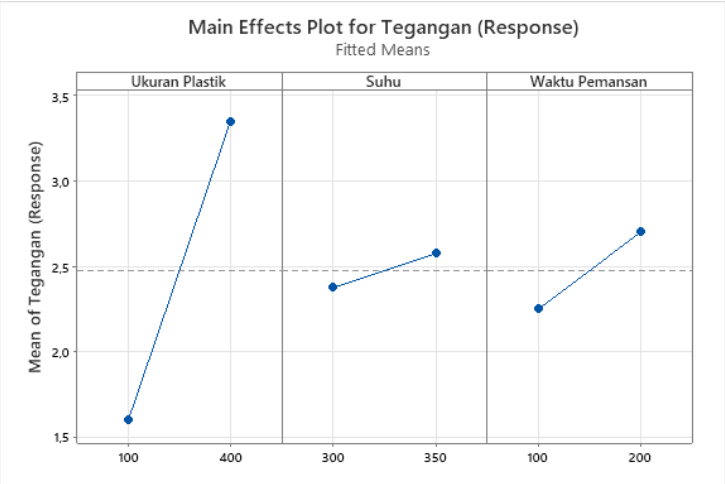
$$= 0.47\ \mathrm{MPa}$$

| KODE SPESIMEN | Elongasi (mm) | Kekuatan Tarik (Mpa) | Renggangan (%) | Modulus Elastisitas (Mpa) |
|---|---|---|---|---|
| PP 20X20 S1 | 3 | 3.16 | 0.60 | 52.60 |
| PP 20X20 S2 | 2.6 | 3.14 | 0.52 | 60.39 |
| PP 20X20 S3 | 2.8 | 3.12 | 0.56 | 55.63 |
| PP 15X15 S1 | 4 | 2.26 | 0.80 | 28.29 |
| PP 15X15 S2 | 4.6 | 2.27 | 0.92 | 24.69 |
| PP 15X15 S3 | 4 | 2.29 | 0.80 | 28.68 |
| PP 10X10 S1 | 2.6 | 1.14 | 0.52 | 21.97 |
| PP 10X10 S2 | 2 | 1.13 | 0.40 | 28.17 |
| PP 10X10 S3 | 2.4 | 1.10 | 0.48 | 22.88 |

| KODE SPESIMEN | Elongasi (mm) | Kekuatan Tarik (Mpa) | Renggangan (%) | Modulus Elastisitas (Mpa) |
|---|---|---|---|---|
| PET 20X20 S1 | 1.6 | 1.61 | 0.32 | 50.18 |
| PET 20X20 S2 | 1.2 | 1.57 | 0.24 | 65.38 |
| PET 20X20 S3 | 1.6 | 1.55 | 0.32 | 48.56 |
| PET 15X15 S1 | 1.4 | 0.68 | 0.28 | 24.31 |
| PET 15X15 S2 | 1.4 | 0.70 | 0.28 | 24.86 |
| PET 15X15 S3 | 1.6 | 0.74 | 0.32 | 23.08 |
| PET 10X10 S1 | 1.4 | 0.51 | 0.28 | 18.06 |
| PET 10X10 S2 | 1.2 | 0.49 | 0.24 | 20.27 |
| PET 10X10 S3 | 1.6 | 0.47 | 0.32 | 14.60 |

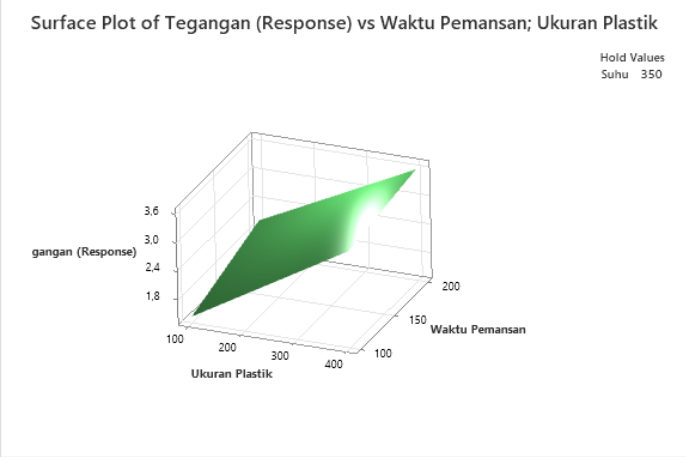
WORKSHEET 3

## Factorial Plots for Tegangan (Response)



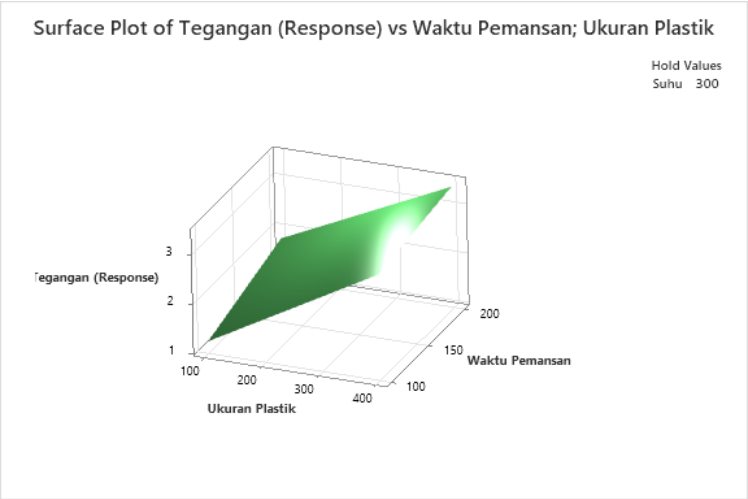

WORKSHEET 3

## Surface Plot of Tegangan (Response) vs Waktu Pemansan; Ukuran Plastik



WORKSHEET 3

# Surface Plot of Tegangan (Response) vs Waktu Pemansan; Ukuran Plastik




WORKSHEET 3

# Factorial Regression: Tegangan (Response) versus Ukuran Plastik; Suhu; Waktu Pemansan

## Coded Coefficients

| Term | Effect | Coef | SE Coef | T-Value | P-Value | VIF |
|---|---|---|---|---|---|---|
| Constant | | 2,4750 | 0,0433 | 57,16 | 0,000 | |
| Ukuran Plastik | 1,7500 | 0,8750 | 0,0433 | 20,21 | 0,000 | 1,00 |
| Suhu | 0,2000 | 0,1000 | 0,0433 | 2,31 | 0,104 | 1,00 |
| Waktu Pemansan | 0,4500 | 0,2250 | 0,0433 | 5,20 | 0,014 | 1,00 |
| Ukuran Plastik*Suhu | 0,0000 | 0,0000 | 0,0433 | 0,00 | 1,000 | 1,00 |

## Model Summary

| S | R-sq | R-sq(adj) | R-sq(pred) |
|---|---|---|---|
| 0,122474 | 99,32% | 98,42% | 95,19% |

## Analysis of Variance

| Source | DF | Adj SS | Adj MS | F-Value | P-Value |
|---|---|---|---|---|---|
| Model | 4 | 6,61000 | 1,65250 | 110,17 | 0,001 |
| Linear | 3 | 6,61000 | 2,20333 | 146,89 | 0,001 |
| Ukuran Plastik | 1 | 6,12500 | 6,12500 | 408,33 | 0,000 |
| Suhu | 1 | 0,08000 | 0,08000 | 5,33 | 0,104 |
| Waktu Pemansan | 1 | 0,40500 | 0,40500 | 27,00 | 0,014 |
| 2-Way Interactions | 1 | 0,00000 | 0,00000 | 0,00 | 1,000 |
| Ukuran Plastik*Suhu | 1 | 0,00000 | 0,00000 | 0,00 | 1,000 |
| Error | 3 | 0,04500 | 0,01500 | | |
| Total | 7 | 6,65500 | | | |

## Regression Equation in Uncoded Units

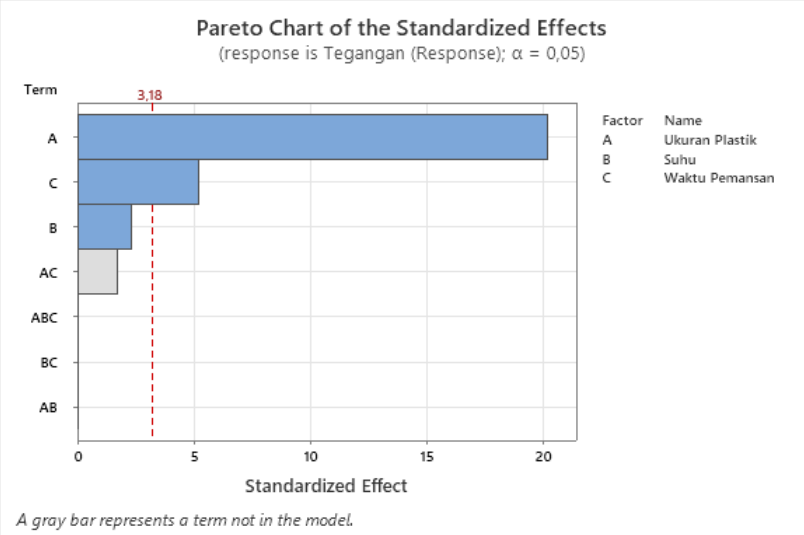
Tegangan (Response) = -0,96 + 0,00583 Ukuran Plastik + 0,00400 Suhu + 0,004500 Waktu Pemansan + 0,000000 Ukuran Plastik*Suhu

## Alias Structure

| Factor | Name |
|---|---|
| A | Ukuran Plastik |
| B | Suhu |
| C | Waktu Pemansan |

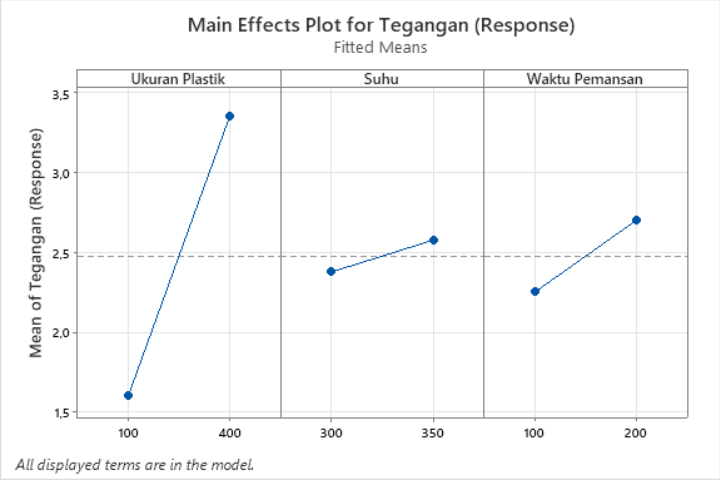
**Aliases**

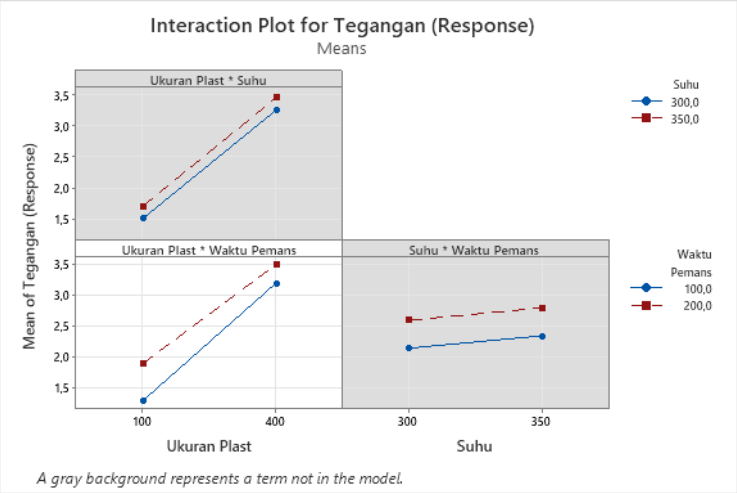
I
A
B
C
AB




WORKSHEET 3

# Factorial Plots for Tegangan (Response)






WORKSHEET 3

# Response Optimization: Tegangan (Response)

## Parameters

| Response | Goal | Lower | Target | Upper | Weight | Importance |
|---|---|---|---|---|---|---|
| Tegangan (Response) | Maximum | 1,2 | 3,6 | | 1 | 1 |

## Solution

| Solution | Ukuran Plastik | Suhu | Waktu Pemansan | Tegangan (Response) Fit | Composite Desirability |
|---|---|---|---|---|---|
| 1 | 400 | 350 | 200 | 3,6 | 1 |

## Multiple Response Prediction

| Variable | Setting |
|---|---|
| Ukuran Plastik | 400 |
| Suhu | 350 |
| Waktu Pemansan | 200 |

| Response | Fit | SE Fit | 95% CI | 95% PI |
|---|---|---|---|---|
| Tegangan (Response) | 3,600 | 0,000 | (3,600; 3,600) | (3,600; 3,600) |