

LAMPIRAN

LAMPIRAN A. PERHITUNGAN PENGUJIAN DENSITAS, POROSITAS, KADAR AIR, DAN DAYA SERAP

A. Perhitungan Densitas Teroritis

Densitas bahan :

Cangkang Telur : 2,571 gr/cm³ Karet Alam : 0,92 gr/cm³ ZnO : 5,6 gr/cm³

Sulfur : 1,96 gr/cm³ Asam Stearat : 0,845 gr/cm³

Volume total : 100 cm³

1. Sampel A komposisi *filler* 55 %

Volume bahan :

a. Cangkang telur : 55 cm³

b. Karet Alam : 34,09 cm³

c. ZnO : 1,7 cm³

d. Sulfur : 8,52 cm³

e. Asam Stearat : 0,68 cm³

$$\rho = V_a\rho_a + V_b\rho_b + V_c\rho_c + V_d\rho_d + V_e\rho_e$$

$$\rho = \frac{55}{100} 2,571 + \frac{34,09}{100} 0,92 + \frac{1,7}{100} 5,6 + \frac{8,52}{100} 1,96 + \frac{0,68}{100} 0,845$$

$$\rho = 1,9951 \text{ gr/cm}^3$$

2. Sampel A komposisi *filler* 60 %

Volume bahan :

a. Cangkang telur : 60 cm³

b. Karet Alam : 34,09 cm³

c. ZnO : 1,7 cm³

d. Sulfur : 8,52 cm³

e. Asam Stearat : 0,68 cm³

$$\rho = V_a\rho_a + V_b\rho_b + V_c\rho_c + V_d\rho_d + V_e\rho_e$$

$$\rho = \frac{60}{100} 2,571 + \frac{34,09}{100} 0,92 + \frac{1,7}{100} 5,6 + \frac{8,52}{100} 1,96 + \frac{0,68}{100} 0,845$$

$$\rho = 2,1236 \text{ gr/cm}^3$$

3. Sampel A komposisi filler 65 %

Volume bahan :

- a. Cangkang telur : 65 cm^3
- b. Karet Alam : $34,09 \text{ cm}^3$
- c. ZnO : $1,7 \text{ cm}^3$
- d. Sulfur : $8,52 \text{ cm}^3$
- e. Asam Stearat : $0,68 \text{ cm}^3$

$$\rho = V_a \rho_a + V_b \rho_b + V_c \rho_c + V_d \rho_d + V_e \rho_e$$

$$\rho = \frac{65}{100} 2,571 + \frac{34,09}{100} 0,92 + \frac{1,7}{100} 5,6 + \frac{8,52}{100} 1,96 + \frac{0,68}{100} 0,845$$

$$\rho = 2,2521 \text{ gr/cm}^3$$

B. Perhitungan Porositas

$$\text{Porositas (\%)} = \frac{(\rho_{\text{teoritis}} - \rho_{\text{aktual}})}{\rho_{\text{teoritis}}} \times 100\%$$

1. Sampel A1

$$\text{a. Porositas} = \frac{(1,9951 - 1,771)}{1,995} = 0,113$$

$$\text{b. Porositas} = \frac{(1,9951 - 1,718)}{1,995} = 0,139$$

$$\text{c. Porositas} = \frac{(1,9951 - 1,840)}{1,995} = 0,078$$

$$\text{Porositas}_{\text{average}} (\%) = 0,1097 \times 100\% = 10,970 \%$$

2. Sampel A2

$$\text{a. Porositas} = \frac{(1,9951 - 1,861)}{1,995} = 0,067$$

$$\text{b. Porositas} = \frac{(1,9951 - 1,738)}{1,995} = 0,129$$

$$\text{c. Porositas} = \frac{(1,9951 - 1,800)}{1,995} = 0,098$$

$$\text{Porositas}_{\text{average}} (\%) = 0,098 \times 100\% = 9,805 \%$$

3. Sampel A3

$$\text{a. Porositas} = \frac{(1,9951 - 1,803)}{1,995} = 0,096$$

$$\text{b. Porositas} = \frac{(1,9951 - 1,944)}{1,995} = 0,026$$

$$c. \text{ Porositas (\%)} = \frac{(1,9951-1,768)}{1,995} = 0,114$$

$$\text{Porositas}_{\text{average}} (\%) = 0,0787 \times 100\% = 7,870 \%$$

4. Sampel B1

$$a. \text{ Porositas} = \frac{(2,1236-1,732)}{2,1236} = 0,184$$

$$b. \text{ Porositas} = \frac{(2,1236-1,715)}{2,1236} = 0,192$$

$$c. \text{ Porositas} = \frac{(2,1236-1,660)}{2,1236} = 0,218$$

$$\text{Porositas}_{\text{average}} (\%) = 0,1984 \times 100\% = 19,837 \%$$

5. Sampel B2

$$a. \text{ Porositas} = \frac{(2,1236-1,695)}{2,1236} = 0,202$$

$$b. \text{ Porositas} = \frac{(2,1236-1,698)}{2,1236} = 0,200$$

$$c. \text{ Porositas} = \frac{(2,1236-1,648)}{2,1236} = 0,224$$

$$\text{Porositas}_{\text{average}} (\%) = 0,2099 \times 100\% = 20,875 \%$$

6. Sampel B3

$$a. \text{ Porositas} = \frac{(2,1236-1,720)}{2,1236} = 0,190$$

$$b. \text{ Porositas} = \frac{(2,1236-1,657)}{2,1236} = 0,220$$

$$c. \text{ Porositas} = \frac{(2,1236-1,617)}{2,1236} = 0,239$$

$$\text{Porositas}_{\text{average}} (\%) = 0,2162 \times 100\% = 21,618 \%$$

7. Sampel C1

$$a. \text{ Porositas} = \frac{(2,2521-1,578)}{2,2521} = 0,300$$

$$b. \text{ Porositas} = \frac{(2,2521-1,642)}{2,2521} = 0,271$$

$$c. \text{ Porositas} = \frac{(2,2521-1,624)}{2,2521} = 0,279$$

$$\text{Porositas}_{\text{average}} (\%) = 0,2832 \times 100\% = 28,315 \%$$

8. Sampel C2

$$a. \text{ Porositas} = \frac{(2,2521-1,807)}{2,2521} = 0,198$$

$$b. \text{ Porositas} = \frac{(2,2521-1,810)}{2,2521} = 0,196$$

$$c. \text{ Porositas} = \frac{(2,2521-1,795)}{2,2521} = 0,203$$

$$\text{Porositas}_{\text{average}} (\%) = 0,199 \times 100\% = 19,901 \%$$

9. Sampel C3

$$\text{a. Porositas} = \frac{(2,2521-1,579)}{2,2521} = 0,299$$

$$\text{b. Porositas} = \frac{(2,2521-1,895)}{2,2521} = 0,159$$

$$\text{c. Porositas} = \frac{(2,2521-1,746)}{2,2521} = 0,225$$

$$\text{Porositas}_{\text{average}} (\%) = 0,2275 \times 100\% = 22,752 \%$$

C. Perhitungan Kadar Air

$$\text{Kadar Air} (\%) = \frac{A-B}{C} \times 100\%$$

1. Sampel A1

$$\text{a. Kadar Air} (\%) = \frac{69,54-69,52}{6,96} \times 100\% = 0,287 \%$$

$$\text{b. Kadar Air} (\%) = \frac{68,57-68,56}{6,687} \times 100\% = 0,150 \%$$

$$\text{c. Kadar Air} (\%) = \frac{68,69-68,67}{7,163} \times 100\% = 0,279 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,239 \%$$

2. Sampel A2

$$\text{a. Kadar Air} (\%) = \frac{69,78-69,76}{7,247} \times 100\% = 0,276 \%$$

$$\text{b. Kadar Air} (\%) = \frac{68,06-68,06}{6,940} \times 100\% = 0,288 \%$$

$$\text{c. Kadar Air} (\%) = \frac{69,9-69,88}{7,693} \times 100\% = 0,260 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,275 \%$$

3. Sampel A3

$$\text{a. Kadar Air} (\%) = \frac{70,27-70,25}{7,730} \times 100\% = 0,259 \%$$

$$\text{b. Kadar Air} (\%) = \frac{69,33-69,32}{8,317} \times 100\% = 0,120 \%$$

$$\text{c. Kadar Air} (\%) = \frac{70,5-70,49}{8,230} \times 100\% = 0,122 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,167\%$$

4. Sampel B1

$$\text{a. Kadar Air} (\%) = \frac{70,48-70,46}{7,927} \times 100\% = 0,252 \%$$

$$\text{b. Kadar Air} (\%) = \frac{67,62-67,6}{6,477} \times 100\% = 0,309 \%$$

$$c. \text{ Kadar Air (\%)} = \frac{67,87-67,86}{5,93} \times 100\% = 0,169 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,243 \%$$

5. Sampel B2

$$a. \text{ Kadar Air (\%)} = \frac{69,6-69,59}{7,05} \times 100\% = 0,142 \%$$

$$b. \text{ Kadar Air (\%)} = \frac{68,82-68,81}{7,707} \times 100\% = 0,130 \%$$

$$c. \text{ Kadar Air (\%)} = \frac{72,57-72,56}{10,62} \times 100\% = 0,094 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,122 \%$$

6. Sampel B3

$$a. \text{ Kadar Air (\%)} = \frac{69,45-69,42}{6,893} \times 100\% = 0,435 \%$$

$$b. \text{ Kadar Air (\%)} = \frac{68,44-68,41}{7,3} \times 100\% = 0,411 \%$$

$$c. \text{ Kadar Air (\%)} = \frac{68,05-68,01}{6,09} \times 100\% = 0,657 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,501 \%$$

7. Sampel C1

$$a. \text{ Kadar Air (\%)} = \frac{69,72-69,64}{7,173} \times 100\% = 1,115 \%$$

$$b. \text{ Kadar Air (\%)} = \frac{68,45-68,39}{7,347} \times 100\% = 0,817 \%$$

$$c. \text{ Kadar Air (\%)} = \frac{69,43-69,36}{7,493} \times 100\% = 0,934 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,955 \%$$

8. Sampel C2

$$a. \text{ Kadar Air (\%)} = \frac{69,24-69,22}{6,67} \times 100\% = 0,300 \%$$

$$b. \text{ Kadar Air (\%)} = \frac{68,68-68,66}{7,540} \times 100\% = 0,265 \%$$

$$c. \text{ Kadar Air (\%)} = \frac{70,97-70,96}{9,007} \times 100\% = 0,111 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,225 \%$$

9. Sampel C3

$$a. \text{ Kadar Air (\%)} = \frac{69,00-68,97}{6,427} \times 100\% = 0,467 \%$$

$$b. \text{ Kadar Air (\%)} = \frac{67,54-67,52}{6,397} \times 100\% = 0,313 \%$$

$$c. \text{ Kadar Air (\%)} = \frac{69,09-69,06}{7,107} \times 100\% = 0,422 \%$$

$$\text{Kadar Air}_{\text{average}} (\%) = 0,401 \%$$

D. Perhitungan Daya Serap

$$\text{Daya Serap} (\%) = \frac{m_1 - m_0}{m_1} \times 100\%$$

1. Sampel A1

$$\text{a. Daya Serap} (\%) = \frac{6,95 - 6,92}{6,95} \times 100\% = 0,434 \%$$

$$\text{b. Daya Serap} (\%) = \frac{6,68 - 6,66}{6,68} \times 100\% = 0,300 \%$$

$$\text{c. Daya Serap} (\%) = \frac{7,17 - 7,15}{7,17} \times 100\% = 0,280 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 0,338 \%$$

2. Sampel A2

$$\text{a. Daya Serap} (\%) = \frac{7,28 - 7,24}{7,28} \times 100\% = 0,460 \%$$

$$\text{b. Daya Serap} (\%) = \frac{6,96 - 6,94}{6,96} \times 100\% = 0,288 \%$$

$$\text{c. Daya Serap} (\%) = \frac{7,73 - 7,693}{7,73} \times 100\% = 0,477 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 0,408 \%$$

3. Sampel A3

$$\text{a. Daya Serap} (\%) = \frac{7,74 - 7,7}{7,74} \times 100\% = 0,519 \%$$

$$\text{b. Daya Serap} (\%) = \frac{8,22 - 8,19}{8,22} \times 100\% = 0,366 \%$$

$$\text{c. Daya Serap} (\%) = \frac{8,33 - 8,23}{8,33} \times 100\% = 1,215 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 0,700 \%$$

4. Sampel B1

$$\text{a. Daya Serap} (\%) = \frac{7,91 - 7,89}{7,91} \times 100\% = 0,253 \%$$

$$\text{b. Daya Serap} (\%) = \frac{6,48 - 6,47}{6,48} \times 100\% = 0,155 \%$$

$$\text{c. Daya Serap} (\%) = \frac{5,92 - 5,90}{5,92} \times 100\% = 1,339 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 0,249 \%$$

5. Sampel B2

$$\text{a. Daya Serap} (\%) = \frac{7,05 - 7,02}{7,05} \times 100\% = 0,427\%$$

$$\text{b. Daya Serap} (\%) = \frac{7,71 - 7,68}{7,71} \times 100\% = 0,391 \%$$

$$c. \text{ Daya Serap (\%)} = \frac{10,63-10,60}{10,63} \times 100\% = 0,283 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 0,367 \%$$

6. Sampel B3

$$a. \text{ Daya Serap (\%)} = \frac{6,9-6,87}{6,9} \times 100\% = 0,437 \%$$

$$b. \text{ Daya Serap (\%)} = \frac{7,34-7,30}{7,34} \times 100\% = 0,548 \%$$

$$c. \text{ Daya Serap (\%)} = \frac{6,08-6,07}{6,08} \times 100\% = 0,165 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 0,383 \%$$

7. Sampel C1

$$a. \text{ Daya Serap (\%)} = \frac{7,23-7,090}{7,23} \times 100\% = 1,975 \%$$

$$b. \text{ Daya Serap (\%)} = \frac{7,32-7,25}{7,32} \times 100\% = 0,966 \%$$

$$c. \text{ Daya Serap (\%)} = \frac{7,47-7,40}{7,47} \times 100\% = 0,946 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 1,295 \%$$

8. Sampel C2

$$a. \text{ Daya Serap (\%)} = \frac{6,69-6,65}{6,69} \times 100\% = 0,602 \%$$

$$b. \text{ Daya Serap (\%)} = \frac{7,56-7,52}{7,56} \times 100\% = 0,532\%$$

$$c. \text{ Daya Serap (\%)} = \frac{9,05-8,990}{9,05} \times 100\% = 0,667 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 0,600 \%$$

9. Sampel C3

$$a. \text{ Daya Serap (\%)} = \frac{6,49-6,410}{6,49} \times 100\% = 1,248 \%$$

$$b. \text{ Daya Serap (\%)} = \frac{6,45-6,370}{6,45} \times 100\% = 1,256 \%$$

$$c. \text{ Daya Serap (\%)} = \frac{7,14-7,080}{7,14} \times 100\% = 0,847 \%$$

$$\text{Daya Serap}_{\text{average}} (\%) = 1,117 \%$$

LAMPIRAN B. DOKUMENTASI PENELITIAN



Proses Perendaman Sampel



Penimbangan Sampel



Proses Pengeringan Sampel



Penggunaan Desikator



**Proses Pengukuran Dimensi dan
Massa Sampel**



Proses Preparasi Sampel

LAMPIRAN C. DESIGN OF EXPERIMENT SAMPEL

Minitab - DOE 1 DENSITAS.mpx

File Edit Data Calc Stat Graph View Help Assistant Predictive Analytics Module Additional Tools

Navigator

Taguchi Design

Taguchi Analysis: DENSITAS AKTUAL...

Taguchi Analysis: DENSITAS AKTUAL...

Taguchi Analysis: DENSITAS AKTUAL...

Taguchi Analysis: DENSITAS AKTUAL...

General Linear Model: DENSITAS A...

General Linear Model: DENSITAS A...

General Linear Model: DENSITAS A...

WORKSHEET 1

Taguchi Analysis: DENSITAS AKTUAL; DENSITAS TEORITIS versus FILLER; P. HOT PRESS; T. HOT PRESS; time. HOT PRESS

Response Table for Signal to Noise Ratios

Smaller is better

Level	FILLER	P. HOT PRESS	T. HOT PRESS	time. HOT PRESS	DENSITAS AKTUAL	DENSITAS TEORITIS
1	-4,616	-4,692	-4,617	-4,657	1,7762	1,5914
2	-4,481	-4,533	-4,745	-4,510	1,8380	1,5914
3	-4,788	-4,660	-4,521	-4,658	1,7995	1,5914
4	60	40	160	70	1,7023	1,6677
5	60	50	170	50	1,6645	1,6677
6	60	30	150	60	1,6803	1,6677
7	65	40	170	60	1,6144	1,7514
8	65	50	150	70	1,7397	1,7514
9	65	30	160	50	1,8039	1,7514

Minitab - DOE 2 DENSITAS.mpx

File Edit Data Calc Stat Graph View Help Assistant Predictive Analytics Module Additional Tools

Navigator

Taguchi Design

Taguchi Design

Taguchi Design

Taguchi Analysis: DENSITAS AKTUAL...

General Linear Model: DENSITAS A...

General Linear Model: DEN...

WORKSHEET 3

General Linear Model: DENSITAS AKTUAL versus SULFUR; P. HOT PRESS; T. HOT PRESS; time. HOT PRESS

* NOTE * Some of the requested means were removed from the model.

Forward Selection of Terms

α to enter = 0,25

Level	SULFUR	P. HOT PRESS	T. HOT PRESS	time. HOT PRESS	DENSITAS AKTUAL	DENSITAS TEORITIS
1	30	40	150	50	1,7762	1,5914
2	30	50	160	60	1,7995	1,5914
3	30	30	170	70	1,80120	1,54172
4	40	40	160	70	1,63476	1,57763
5	40	50	170	50	1,68915	1,57763
6	40	30	150	60	1,56109	1,57763
7	50	40	170	60	1,58721	1,60899
8	50	50	150	70	1,57247	1,60899
9	50	30	160	50	1,73961	1,60899

Minitab - DOE 1 POROSITAS.mpx

File Edit Data Calc Stat Graph View Help Assistant Predictive Analytics Module Additional Tools

Navigator

Taguchi Design

Taguchi Analysis: POROSITAS versa...

Taguchi Analysis: POROSITAS versa...

General Linear Model: POROSITAS ...

WORKSHEET 1

Taguchi Analysis: POROSITAS versus FILLER; P. HOT PRESS; T. HOT PRESS; time. HOT PRESS

Response Table for Signal to Noise Ratios

Smaller is better

Level	FILLER	P. HOT PRESS	T. HOT PRESS	time. HOT PRESS	POROSITAS
1	-22,480	-15,578	-12,674	-13,587	11,6155

Level	FILLER	P. HOT PRESS	T. HOT PRESS	time. HOT PRESS	POROSITAS
1	55	40	150	50	11,6155
2	55	50	160	60	13,0770
3	55	30	170	70	15,5021
4	60	40	160	70	2,3778
5	60	50	170	50	1,5341
6	60	30	150	60	2,2862
7	65	40	170	60	7,8209
8	65	50	150	70	2,9992
9	65	30	160	50	6,1252

