**LAMPIRAN 1**

**PENGUJIAN MATERIAL PASIR**

1. **Pengujian Gradasi Pasir**

Hasil Pengujian Gradasi Pasir

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lubang ayakan****( mm )** | **Berat tinggal****( gr )** | **Persen tinggal****( % )** | **Persen komulatif****( % )** | **Persen kom. lewat ayakan****( % )** |
| 9.75 | 0 | 0 | 0 | 100 |
| 4.75 | 7,73 | 0,43 | 0.43 | 99,57 |
| 2.36 | 30,33 | 1,69 | 2,12 | 97,88 |
| 1.18 | 55,93 | 3,11 | 5,23 | 94,77 |
| 0.6 | 608,26 | 33,79 | 39,02 | 60,98 |
| 0.4 | 554,12 | 30,78 | 69,8 | 30,20 |
| 0.15 | 531,78 | 29,54 | 99,34 | 0,66 |
| Pan | 11.85 | 0.66 | --- | 0 |
| Jumlah | 1800 |  | 215,94 |  |

Sumber : Hasil Pengolahan Data

Penentuan Jenis Gradasi Pasir

|  |  |
| --- | --- |
| **Lubang Ayakan****( mm )** | **% Berat Butir Yang Lewat Ayakan** |
| **Zona I****( Kasar )** | **Zona II****( Agak Kasar )** | **Zona III****( Agak Halus )** | **Zona IV****( Halus )** | **Pasir Lampung** |
| 9,75 | 100 | 100 | 100 | 100 | 100 |
| 4,75 | 90 – 100 | 90 – 100 | 90 – 100 | 95 – 100 | 99,57 |
| 2,36 | 60 – 95 | 75 - 100 | 85 - 100 | 95 – 100 | 97,88 |
| 1,18 | 30 – 75 | 55 – 90 | 75 - 100 | 90 – 100 | 94,77 |
| 0,6 | 15 – 34 | 33 – 59 | 60 – 79 | 80 - 100 | 60,98 |
| 0,4 | 5 – 20 | 8 - 30 | 12 – 40 | 15 - 100 | 30,20 |
| 0,15 | 0 - 10 | 0 - 10 | 0 - 10 | 0 - 15 | 0,66 |

Sumber : Hasil Pengolahan Data

Modulus halus butir ( *Fineness Modulus )*

$$FM= \frac{Jumlah \% Komulatif yang tinggal}{100\%}$$

$$FM= \frac{215,94}{100}=2,16$$

Grafik hasil analisis gradasi pasir

1. **Pengujian Berat Satuan Pasir**

Berat bejana kosong (B1) = 4,68 kg

Berat bejana + pasir (B2) = 20,24 kg

Berat pasir (B3) = 20,24 kg – 4,68 kg

 = 15,56 kg

Tinggi bejana = 22 cm

Diameter dalam bejana = 24 cm

Volume bejana = $π x r^{2} x t$

 = $π x 12^{2} x 22$

 = 9952,57 cm³

 = 0.00995257 cm³

Berat satuan pasir = $\frac{berat pasir}{volume silinder}$

 = $\frac{15,56}{0.00995257}$ = 1563,42 kg/ m³

Hasil Pengujian Berat Satuan Pasir

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Keterangan** | **Hasil** | **Satuan** |
| 1 | Berat bejana kosong ( B1 ) | 4,68 | kg |
| 2 | Berat bejana + pasir ( B2 ) | 20,24 | kg |
| 3 | Berat pasir ( B3 = B2 - B1 ) | 15,56 | kg |
| 4 | Volume bejana baja ( V ) | 0.00995257 | m³ |
| 5 | Berat satuan pasir ( ɣ )$$γ= \frac{B3}{V}$$ | 1563,42 | kg/ m³ |

 Sumber : Hasil Pengolahan Data

**LAMPIRAN 2**

**PENGUJIAN MATERAL LIMBAH CANGKANG KELAPA SAWIT**

1. **Pengujian Gradasi Limbah CKS**

Hasil Pengujian GradasiCangkang Kelapa Sawit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lubang ayakan****( mm )** | **Berat tinggal****( gr )** | **Persen tinggal****( % )** | **Persen komulatif****( % )** | **Persen kom. lewat ayakan****( % )** |
| 9.75 | 0 | 0 | 0 | 100 |
| 4.75 | 58,14 | 5,81 | 5,81 | 94,19 |
| 2.36 | 101,26 | 10,73 | 16,54 | 83,46 |
| 1.18 | 264,12 | 26,41 | 42,95 | 57,05 |
| 0.6 | 315,37 | 31,54 | 74,49 | 25,51 |
| 0.4 | 156,72 | 15,67 | 90,16 | 9,84 |
| 0.15 | 90,03 | 9,00 | 99,16 | 0,84 |
| Pan | 8,36 | 0,84 | --- | 0 |
| Jumlah | 1000 |  | 329.11 |  |

Sumber : Hasil Pengolahan Data

Penentuan Jenis GradasiCangkang Kelapa Sawit

|  |  |
| --- | --- |
| **Lubang Ayakan****( mm )** | **% Berat Butir Yang Lewat Ayakan** |
| **Zona I****( Kasar )** | **Zona II****( Agak Kasar )** | **Zona III****( Agak Halus )** | **Zona IV****( Halus )** | **CKS** |
| 9.5 | 100 | 100 | 100 | 100 | 100 |
| 4.75 | 90 – 100 | 90 – 100 | 90 – 100 | 95 – 100 | 94,19 |
| 2.36 | 60 – 95 | 75 - 100 | 85 - 100 | 95 – 100 | 83,46 |
| 1.18 | 30 – 75 | 55 – 90 | 75 - 100 | 90 – 100 | 57,05 |
| 0.6 | 15 – 34 | 33 – 59 | 60 – 79 | 80 - 100 | 25,51 |
| 0.4 | 5 – 20 | 8 - 30 | 12 – 40 | 15 - 100 | 9,84 |
| 0.15 | 0 - 10 | 0 - 10 | 0 - 10 | 0 - 15 | 0,84 |

Sumber : Hasil Pengolahan Data

Modulus halus butir ( *Fineness Modulus )*

$$FM= \frac{Jumlah \% Komulatif yang tinggal}{100\%}$$

$$ FM= \frac{329,11}{100}=3.29$$

Grafik Hasil Analisis Gradasi CKS

1. **Pengujian Berat Satuan Cangkang Kelapa Sawit**

Berat bejana kosong (B1) = 4,68 kg

Berat bejana + pasir (B2) = 10,32 kg

Berat pasir (B3) = 10,32 kg – 4,68 kg

 = 5,64 kg

Tinggi bejana = 22 cm

Diameter dalam bejana = 24 cm

Volume bejana = $π x r^{2} x t$

 = $π x 12^{2} x 22$

 = 9952,57 cm³

 = 0.00995257 cm³

Berat satuan CKS = $\frac{berat pasir}{volume silinder}$

= $\frac{5,64}{0.00995257}$ = 566,69 kg/ m³

Hasil Pengujian Berat Satuan CKS

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Keterangan** | **Benda uji I** | **Satuan** |
| 1 | Berat bejana kosong ( B1 ) | 4,68 | kg |
| 2 | Berat bejana + CKS ( B2 ) | 10,32 | kg |
| 3 | Berat CKS ( B3 = B2 - B1 ) | 5,64 | kg |
| 4 | Volume bejana baja ( V ) | 0.00995257 | m³ |
| 5 | Berat satuan CKS ( ɣ )$$γ= \frac{B3}{V}$$ | 566,69 | kg/ m³ |

 Sumber : Hasil Pengolahan Data

**LAMPIRAN 3**

**PENGUJIAN BERAT JENIS SEMEN**

Berat semen ( A ) = 75 gram = 0.075 kg

Volume minyak tanah ( B1) = 0.8 ml = $0.8x10^{-6}$ m³.

Volume minyak tanah + semen ( B2 ) = 24,6 ml = $28,6x10^{-6}$ m³

Berat Jenis Semen = $\frac{A}{B2-B1}$

 = $\frac{0.075}{\left( 24,6-0,8 \right) x 10^{-6} }$

 = 3151,26 kg/ m³.

Hasil Pengujian Berat Jenis semen

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Pemeriksaan** | **Hasil** | **Satuan** |
| 1 | Berat semen ( A ) | 0.075 | kg |
| 2 | Volume minyak tanah ( B1 ) | $$0.8x10^{-6}$$ | m³. |
| 3 | Volume minyak tanah + semen ( B2) | $$24,6x10^{-6}$$ | m³. |
| 4 | Berat jenis semen$$\frac{A}{B2-B1}$$ | 3151,26 | kg/ m³. |

Sumber : Hasil Pengolahan Data

**LAMPIRAN 4**

**MIX DESIGN**

Perbandingan volume = 1 semen : 6 Pasir

Volume batako $=P x L x T$

 = $40 cm x 20 cm x 10 cm$

 =$ 8000 cm³=0.008 m³$

1. **Semen**

Komposisi Semen = $\frac{1}{7}$ $x$ Volume Batako $x$ Berat Jenis Semen

 = $\frac{1}{7} x 0.008 x 3151,26$

$$=3,6+ faktor waste 15 \% $$

$$=3,6+0,54 $$

 = 4,14 kg

1. **Air**

Faktor air-semen yang digunakan adalah 30% dari berat semen :

$$ \frac{30}{100} x 4.14=1.24 kg $$

1. **Pasir**
2. Persentase 100%

Komposisi Pasir = $\frac{6}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{6}{7} x 0.008 x 1563,42$

= $10,72 $+ $faktor waste 15\% $

= $10,72 $+ $1,61 $

 = 12,33 kg

1. Persentase 90%

Komposisi Pasir = $\frac{5,4}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{5,4}{7} x 0.008 x 1563,42$

= $9,65$ + $faktor waste 15\% $

= $9,65 $+ $1,45 $

 = 11,1 kg

1. Persentase 80%

Komposisi Pasir = $\frac{5,4}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{5,4}{7} x 0.008 x 1563,42$

= $9,65$ + $faktor waste 15\% $

= $9,65 $+ $1,45 $

 = 11,1 kg

1. Persentase 70%

Komposisi Pasir = $\frac{4,2}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{4,2}{7} x 0.008 x 1563,42$

= $7,5$ + $faktor waste 15\% $

= $7,5 $+ $1,13 $

 = 8,63 kg

1. Persentase 60%

Komposisi Pasir = $\frac{3,6}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{3,6}{7} x 0.008 x 1563,42$

= $6,43$ + $faktor waste 15\% $

= $6,43 $+ $0,93$

 = 7,39 kg

1. **Limbah Cangkang Kelapa Sawit**
2. Persentase 10%

Komposisi CKS = $\frac{0,6}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{0,6}{7} x 0.008 x 566,69$

= $0,39$ + $faktor waste 15\% $

= $0,39$+ $0,06$

 = 0,45 kg

1. Persentase 20%

Komposisi CKS = $\frac{1,2}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{1,2}{7} x 0.008 x 566,69$

= $0,78$ + $faktor waste 15\% $

= $0,78$+ $0,12$

 = 0,90 kg

1. Persentase 30%

Komposisi CKS = $\frac{1,8}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{1,8}{7} x 0.008 x 566,69$

= $1,17$ + $faktor waste 15\% $

= $1,17$+ $0,18$

 = 1,35 kg

1. Persentase 40%

Komposisi CKS = $\frac{2,4}{7}$ $x$ Volume Batako $x $Berat Satuan

= $\frac{2,4}{7} x 0.008 x 566,69$

= $1,55$ + $faktor waste 15\% $

= $1,55$+ $0,23$

 = 1,78 kg

Jumlah Kebutuhan Material Untuk Pembuatan Batako

|  |  |
| --- | --- |
| **Benda uji** | **Komposisi Material ( kg )** |
| **Air** | **Semen** | **Pasir** | **CKS** |
| 0% | 1,24 | 4,14 | 12,33 | 0 |
| 10% CKS | 1,24 | 4,14 | 11.1 | 0,45 |
| 20% CKS | 1,24 | 4,14 | 9,87 | 0,9 |
| 30% CKS  | 1,24 | 4,14 | 8,63 | 1,35 |
| 40% CKS | 1,24 | 4,14 | 7,39 | 1,78 |
| Jumlah | 6,2 | 20,7 | 38,68 | 4,48 |
| 7 Hari(Jumlah x 3) | 18,6 | 62,1 | 116,04 | 13,44 |
| 14 Hari(Jumlah x 3) | 18,6 | 62,1 | 116,04 | 13,44 |
| 28 Hari(Jumlah x 3) | 18,6 | 62,1 | 116,04 | 13,44 |
| 28 Hari Penyerapan(Jumlah x 2) | 12,4 | 41,4 | 77,36 | 8,96 |
| TOTAL(Semua Umur) | 68,2 | 227,7 | 425,48 | 49,28 |
|  |

**LAMPIRAN 5**

**PENGUJIAN BERAT BATAKO**

Tabel Berat Batako

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Umur | Variasi (%) | Benda Uji | Berat (kg) | Berat rata –rata(kg) |
| 7 Hari | 0 | I | 15,62 | 15,53 |
| II | 15,82 |
| III | 15,16 |
| 10 | I | 14,76 | 14,73 |
| II | 13,64 |
| III | 15,80 |
| 20 | I | 14,90 | 14,38 |
| II | 13,70 |
| III | 14,54 |
| 30 | I | 13,74 | 14,04 |
| II | 14,18 |
| III | 14,20 |
| 40 | I | 13,76 | 13,26 |
| II | 13,10 |
| III | 12,94 |
| 14 Hari | 0 | I | 15,66 | 15,53 |
| II | 14,46 |
| III | 14,28 |
| 10 | I | 14,72 | 14,56 |
| II | 15,10 |
| III | 13,86 |
| 20 | I | 14,68 | 14,28 |
| II | 13,82 |
| III | 15,34 |
| 30 | I | 14,14 | 14,04 |
| II | 13,42 |
| III | 14,12 |
| 40 | I | 13,44 | 13,04 |
| II | 13,16 |
| III | 12,52 |
| 28 Hari | 0 | I | 14,48 | 14,51 |
| II | 14,72 |
| III | 14,34 |
| 10 | I | 14.12 | 14,31 |
| II | 14,84 |
| III | 13,96 |
| 20 | I | 14,80 | 13,83 |
| II | 13,20 |
| III | 13,48 |
| 30 | I | 13,64 | 13,57 |
| II | 13,22 |
| III | 13,86 |
| 40 | I | 12,80 | 12,95 |
| II | 12,77 |
| III | 13,28 |

Grafik Berat Batako

Bar Chart Berat Batako

**LAMPIRAN 6**

**PENGUJIAN KUAT TEKAN BATAKO**

1. **Batako Normal (0%)**
2. **Batako Umur 7 Hari**
3. Benda Uji 1

 Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{18500 kg}{400 cm²}$ = 46,25 kg/cm²

1. Benda Uji 2

 Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{19500 kg}{400 cm²}$ = 48,75 kg/cm²

1. Benda Uji 3

 Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{10500 kg}{400 cm²}$ = 26,25 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 46,25+48,75+26,25}{3}$

 = 40,42 kg/cm²

1. **Batako Umur 14 Hari**
2. Benda Uji 1

 Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{23500 kg}{400 cm²}$ = 58,75 kg/cm²

1. Benda Uji 2

 Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{22000 kg}{400 cm²}$ = 55 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{22500 kg}{400 cm²}$ = 56,22 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 48,75+55+56,22}{3}$

 = 56,67 kg/cm²

1. **Batako Umur 28 Hari**
2. Benda Uji 1

 Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{32000 kg}{400 cm²}$ = 80 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{31000 kg}{400 cm²}$ = 77,5 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{35000 kg}{400 cm²}$ = 87,5 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 80+77,5+87,5}{3}$

 = 81,67 kg/cm²

1. **Batako 10% CKS**
2. **Batako Umur 7 Hari**
3. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{6500 kg}{400 cm²}$ = 16,25 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{6000 kg}{400 cm²}$ = 15 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{7500 kg}{400 cm²}$ = 18,75 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 16,25+15+18,75}{3}$

 = 16,67 kg/cm²

1. **Batako Umur 14 Hari**
2. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{10000 kg}{400 cm²}$ = 25 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{7500 kg}{400 cm²}$ = 18,75 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{9500 kg}{400 cm²}$ = 23,75 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 25+18,75+23,75}{3}$

 = 22,75 kg/cm²

1. **Batako Umur 28 Hari**
2. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{18500 kg}{400 cm²}$ = 46,25 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{19500 kg}{400 cm²}$ = 48,75 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{24000 kg}{400 cm²}$ = 60 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 46,25+48,75+60}{3}$

 = 51,67 kg/cm²

1. **Batako 20% CKS**
	1. **Batako Umur 7 Hari**
2. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{5000 kg}{400 cm²}$ = 12,5 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{3500 kg}{400 cm²}$ = 8,75 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{4500 kg}{400 cm²}$ = 11,25 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 12,5+8,75+11,25}{3}$

 = 10,83 kg/cm²

* 1. **Batako Umur 14 Hari**
1. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{7500 kg}{400 cm²}$ = 18,75 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{6500 kg}{400 cm²}$ = 16,25 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{7000 kg}{400 cm²}$ = 17,5 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 18,75+16,25+17,5}{3}$

 = 17,5 kg/cm²

* 1. **Batako Umur 28 Hari**
1. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{10000 kg}{400 cm²}$ = 25 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{9500 kg}{400 cm²}$ = 23,75 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{12000 kg}{400 cm²}$ = 30 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 25+23,75+30}{3}$

 = 26,25 kg/cm²

1. **Batako 30% CKS**
	1. **Batako Umur 7 Hari**
2. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{3500 kg}{400 cm²}$ = 8,75 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{4500 kg}{400 cm²}$ = 11,25 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{3000 kg}{400 cm²}$ = 7,5 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 8,75+11,25+7,5}{3}$

 = 9,17 kg/cm²

* 1. **Batako Umur 14 Hari**
1. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{5000 kg}{400 cm²}$ = 12,5 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{6000 kg}{400 cm²}$ = 15 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{4500 kg}{400 cm²}$ = 11,25 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 12,5+15+11,25}{3}$

 = 12,92 kg/cm²

* 1. **Batako Umur 28 Hari**
1. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{9000 kg}{400 cm²}$ = 22,5 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{8500 kg}{400 cm²}$ = 21,25 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{6500 kg}{400 cm²}$ = 16,25 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 22,5+21,25+16,25}{3}$

 = 20 kg/cm

1. **Batako 40% CKS**
	1. **Batako Umur 7 Hari**
2. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{2500 kg}{400 cm²}$ = 6,25 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{3000 kg}{400 cm²}$ = 7,5 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{2500 kg}{400 cm²}$ = 6,25 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 6,25+7,5+6,25}{3}$

 = 6,67 kg/cm²

* 1. **Batako Umur 14 Hari**
1. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{3500 kg}{400 cm²}$ = 8,25 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{3500 kg}{400 cm²}$ = 8,25 kg/cm²

1. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{4000 kg}{400 cm²}$ = 10 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 8,25+8,25+10}{3}$

 = 9,17 kg/cm²

* 1. **Batako Umur 28 Hari**
1. Benda Uji 1

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{4500 kg}{400 cm²}$ = 11,25 kg/cm²

1. Benda Uji 2

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{5000 kg}{400 cm²}$ = 12,5 kg/cm²

1. Benda Uji 3

Kuat Tekan = $\frac{beban}{luas penampang}$

 = $\frac{4500 kg}{400 cm²}$ = 11,25 kg/cm²

Rata-rata Kuat Tekan = $ \frac{Benda Uji I + Benda Uji II + Benda Uji III}{3}$

 = $\frac{ 11,25+12,5+11,25}{3}$

 = 56,67 kg/cm²

Hasil Pengujian Kuat Tekan Batako

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variasi | Hari | luas permukaan (cm²) | Beban Tekan (kN) | Beban Tekan ( kg ) | Beban Tekan Rata – rata(kg) | Kuat Tekan | Kuat Tekan rata rata( kg/ cm²) | Mutu |
| 0 | 7 | 400 | 185 | 18500 | 16166,67 | 46,25 | 40,42 | III |
| 400 | 195 | 19500 | 48,75 |
| 400 | 105 | 10500 | 26,25 |
| 14 | 400 | 235 | 23500 | 22666,67 | 58,75 | 56,67 | III |
| 400 | 220 | 22000 | 55 |
| 400 | 225 | 22500 | 56,22 |
| 28 | 400 | 320 | 32000 | 32,666,67 | 80 | 81,67 | II |
| 400 | 310 | 31000 | 77,5 |
| 400 | 350 | 35000 | 87,5 |
| 10CKS | 7 | 400 | 65 | 6500 | 6666,67 | 16,25 | 16,67 | --- |
| 400 | 60 | 6000 | 15 |
| 400 | 75 | 7500 | 18,75 |
| 14 | 400 | 100 | 10000 | 9000 | 25 | 22,5 | --- |
| 400 | 75 | 7500 | 18,75 |
| 400 | 95 | 9500 | 23,75 |
| 28 | 400 | 165 | 16500 | 19666.67 | 46,25 | 51,67 | III |
| 400 | 185 | 18500 | 48,75 |
| 400 | 240 | 24000 | 60 |
| 20CKS | 7 | 400 | 50 | 5000 | 4333,3 | 12,5 | 10,83 | --- |
| 400 | 35 | 3500 | 8,75 |
| 400 | 45 | 4500 | 11,25 |
| 14 | 400 | 75 | 7500 | 7000 | 18,75 | 17,5 | --- |
| 400 | 65 | 6500 | 16,25 |
| 400 | 70 | 7000 | 17,5 |
| 28 | 400 | 100 | 10000 | 10500 | 25 | 26,25 | IV |
| 400 | 95 | 9500 | 23,75 |
| 400 | 120 | 12000 | 30 |
| 30CKS | 7 | 400 | 35 | 3500 | 3666,67 | 8,75 | 9,17 | --- |
| 400 | 45 | 4500 | 11,25 |
| 400 | 30 | 3000 | 7,5 |
| 14 | 400 | 50 | 5000 | 5166,67 | 12,5 | 12,92 | --- |
| 400 | 60 | 6000 | 15 |
| 400 | 45 | 4500 | 11,25 |
| 28 | 400 | 50 | 5000 | 8000 | 22,5 | 20 | --- |
| 400 | 85 | 8500 | 21,25 |
| 400 | 65 | 6500 | 16,25 |
| 40CKS | 7 | 400 | 25 | 2500 | 2666,67 | 6,25 | 6,67 | --- |
| 400 | 30 | 3000 | 7,5 |
| 400 | 25 | 2500 | 6,25 |
| 14 | 400 | 35 | 3500 | 3666,67 | 8,75 | 9,17 | --- |
| 400 | 35 | 3500 | 8,75 |
| 400 | 40 | 4000 | 10 |
| 28 | 400 | 45 | 4500 | 4666,67 | 11,25 | 11,67 | --- |
| 400 | 50 | 5000 | 12,5 |
| 400 | 45 | 4500 | 11,25 |

Hasil Pengujian Kuat Tekan Batako

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variasi | Umur | Luas Permukaan (cm²) | Beban Tekan Rata- rata( kg ) | Kuat Tekan Rata-rata( kg/cm²) | Mutu |
| 0 | 7 Hari | 400 | 16166,67 | 40,42 | III |
| 14 Hari | 22666,67 | 56,67 | III |
| 28 Hari | 32666,67 | 81,67 | II |
| 10%CKS | 7 Hari | 400 | 6666,67 | 16,67 | --- |
| 14 Hari | 9000 | 22,5 | --- |
| 28 Hari | 19666,67 | 51,67 | III |
| 20%CKS | 7 Hari | 400 | 4333,33 | 10,83 | --- |
| 14 Hari | 7000 | 17,5 | --- |
| 28 Hari | 10500 | 26,25 | IV |
| 30%CKS | 7 Hari | 400 | 3666,67 | 9,17 | --- |
| 14 Hari | 5166,67 | 12,92 | --- |
| 28 Hari | 8000 | 20 | --- |
| 40%CKS | 7 Hari | 400 | 2666,67 | 6,67 | --- |
| 14 Hari  | 3666,67 | 9,17 | --- |
| 28 Hari | 4666,67 | 11,67 | --- |

Grafik Hasil Pengujian Kuat Tekan Batako

Bar Chart Hasil Pengujian Kuat Tekan Batako

**LAMPIRAN 7**

**PENGUJIAN PENYERAPAN AIR BATAKO**

1. **Batako Normal**
2. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{15,62-14.54 }{14.54} x$ 100%

= 7,43 %

1. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{16.8-15.52 }{15.52} x$ 100%

= 8.25 %

1. **Batako 10% Limbah Cangkang Kelapa Sawit**
2. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{15,84-14.66 }{14.66} x$ 100%

= 8,05 %

1. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Bera tKering} x$ 100%

 = $\frac{14,28-12.88 }{12.88} x$ 100%

= 10,87 %

1. **Batako 20% Limbah Cangkang Kelapa Sawit**
2. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{15,2-13.7 }{13.7} x$ 100%

= 10,95 %

1. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{14,7-12.98 }{12.98} x$ 100%

= 13,25 %

1. **Batako 30% Limbah Cangkang Kelapa Sawit**
2. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{13,24-11.52 }{11.52} x$ 100%

= 14,93 %

1. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{13,48-12 }{12} x$ 100%

= 12,33 %

1. **Batako 40% Limbah Cangkang Kelapa Sawit**
2. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{12,36-10.84 }{10.84} x$ 100%

= 14,02 %

1. Penyerapan Air = $\frac{Berat Basah-Berat Kering}{Berat Kering} x$ 100%

 = $\frac{12,18-10.56 }{10.56} x$ 100%

= 15,34 %

Tabel 4.14 Hasil Pengujian Penyerapan Air Batako

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variasi Campuran | Berat Basah (Kg) | Berat Kering (Kg) | Serapan Air (%) | Rata – Rata Serapan Air (%) |
| 0% | 15,62 | 14,54 | 7,43 | 7,84 |
| 16,8 | 15,52 | 8,25 |
| 10%CKS | 15,84 | 14,66 | 8,05 | 9,46 |
| 14,28 | 12,88 | 10,87 |
| 20%CKS | 15,20 | 13,70 | 10,95 | 12,10 |
| 14,70 | 12,98 | 13,25 |
| 30%CKS | 13,24 | 11,52 | 14,93 | 13,63 |
| 13,48 | 12 | 12,33 |
| 40%CKS | 12,36 | 10,84 | 14,02 | 14,68 |
| 12,18 | 10,56 | 15,34 |

Sumber : Hasil Pengolahan Data

Gambar 4.7 Grafik Hasil Pengujian Penyerapan Air