

UNIVERSITAS BRAWIJAYA

LAMPIRAN A

Hasil Pengujian Kandungan Kimia *Fly Ash* di Laboratorium





ITS
Institut
Teknologi
Sepuluh Nopember

JURUSAN TEKNIK KIMIA FTI - ITS

TEAM AFILIASI DAN KONSULTASI INDUSTRI

KAMPUS ITS, SUKOLILO - SURABAYA, TELP. (031) 5922935 FAX. (031) 5999282

REPORT OF ANALYSIS

No.144/LTAKI/II/2010

Principals : **Sdr Qomariah**
Politeknik Negeri Malang
Jl. Veteran PO. Box 04
Malang

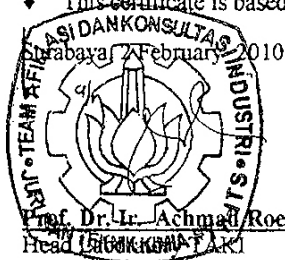
Type sample : Fly Ash
Code sample : Produk Paiton B
Tested for : Chemical Analysis
Packing : Plastic bag
Received On : 26 February 2010

| Parameter | Unit | Test Results | Methode Test |
|---|------|--------------|-------------------|
| Silicon dioxide (SiO ₂) | % | 65.88 | Gravimetry |
| Alumunium Oxide (Al ₂ O ₃) | % | 4.27 | Spektrophotometry |
| Iron Oxide (Fe ₂ O ₃) | % | 6.86 | AAS |
| Calsium Oxide (CaO) | % | 9.82 | Titrimetry |
| Magnesium Oxide (MgO) | % | 6.74 | Titrimetry |
| Sodium dioxide (Na ₂ O) | % | 0.92 | Flamephotometry |
| Kalium dioxide (K ₂ O) | % | 0.48 | Flamephotometry |
| Sulfur trioxide (SO ₃) | % | 0.54 | Spektrophotometry |
| Phosphate as (P ₂ O ₅) | % | 1.35 | Spektrophotometry |
| Titanium Dioxide (TiO ₂) | % | 0.12 | Spektrophotometry |
| Los Of Ignation (LOI) | % | 2.21 | Gravimetry\ |

Note :

♦ This certificate is based on the tested sample only

Obj = 2,8



Prof. Dr. Ir. Achmad Roesyadi, DEA
Head of ITS Team Afiliasi dan Konsultasi Industri



LAMPIRAN B

Detail Kebutuhan Campuran per *Batch*, Suhu *Curing*, Perlakuan Larutan, dan Umur Mortar Geopolimer Sodium dan Potasium



| Mix Design | Material | | Alkali Aktivator | | | | | | Tambahan air (gr) | | Perlakuan larutan | Suhu Curing (°C) | Umur saat diuji (hari) |
|------------|--------------|------------|--------------------|----------|---------------------------------------|--------------------|----------|--------------------------------------|-------------------|----------|-------------------|------------------|------------------------|
| | Fly Ash (gr) | Pasir (gr) | Sodium | | | Potasium | | | Sodium | Potasium | | | |
| | | | Larutan Hidroksida | | Silikat | Larutan Hidroksida | | Silikat | | | | | |
| | | | NaOH (gr) | Air (gr) | Na ₂ SiO ₃ (gr) | KOH (gr) | Air (gr) | K ₂ SiO ₃ (gr) | | | | | |
| 1b | 300 | 600 | 8,6 | 25,7 | 85,7 | 12,5 | 21,8 | 85,7 | 8,9 | 9,0 | D | 90 | 7 |
| 2 | 300 | 600 | 10,5 | 23,7 | 85,7 | 15,1 | 19,2 | 85,7 | 8,9 | 9,1 | D | 90 | 7 |
| 3 | 300 | 600 | 12,3 | 22,0 | 85,7 | 17,7 | 16,6 | 85,7 | 9,0 | 9,1 | D | 90 | 7 |
| 4 | 300 | 600 | 23,2 | 69,1 | 27,7 | 33,5 | 58,8 | 27,7 | 8,5 | 8,7 | D | 90 | 7 |
| 5 | 300 | 600 | 21,6 | 64,2 | 34,3 | 31,1 | 54,6 | 34,3 | 8,5 | 8,8 | D | 90 | 7 |
| 6 | 300 | 600 | 20,1 | 59,9 | 40,0 | 29,1 | 50,9 | 40,0 | 8,5 | 8,8 | D | 90 | 7 |
| 7 | 300 | 600 | 15,1 | 44,9 | 60,0 | 21,8 | 38,2 | 60,0 | 8,7 | 8,9 | D | 90 | 7 |
| 8a | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 8,8 | 9,0 | D | 90 | 7 |
| 9 | 300 | 600 | 9,3 | 27,6 | 83,1 | 13,4 | 23,5 | 83,1 | 8,9 | 9,0 | D | 90 | 7 |
| 10 | 300 | 600 | 8,0 | 24,0 | 88,0 | 11,6 | 20,4 | 88,0 | 8,9 | 9,0 | D | 90 | 7 |
| 11 | 300 | 600 | 7,5 | 22,5 | 90,0 | 10,9 | 19,1 | 90,0 | 8,9 | 9,0 | D | 90 | 7 |
| 12 | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 10,6 | 10,8 | D | 90 | 7 |
| 13 | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 7,1 | 7,2 | D | 90 | 7 |
| 14 | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 5,3 | 5,4 | D | 90 | 7 |
| 15a | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 3,5 | 3,6 | D | 90 | 7 |
| 16 | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 0,0 | 0,0 | D | 90 | 7 |
| 17 | 300 | 600 | 7,5 | 22,5 | 60,0 | 10,9 | 19,1 | 60,0 | 8,5 | 8,6 | D | 90 | 7 |
| 18 | 300 | 600 | 8,8 | 26,2 | 70,0 | 12,7 | 22,3 | 70,0 | 8,7 | 8,8 | D | 90 | 7 |
| 19 | 300 | 600 | 11,3 | 33,7 | 90,0 | 16,4 | 28,6 | 90,0 | 9,0 | 9,2 | D | 90 | 7 |
| 20 | 300 | 600 | 12,6 | 37,4 | 100,0 | 18,2 | 31,8 | 100,0 | 9,2 | 9,3 | D | 90 | 7 |
| 8b | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 8,8 | 9,0 | TD | 90 | 7 |
| 1a | 300 | 600 | 8,6 | 25,7 | 85,7 | 12,5 | 21,8 | 85,7 | 8,9 | 9,0 | D | 90 | 1 |
| 1c | 300 | 600 | 8,6 | 25,7 | 85,7 | 12,5 | 21,8 | 85,7 | 8,9 | 9,0 | D | 90 | 14 |
| 1d | 300 | 600 | 8,6 | 25,7 | 85,7 | 12,5 | 21,8 | 85,7 | 8,9 | 9,0 | D | 90 | 28 |
| 15b | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 3,5 | 3,6 | D | 75 | 7 |
| 15c | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 3,5 | 3,6 | D | 60 | 7 |
| 15d | 300 | 600 | 10,1 | 29,9 | 80,0 | 14,5 | 25,5 | 80,0 | 3,5 | 3,6 | D | 25 | 7 |

LAMPIRAN C

Detail Kebutuhan Campuran per *Batch*, Suhu *Curing*, dan Perlakuan Larutan
Uji Waktu Ikat Pasta Geopolimer Sodium dan Potasium



| Mix Design | Material Fly Ash (gr) | Alkali Aktivator | | | | | | Tambahan air (gr) | | Perlakuan larutan | Suhu Curing (°C) |
|------------|--------------------------|--------------------|----------|---------------------------------------|--------------------|----------|--------------------------------------|-------------------|----------|-------------------|------------------|
| | | Sodium | | | Potasium | | | Sodium | Potasium | | |
| | | Larutan Hidroksida | | Silikat | Larutan Hidroksida | | Silikat | | | | |
| | | NaOH (gr) | Air (gr) | Na ₂ SiO ₃ (gr) | KOH (gr) | Air (gr) | K ₂ SiO ₃ (gr) | | | | |
| 1b | 250 | 7,2 | 21,4 | 71,4 | 10,4 | 18,2 | 71,4 | 7,4 | 7,5 | D | 90 |
| 2 | 250 | 8,8 | 19,8 | 71,4 | 12,6 | 16,0 | 71,4 | 7,4 | 7,6 | D | 90 |
| 3 | 250 | 10,2 | 18,3 | 71,4 | 14,8 | 13,8 | 71,4 | 7,5 | 7,6 | D | 90 |
| 4 | 250 | 19,3 | 57,6 | 23,1 | 28,0 | 49,0 | 23,1 | 7,0 | 7,3 | D | 90 |
| 5 | 250 | 18,0 | 53,5 | 28,6 | 26,0 | 45,5 | 28,6 | 7,1 | 7,3 | D | 90 |
| 6 | 250 | 16,8 | 49,9 | 33,3 | 24,2 | 42,4 | 33,3 | 7,1 | 7,3 | D | 90 |
| 7 | 250 | 12,6 | 37,4 | 50,0 | 18,2 | 31,8 | 50,0 | 7,2 | 7,4 | D | 90 |
| 8a | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 7,4 | 7,5 | D | 90 |
| 9 | 250 | 7,7 | 23,0 | 69,2 | 11,2 | 19,6 | 69,2 | 7,4 | 7,5 | D | 90 |
| 10 | 250 | 6,7 | 20,0 | 73,3 | 9,7 | 17,0 | 73,3 | 7,4 | 7,5 | D | 90 |
| 11 | 250 | 6,3 | 18,7 | 75,0 | 9,1 | 15,9 | 75,0 | 7,4 | 7,5 | D | 90 |
| 12 | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 8,8 | 9,0 | D | 90 |
| 13 | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 5,9 | 6,0 | D | 90 |
| 14 | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 4,4 | 4,5 | D | 90 |
| 15a | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 2,9 | 3,0 | D | 90 |
| 16 | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 0,0 | 0,0 | D | 90 |
| 17 | 250 | 6,3 | 18,7 | 50,0 | 9,1 | 15,9 | 50,0 | 7,1 | 7,2 | D | 90 |
| 18 | 250 | 7,3 | 21,8 | 58,3 | 10,6 | 18,6 | 58,3 | 7,2 | 7,3 | D | 90 |
| 19 | 250 | 9,4 | 28,1 | 75,0 | 13,6 | 23,9 | 75,0 | 7,5 | 7,6 | D | 90 |
| 20 | 250 | 10,5 | 31,2 | 83,3 | 15,1 | 26,5 | 83,3 | 7,6 | 7,8 | D | 90 |
| 8b | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 7,4 | 7,5 | TD | 90 |
| 15b | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 2,9 | 3,0 | D | 75 |
| 15c | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 2,9 | 3,0 | D | 60 |
| 15d | 250 | 8,4 | 24,9 | 66,7 | 12,1 | 21,2 | 66,7 | 2,9 | 3,0 | D | Suhu ruang |

Keterangan: D = didiamkan; TD = tidak didiamkan

LAMPIRAN D

Hasil Pengujian Kuat Tekan Mortar Geopolimer Potasium dan Sodium



Hasil Pengujian Kuat Tekan Mortar Sodium

| Mix Design | BERAT (gr) | | | BERAT (kg/m ³) | | | Rata-rata | KUAT TEKAN (kN) | | | KUAT TEKAN (MPa) | | | Rata-rata |
|------------|------------|-------|-------|----------------------------|------|------|-----------|-----------------|-----|-----|------------------|------|------|-----------|
| | A | B | C | A | B | C | | A | B | C | A | B | C | |
| 1b | 278,8 | 276,4 | 283,4 | 2230 | 2211 | 2267 | 2236 | 88 | 80 | 70 | 35,2 | 32 | 28 | 31,73 |
| 2 | 266 | 250,2 | 266,8 | 2128 | 2002 | 2134 | 2088 | 91 | 85 | 88 | 36,4 | 34 | 35,2 | 35,2 |
| 3 | 292,4 | 273,8 | 274,2 | 2339 | 2190 | 2194 | 2241 | 146 | 143 | 128 | 58,4 | 57,2 | 51,2 | 55,6 |
| 4 | 269,8 | 270,6 | 268,2 | 2158 | 2165 | 2146 | 2156 | 6 | 10 | 9 | 2,4 | 4 | 3,6 | 3,333 |
| 5 | 275,8 | 261,2 | 264 | 2206 | 2090 | 2112 | 2136 | 31 | 24 | 25 | 12,4 | 9,6 | 10 | 10,67 |
| 6 | 267,6 | 268,8 | 276,4 | 2141 | 2150 | 2211 | 2167 | 57 | 70 | 70 | 22,8 | 28 | 28 | 26,27 |
| 7 | 278,2 | 284 | 278,4 | 2226 | 2272 | 2227 | 2242 | 104 | 102 | 116 | 41,6 | 40,8 | 46,4 | 42,93 |
| 8a | 280,4 | 284,2 | 275,2 | 2243 | 2274 | 2202 | 2239 | 143 | 134 | 143 | 57,2 | 53,6 | 57,2 | 56 |
| 9 | 271,8 | 280,6 | 267,6 | 2174 | 2245 | 2141 | 2187 | 89 | 143 | 129 | 35,6 | 57,2 | 51,6 | 48,13 |
| 10 | 272,6 | 273 | 274,6 | 2181 | 2184 | 2197 | 2187 | 83 | 101 | 120 | 33,2 | 40,4 | 48 | 40,53 |
| 11 | 274,4 | 277,4 | 271,2 | 2195 | 2219 | 2170 | 2195 | 126 | 116 | 129 | 50,4 | 46,4 | 51,6 | 49,47 |
| 12 | 287 | 291,2 | 279 | 2296 | 2330 | 2232 | 2286 | 111 | 170 | 145 | 44,4 | 68 | 58 | 56,8 |
| 13 | 271,6 | 291,2 | 281,4 | 2173 | 2330 | 2251 | 2251 | 118 | 129 | 124 | 47,2 | 51,6 | 49,6 | 49,47 |
| 14 | 277 | 280,6 | 275,8 | 2216 | 2245 | 2206 | 2222 | 130 | 170 | 148 | 52 | 68 | 59,2 | 59,73 |
| 15a | 276,8 | 274,4 | 283,2 | 2214 | 2195 | 2266 | 2225 | 144 | 164 | 147 | 57,6 | 65,6 | 58,8 | 60,67 |
| 16 | 284,2 | 285,2 | 287,4 | 2274 | 2282 | 2299 | 2285 | 143 | 89 | 111 | 57,2 | 35,6 | 44,4 | 45,73 |
| 17 | 265,8 | 261,6 | 260,4 | 2126 | 2093 | 2083 | 2101 | 79 | 106 | 92 | 31,6 | 42,4 | 36,8 | 36,93 |
| 18 | 280,8 | 288 | 283,4 | 2246 | 2304 | 2267 | 2273 | 119 | 109 | 131 | 47,6 | 43,6 | 52,4 | 47,87 |
| 19 | 279,6 | 286,8 | 282 | 2237 | 2294 | 2256 | 2262 | 109 | 100 | 125 | 43,6 | 40 | 50 | 44,53 |
| 20 | 284,8 | 281 | 283,4 | 2278 | 2248 | 2267 | 2265 | 108 | 105 | 118 | 43,2 | 42 | 47,2 | 44,13 |
| 8b | 283,6 | 276,4 | 280,4 | 2269 | 2211 | 2243 | 2241 | 165 | 138 | 120 | 66 | 55,2 | 48 | 56,4 |
| 1a | 275,2 | 271,8 | 280,8 | 2202 | 2174 | 2246 | 2207 | 132 | 83 | 140 | 52,8 | 33,2 | 56 | 47,33 |
| 1c | 280,6 | 284,4 | 281,2 | 2245 | 2275 | 2250 | 2257 | 105 | 104 | 101 | 42 | 41,6 | 40,4 | 41,33 |
| 1d | 281,8 | 287,8 | 278,6 | 2254 | 2302 | 2229 | 2262 | 120 | 122 | 134 | 48 | 48,8 | 53,6 | 50,13 |
| 15b | 288,6 | 289,4 | 285,2 | 2309 | 2315 | 2282 | 2302 | 109 | 102 | 105 | 43,6 | 40,8 | 42 | 42,13 |
| 15c | 280,2 | 284,6 | 274 | 2242 | 2277 | 2192 | 2237 | 100 | 106 | 98 | 40 | 42,4 | 39,2 | 40,53 |
| 15d | 294 | 288,8 | 283 | 2352 | 2310 | 2264 | 2309 | 55 | 59 | 60 | 22 | 23,6 | 24 | 23,2 |

Hasil Pengujian Kuat Tekan Mortar Potasium

| Mix Design | BERAT (gr) | | | BERAT (kg/m ³) | | | Rata-rata | KUAT TEKAN (kN) | | | KUAT TEKAN (MPa) | | | Rata-rata |
|------------|------------|-------|-------|----------------------------|---------|---------|-----------|-----------------|-----|-----|------------------|------|------|-----------|
| | A | B | C | A | B | C | | A | B | C | A | B | C | |
| 1b | 275,2 | 276,4 | 277 | 2201,6 | 2211,2 | 2216 | 2210 | 169 | 150 | 163 | 67,6 | 60 | 65,2 | 64,27 |
| 2 | 284,5 | 280,8 | 282,4 | 2276 | 2246,4 | 2259,2 | 2261 | 172 | 181 | 175 | 68,8 | 72,4 | 70 | 70,40 |
| 3 | 281,2 | 286,4 | 283 | 2249,6 | 2291,2 | 2264 | 2268 | 180 | 179 | 186 | 72 | 71,6 | 74,4 | 72,67 |
| 4 | 281,5 | 278,8 | 282,4 | 2252 | 2230,4 | 2259,2 | 2247 | 59 | 51 | 68 | 23,6 | 20,4 | 27,2 | 23,73 |
| 5 | 292,3 | 280,7 | 289,3 | 2338,72 | 2245,28 | 2314,4 | 2299 | 86 | 76 | 94 | 34,4 | 30,4 | 37,6 | 34,13 |
| 6 | 283,5 | 281,6 | 285,2 | 2268 | 2252,8 | 2281,6 | 2267 | 153 | 167 | 155 | 61,2 | 66,8 | 62 | 63,33 |
| 7 | 278,5 | 276,5 | 285,7 | 2228 | 2212 | 2285,6 | 2242 | 172 | 166 | 178 | 68,8 | 66,4 | 71,2 | 68,80 |
| 8a | 287,2 | 284,6 | 279,8 | 2297,6 | 2276,8 | 2238,4 | 2271 | 170 | 168 | 175 | 68 | 67,2 | 70 | 68,40 |
| 9 | 277,6 | 281,5 | 281,8 | 2220,8 | 2252 | 2254,4 | 2242 | 168 | 165 | 159 | 67,2 | 66 | 63,6 | 65,60 |
| 10 | 281,6 | 283,5 | 290 | 2252,8 | 2268 | 2320 | 2280 | 150 | 145 | 152 | 60 | 58 | 60,8 | 59,60 |
| 11 | 279,2 | 280,4 | 275,6 | 2233,6 | 2243,2 | 2204,8 | 2227 | 120 | 135 | 122 | 48 | 54 | 48,8 | 50,27 |
| 12 | 287,1 | 287,6 | 288,4 | 2297,04 | 2300,88 | 2306,96 | 2302 | 165 | 172 | 160 | 66 | 68,8 | 64 | 66,27 |
| 13 | 285,6 | 283,7 | 283,1 | 2284,64 | 2269,44 | 2264,48 | 2273 | 168 | 170 | 161 | 67,2 | 68 | 64,4 | 66,53 |
| 14 | 289,3 | 282,2 | 285,2 | 2314 | 2257,36 | 2281,36 | 2284 | 160 | 164 | 169 | 64 | 65,6 | 67,6 | 65,73 |
| 15a | 282,9 | 281,5 | 280,8 | 2262,8 | 2252 | 2246,56 | 2254 | 161 | 168 | 152 | 64,4 | 67,2 | 60,8 | 64,13 |
| 16 | 285,2 | 293,2 | 290,8 | 2281,6 | 2345,76 | 2326,56 | 2318 | 149 | 172 | 140 | 59,6 | 68,8 | 56 | 61,47 |
| 17 | 284 | 288,1 | 275,8 | 2272 | 2304,8 | 2206,4 | 2261 | 112 | 108 | 118 | 44,8 | 43,2 | 47,2 | 45,07 |
| 18 | 278,2 | 280 | 277,6 | 2225,6 | 2240 | 2220,8 | 2229 | 155 | 140 | 149 | 62 | 56 | 59,6 | 59,20 |
| 19 | 281,5 | 279,2 | 281,8 | 2252 | 2233,6 | 2254,4 | 2247 | 172 | 167 | 175 | 68,8 | 66,8 | 70 | 68,53 |
| 20 | 287,2 | 284,5 | 285 | 2297,6 | 2276 | 2280 | 2285 | 162 | 150 | 157 | 64,8 | 60 | 62,8 | 62,53 |
| 8b | 287,8 | 289,2 | 283,4 | 2302,4 | 2313,6 | 2267,2 | 2294 | 148 | 135 | 154 | 59,2 | 54 | 61,6 | 58,27 |
| 1a | 288,8 | 288 | 284,2 | 2310,4 | 2304 | 2273,6 | 2296 | 150 | 112 | 140 | 60 | 44,8 | 56 | 53,60 |
| 1c | 281,6 | 285,8 | 286,8 | 2252,8 | 2286,4 | 2294,4 | 2278 | 194 | 198 | 183 | 77,6 | 79,2 | 73,2 | 76,67 |
| 1d | 292,3 | 280,7 | 289,3 | 2338,72 | 2245,28 | 2314,4 | 2299 | 153 | 129 | 140 | 61,2 | 51,6 | 56 | 56,27 |
| 15b | 285,4 | 279,1 | 282,8 | 2283,2 | 2232,8 | 2262,4 | 2259 | 142 | 152 | 144 | 56,8 | 60,8 | 57,6 | 58,40 |
| 15c | 290,2 | 281,8 | 285,4 | 2321,6 | 2254,4 | 2283,2 | 2286 | 132 | 145 | 128 | 52,8 | 58 | 51,2 | 54,00 |
| 15d | 284,5 | 276,8 | 283,5 | 2276 | 2214,4 | 2268 | 2253 | 78 | 88 | 75 | 31,2 | 35,2 | 30 | 32,13 |

Perbandingan Kuat Tekan Mortar Geopolimer Sodium dan Potasium

| <i>Mix Design</i> | Kuat Tekan (MPa) | | Rasio |
|-------------------|------------------|----------|-------|
| | Sodium | Potasium | |
| 1b | 31,73 | 64,27 | 2,0 |
| 2 | 35,2 | 70,4 | 2,0 |
| 3 | 55,6 | 72,67 | 1,3 |
| 4 | 3,33 | 23,73 | 7,1 |
| 5 | 10,67 | 34,13 | 3,2 |
| 6 | 26,27 | 63,33 | 2,4 |
| 7 | 42,93 | 68,8 | 1,6 |
| 8a | 56 | 68,4 | 1,2 |
| 9 | 48,13 | 65,6 | 1,4 |
| 1b | 31,73 | 64,27 | 2,0 |
| 10 | 40,53 | 59,6 | 1,5 |
| 11 | 49,47 | 50,27 | 1,0 |
| 16 | 45,73 | 61,47 | 1,3 |
| 15a | 60,67 | 64,13 | 1,1 |
| 14 | 59,73 | 65,73 | 1,1 |
| 13 | 49,47 | 66,53 | 1,3 |
| 8a | 56 | 68,4 | 1,2 |
| 12 | 56,8 | 66,27 | 1,2 |
| 17 | 36,93 | 45,07 | 1,2 |
| 18 | 47,87 | 59,2 | 1,2 |
| 8a | 56 | 68,4 | 1,2 |
| 19 | 44,53 | 68,53 | 1,5 |
| 20 | 44,13 | 62,53 | 1,4 |
| 8a | 56 | 68,4 | 1,2 |
| 8b | 56,4 | 58,27 | 1,0 |
| 1a | 47,33 | 53,6 | 1,1 |
| 1b | 31,73 | 64,27 | 2,0 |
| 1c | 41,33 | 76,67 | 1,9 |
| 1d | 50,13 | 56,27 | 1,1 |
| 15a | 60,67 | 64,13 | 1,1 |
| 15b | 42,13 | 58,4 | 1,4 |
| 15c | 40,53 | 54 | 1,3 |
| 15d | 23,2 | 32,13 | 1,4 |

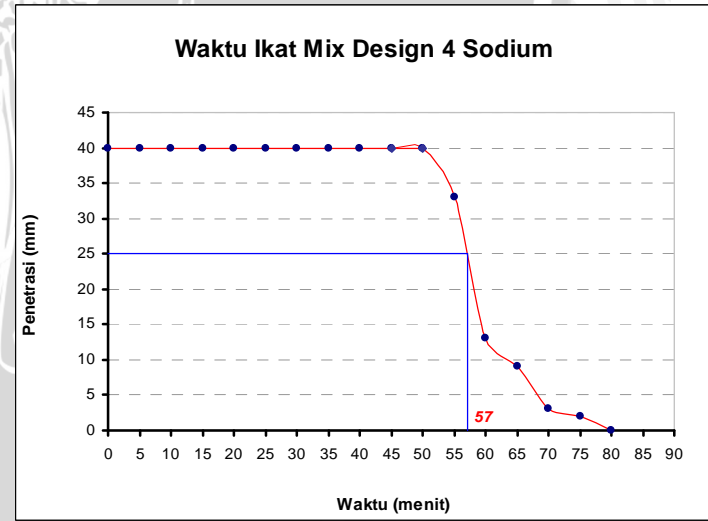
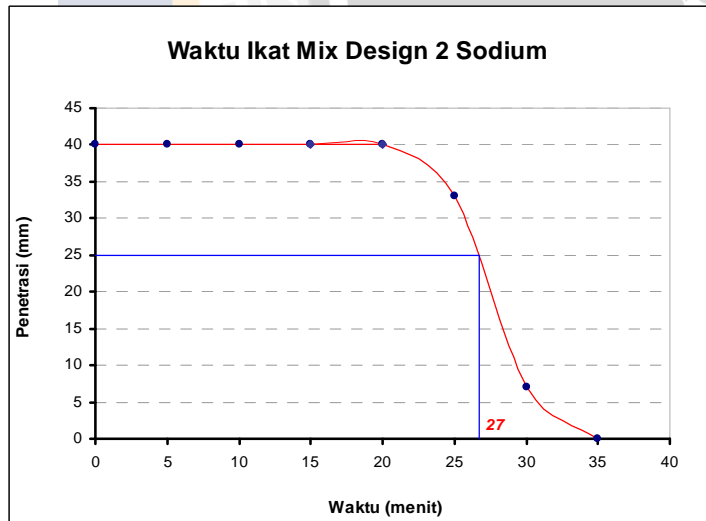
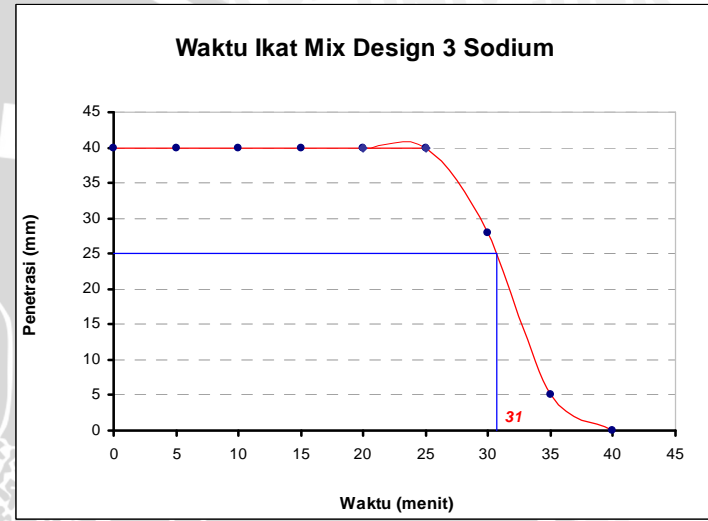
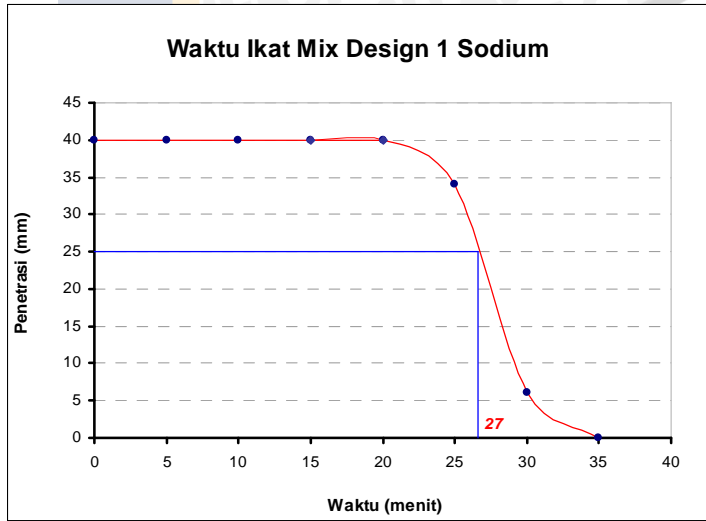
LAMPIRAN E

Hasil Pengujian Waktu Ikat Pasta Geopolimer Potasium dan Sodium

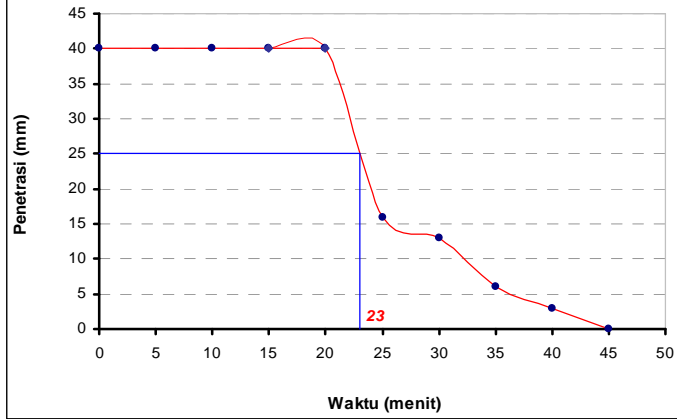


Hasil Pengujian Waktu Ikat Pasta Sodium

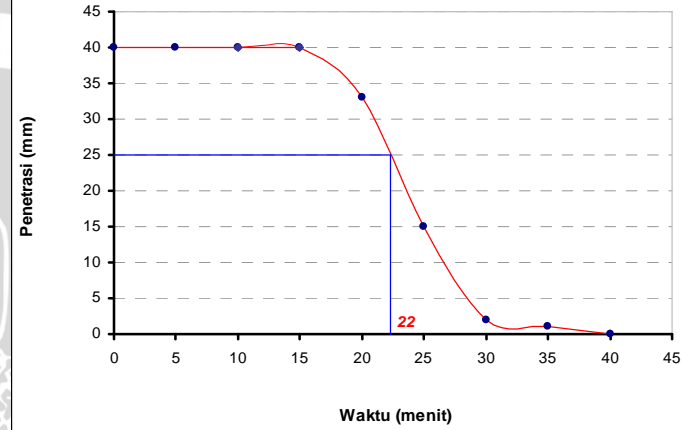
| Mix Design | Penetrasi Jarum Per 5 Menit (mm) | | | | | | | | | | | | | | | | |
|------------|----------------------------------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | 160 | 165 |
| 1b | 40 | 40 | 40 | 40 | 40 | 34 | 6 | 0 | | | | | | | | | |
| 2 | 40 | 40 | 40 | 40 | 40 | 33 | 7 | 0 | | | | | | | | | |
| 3 | 40 | 40 | 40 | 40 | 40 | 40 | 28 | 5 | 0 | | | | | | | | |
| 4 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | | | | | | |
| 5 | 40 | 40 | 40 | 40 | 40 | 16 | 13 | 6 | 3 | 0 | | | | | | | |
| 6 | 40 | 40 | 40 | 40 | 33 | 24 | 12 | 5 | 0 | | | | | | | | |
| 7 | 40 | 40 | 40 | 40 | 33 | 15 | 2 | 1 | 0 | | | | | | | | |
| 8a | 40 | 40 | 40 | 40 | 35 | 16 | 3 | 1 | 0 | | | | | | | | |
| 9 | 40 | 40 | 40 | 40 | 40 | 34 | 5 | 0 | | | | | | | | | |
| 10 | 40 | 40 | 40 | 40 | 40 | 40 | 7 | 0 | | | | | | | | | |
| 11 | 40 | 40 | 40 | 40 | 30 | 6 | 0 | | | | | | | | | | |
| 12 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 12 | 3 | 0 | | | | | | |
| 13 | 40 | 40 | 40 | 40 | 40 | 40 | 15 | 1 | 0 | | | | | | | | |
| 14 | 40 | 40 | 40 | 40 | 40 | 40 | 10 | 3 | 0 | | | | | | | | |
| 15a | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 8 | 0 | | | | | | | | |
| 16 | 40 | 40 | 40 | 40 | 40 | 36 | 7 | 0 | | | | | | | | | |
| 17 | 40 | 40 | 40 | 40 | 40 | 27 | 0 | | | | | | | | | | |
| 18 | 40 | 40 | 40 | 40 | 40 | 34 | 0 | | | | | | | | | | |
| 19 | 40 | 40 | 40 | 40 | 40 | 40 | 37 | 3 | 0 | | | | | | | | |
| 20 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 6 | 0 | | | | | | | | |
| 8b | 40 | 40 | 40 | 40 | 11 | 0 | | | | | | | | | | | |
| 1a, 1c, 1d | Sama dengan pengujian 1b | | | | | | | | | | | | | | | | |
| 15b | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 27 | 9 | 0 | | | | | | |
| 15c | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 11 | 4 | 0 | | | | | |
| 15d | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| | 40 | 40 | 40 | 40 | 40 | 35 | 28 | 25 | 16 | 13 | 11 | 8 | 7 | 6 | 5 | 3 | 0 |



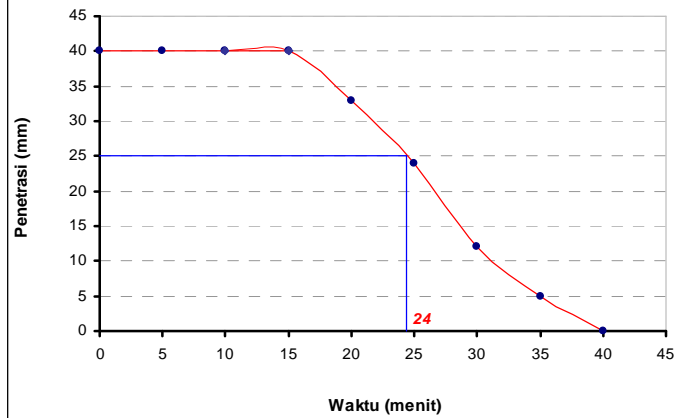
Waktu Ikat Mix Design 5 Sodium



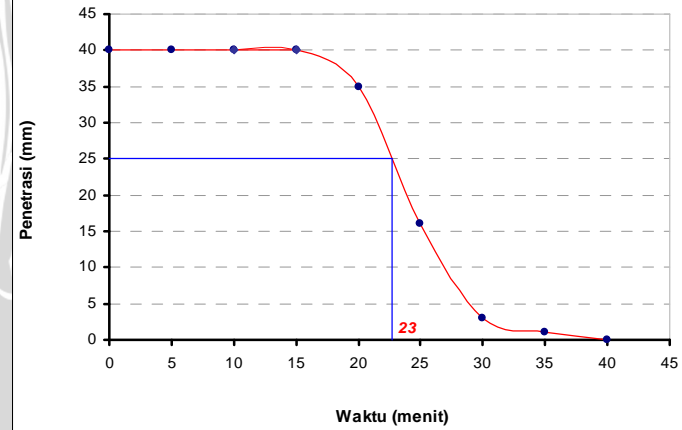
Waktu Ikat Mix Design 7 Sodium

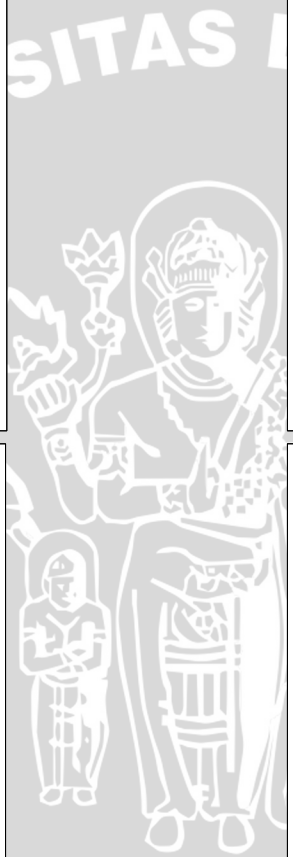
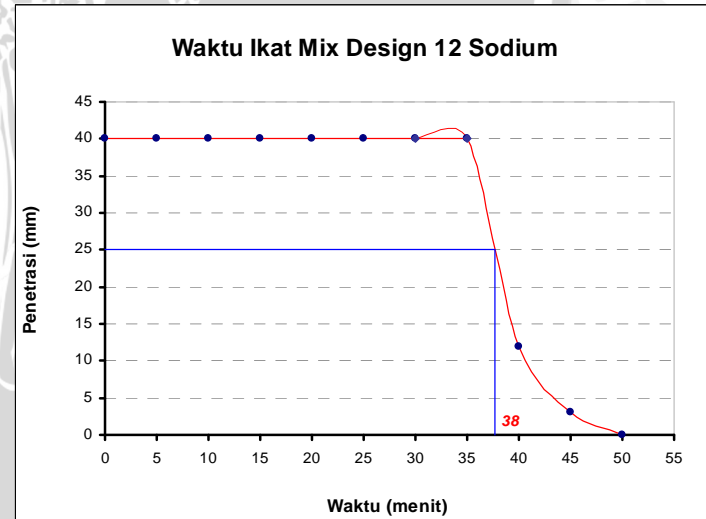
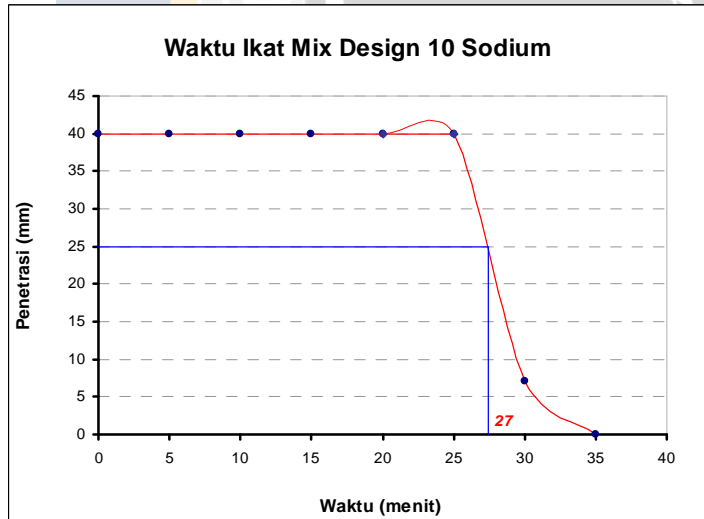
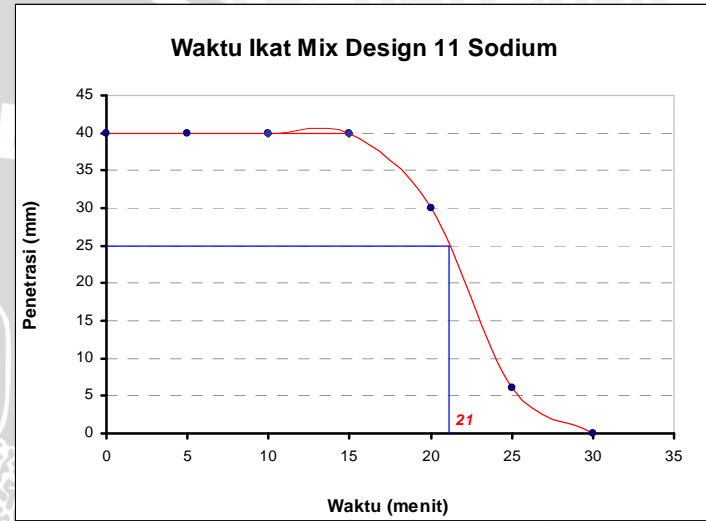
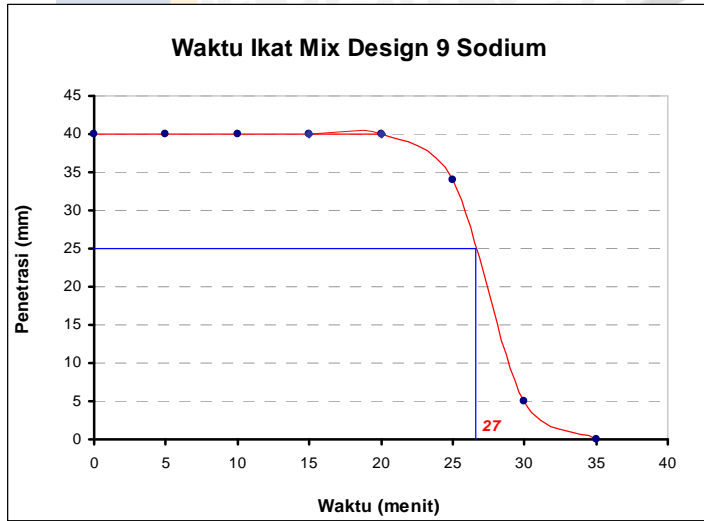


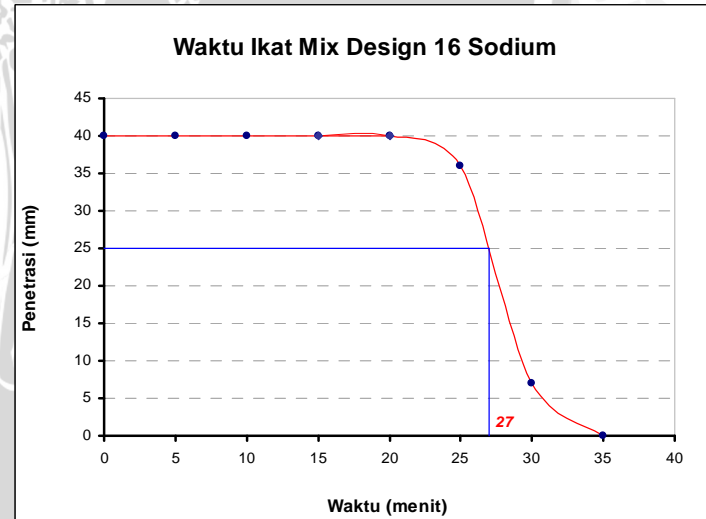
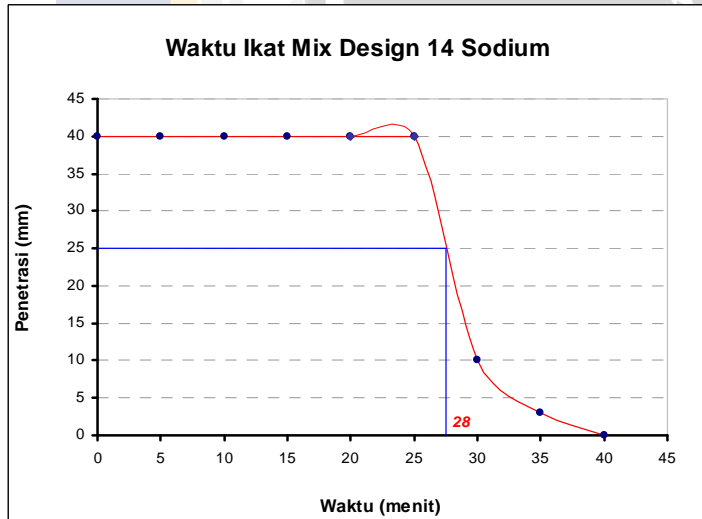
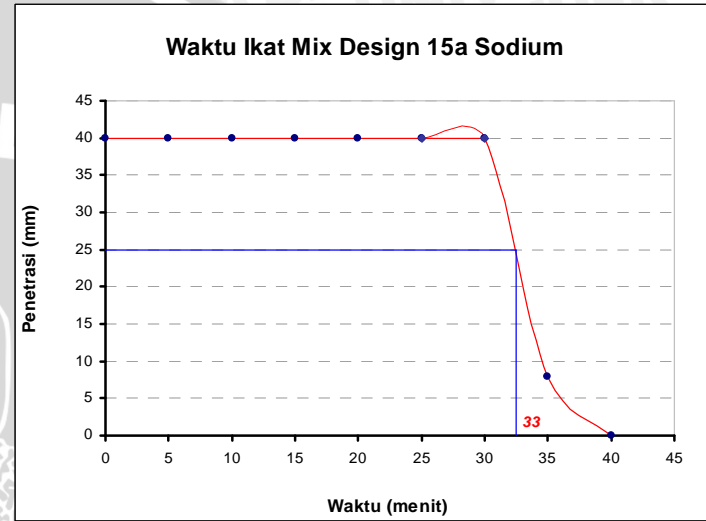
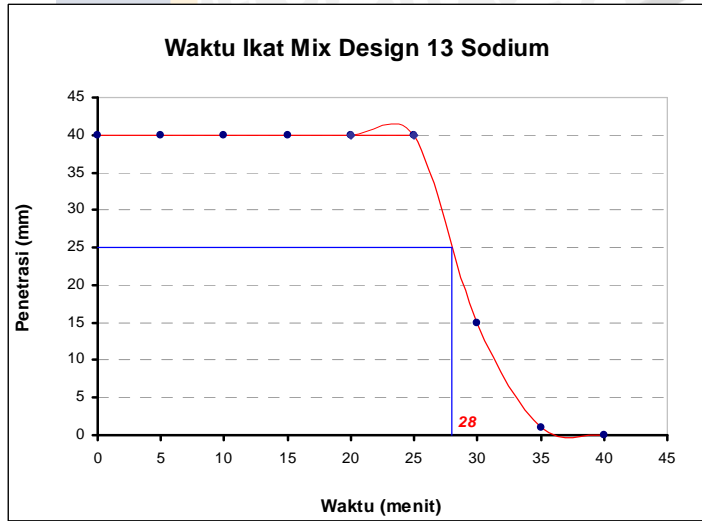
Waktu Ikat Mix Design 6 Sodium

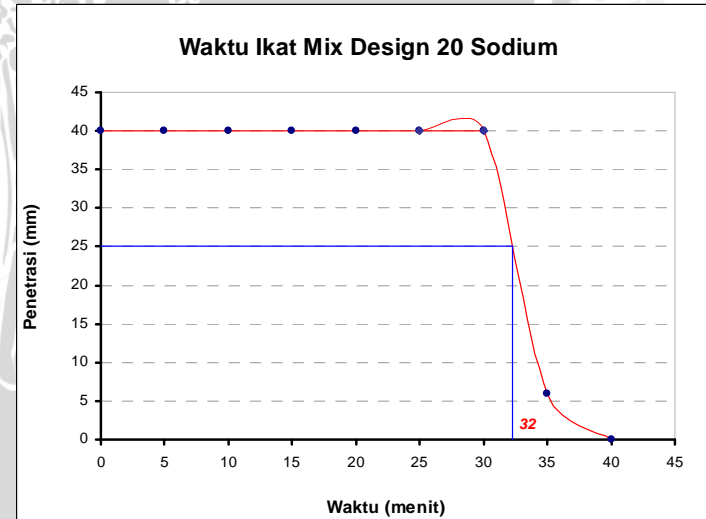
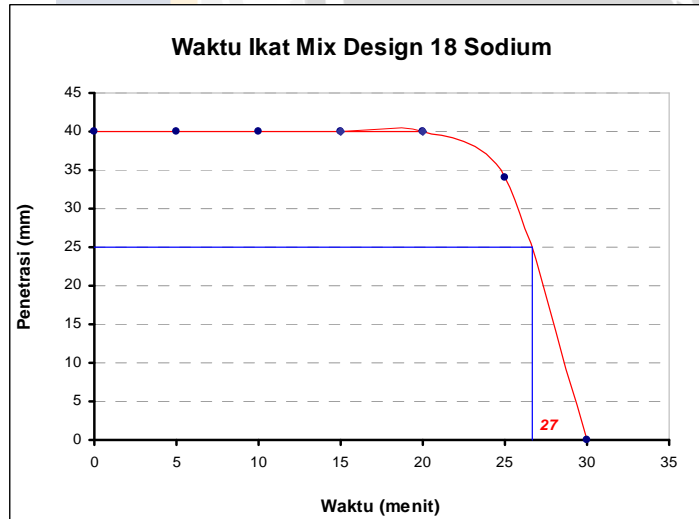
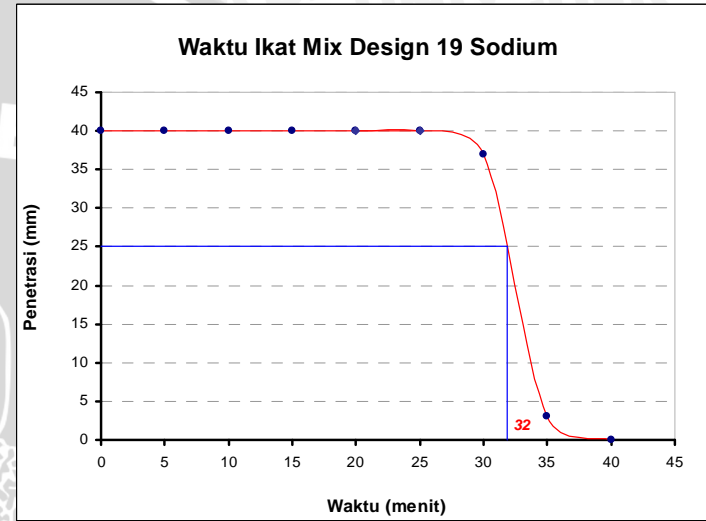
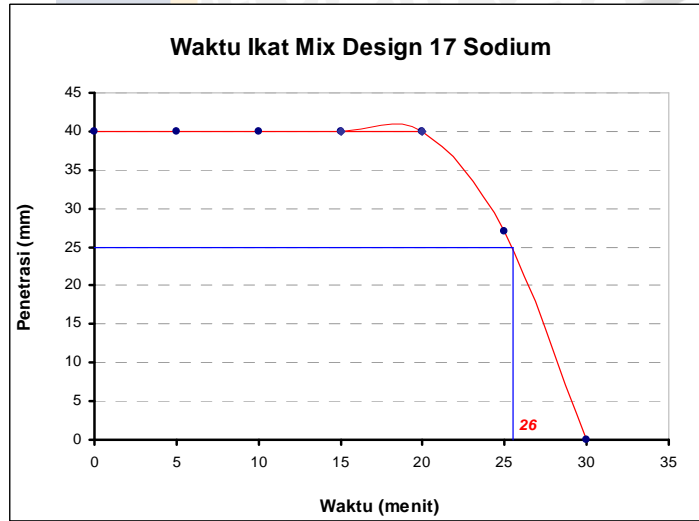


Waktu Ikat Mix Design 8a Sodium

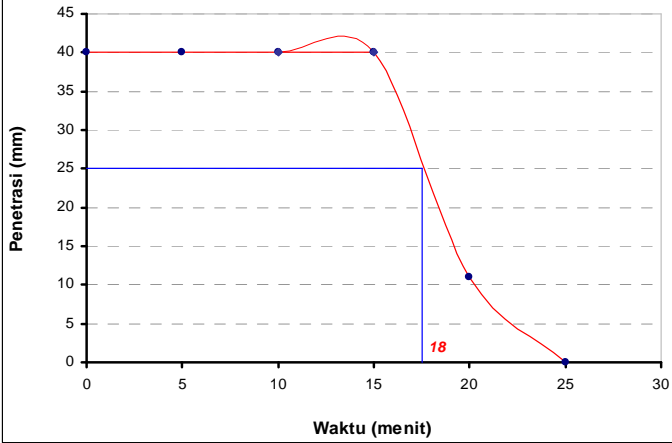




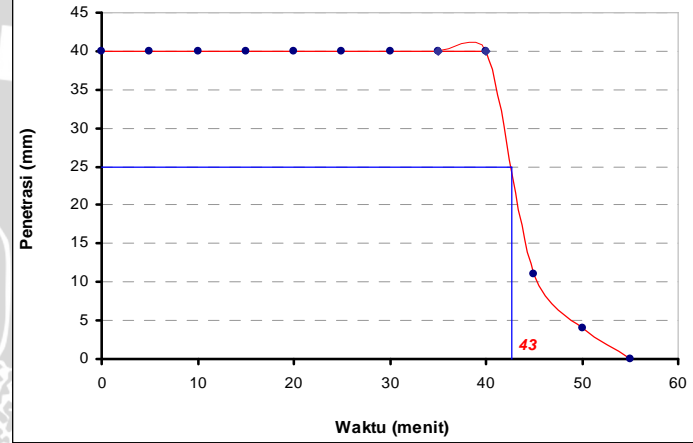




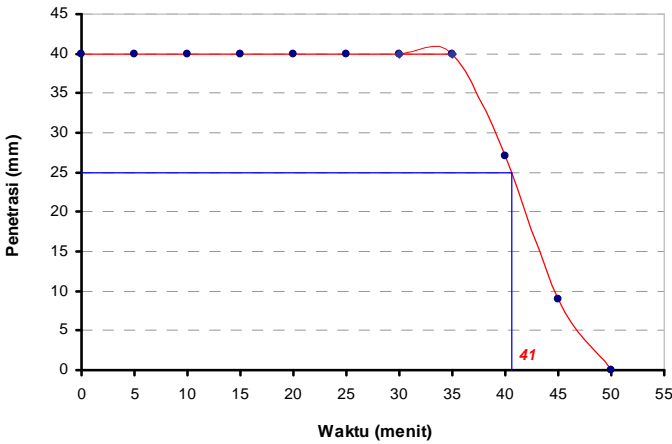
Waktu Ikat Mix Design 8b Sodium



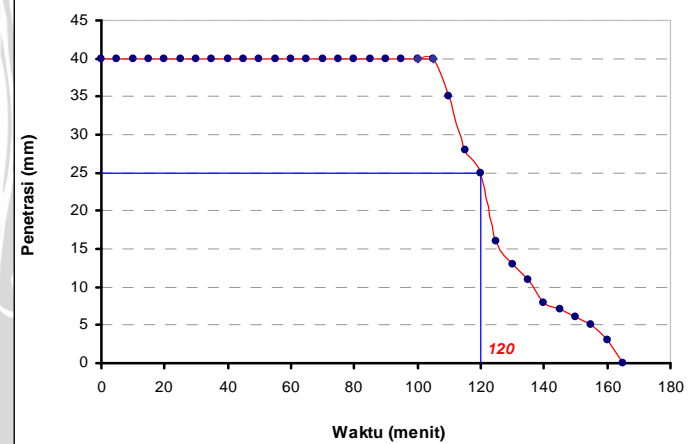
Waktu Ikat Mix Design 15c Sodium



Waktu Ikat Mix Design 15b Sodium



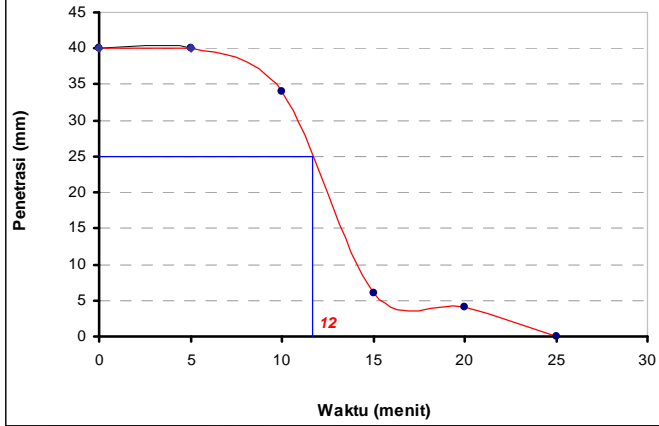
Waktu Ikat Mix Design 15d Sodium



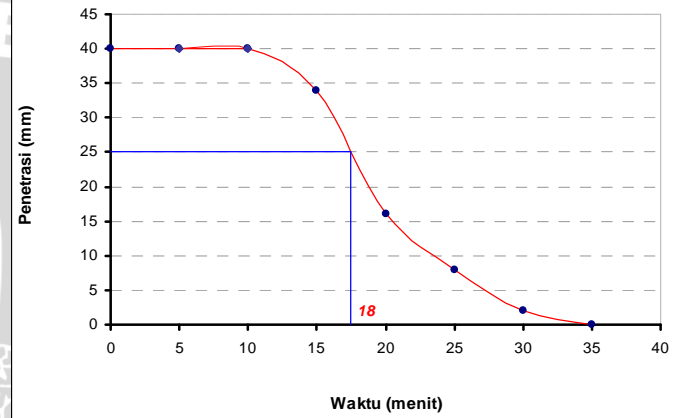
Hasil Pengujian Waktu Ikat Pasta Potasium

| Mix Design | Penetrasi Jarum Per 5 Menit (mm) | | | | | | | | | | | | | | | | |
|------------|----------------------------------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | 160 | 165 |
| 1b | 40 | 40 | 34 | 6 | 4 | 0 | | | | | | | | | | | |
| 2 | 40 | 40 | 40 | 24 | 15 | 6 | 0 | | | | | | | | | | |
| 3 | 40 | 40 | 40 | 34 | 16 | 8 | 2 | 0 | | | | | | | | | |
| 4 | 40 | 40 | 40 | 40 | 35 | 20 | 15 | 8 | 6 | 3 | 0 | | | | | | |
| 5 | 40 | 40 | 38 | 26 | 8 | 3 | 0 | | | | | | | | | | |
| 6 | 40 | 40 | 40 | 22 | 4 | 0 | | | | | | | | | | | |
| 7 | 40 | 40 | 40 | 20 | 3 | 0 | | | | | | | | | | | |
| 8a | 40 | 40 | 40 | 18 | 5 | 0 | | | | | | | | | | | |
| 9 | 40 | 40 | 35 | 21 | 4 | 0 | | | | | | | | | | | |
| 10 | 40 | 40 | 24 | 10 | 5 | 0 | | | | | | | | | | | |
| 11 | 40 | 40 | 15 | 7 | 0 | | | | | | | | | | | | |
| 12 | 40 | 40 | 40 | 40 | 7 | 0 | | | | | | | | | | | |
| 13 | 40 | 40 | 40 | 40 | 5 | 0 | | | | | | | | | | | |
| 14 | 40 | 40 | 40 | 40 | 3 | 0 | | | | | | | | | | | |
| 15a | 40 | 40 | 40 | 40 | 2 | 0 | | | | | | | | | | | |
| 16 | 40 | 40 | 40 | 11 | 0 | | | | | | | | | | | | |
| 17 | 40 | 40 | 25 | 18 | 9 | 0 | | | | | | | | | | | |
| 18 | 40 | 40 | 36 | 10 | 7 | 5 | 0 | | | | | | | | | | |
| 19 | 40 | 40 | 40 | 36 | 21 | 16 | 8 | 0 | | | | | | | | | |
| 20 | 40 | 40 | 40 | 38 | 28 | 10 | 4 | 2 | 0 | | | | | | | | |
| 8b | 40 | 40 | 40 | 3 | 0 | | | | | | | | | | | | |
| 1a, 1c, 1d | <i>Sama dengan pengujian 1b</i> | | | | | | | | | | | | | | | | |
| 15b | 40 | 40 | 40 | 40 | 35 | 15 | 7 | 0 | | | | | | | | | |
| 15c | 40 | 40 | 40 | 40 | 40 | 40 | 33 | 20 | 12 | 8 | 0 | | | | | | |
| 15d | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 34 |
| | 28 | 23 | 17 | 10 | 5 | 3 | 0 | | | | | | | | | | |

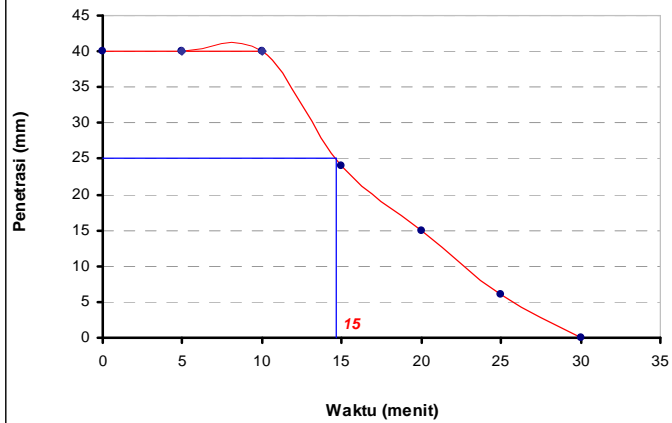
Waktu Ikat Mix Design 1 Potassium



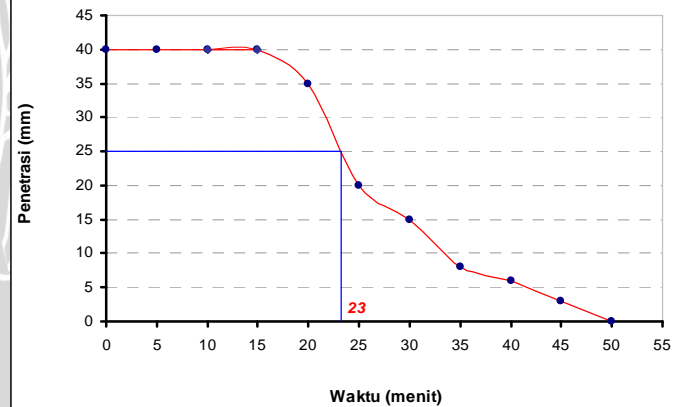
Waktu Ikat Mix Design 3 Potassium



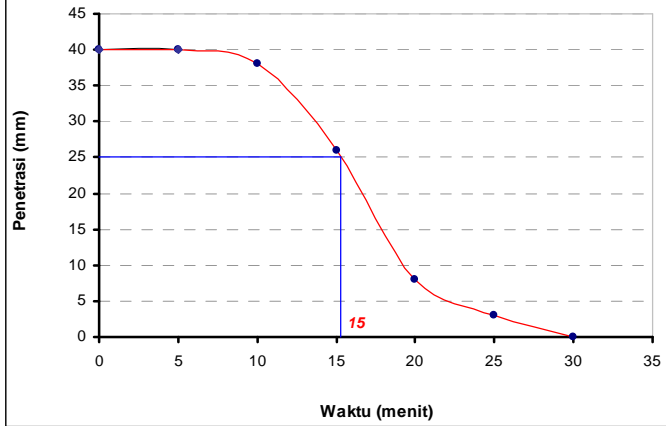
Waktu Ikat Mix Design 2 Potassium



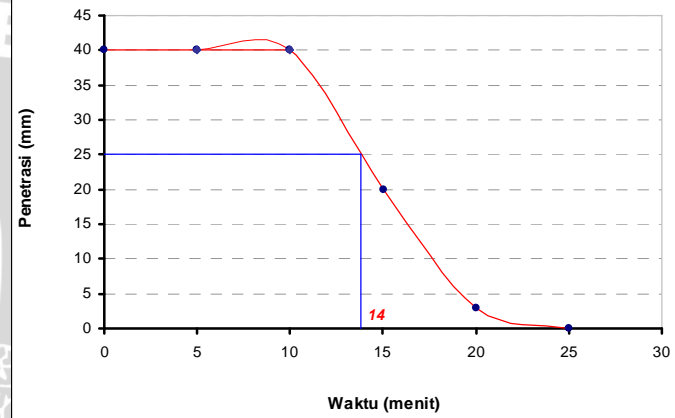
Waktu Ikat Mix Design 4 Potassium



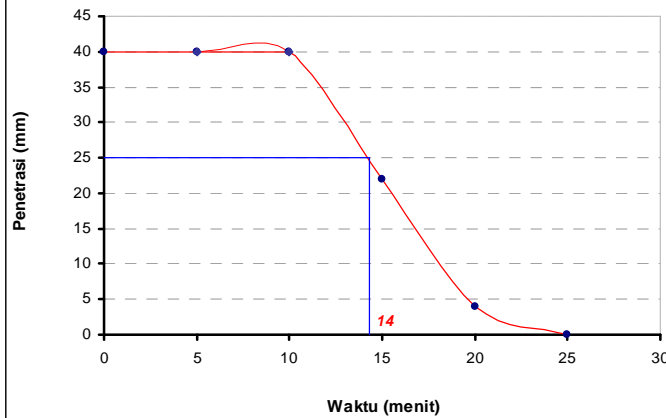
Waktu Ikat Mix Design 5 Potassium



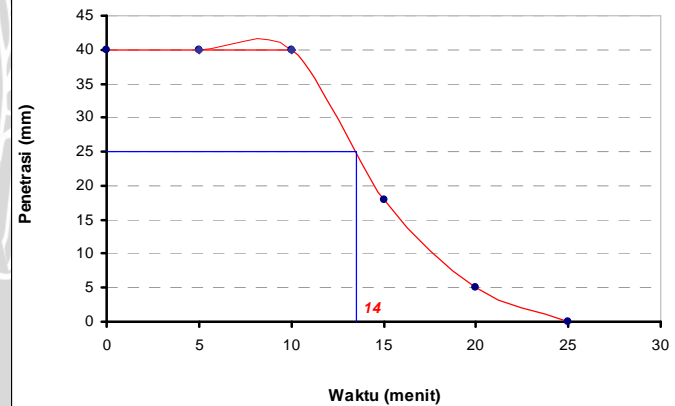
Waktu Ikat Mix Design 7 Potassium



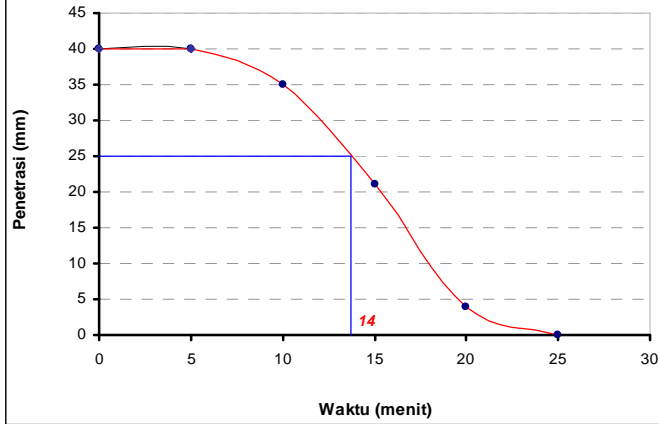
Waktu Ikat Mix Design 6 Potassium



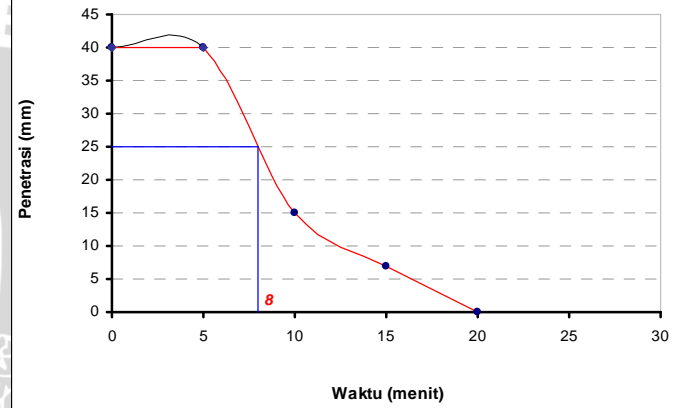
Waktu Ikat Mix Design 8a Potassium



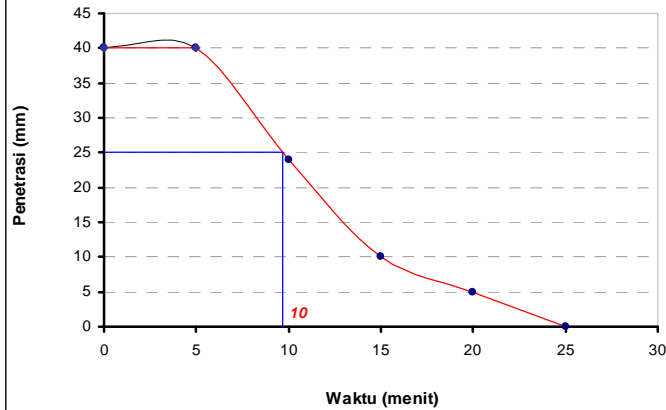
Waktu Ikat Mix Design 9 Potassium



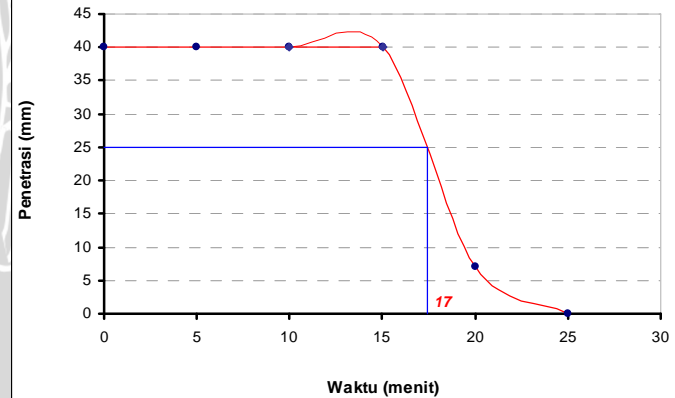
Waktu Ikat Mix Design 11 Potassium

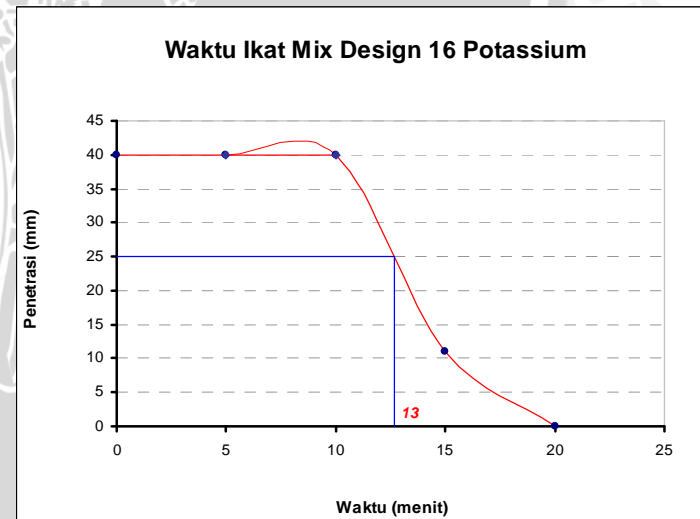
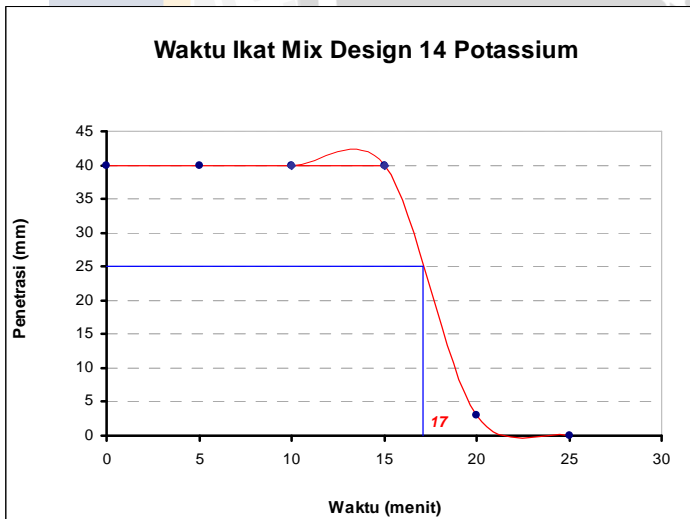
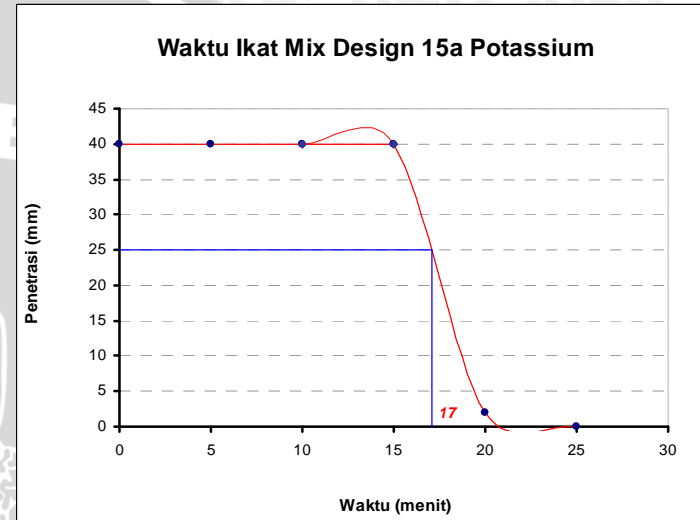
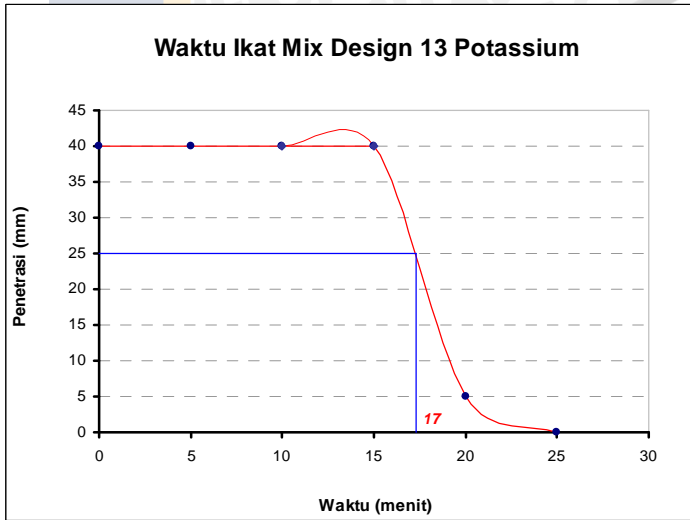


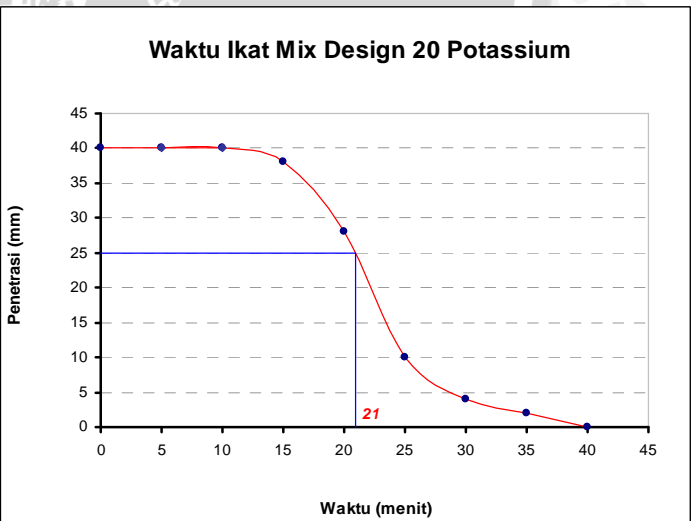
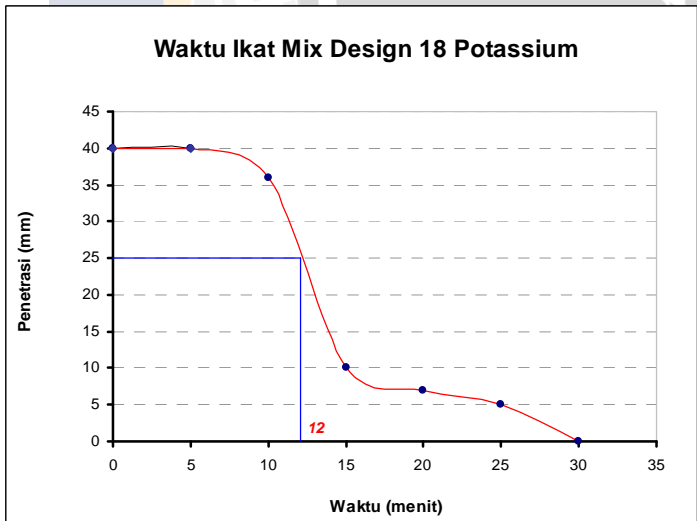
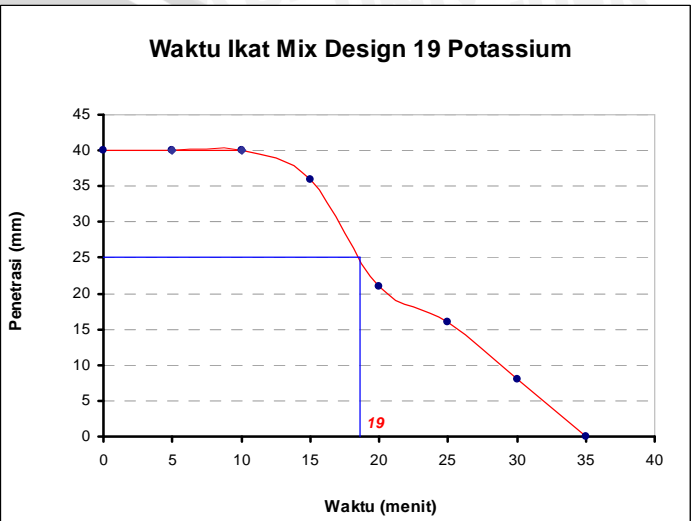
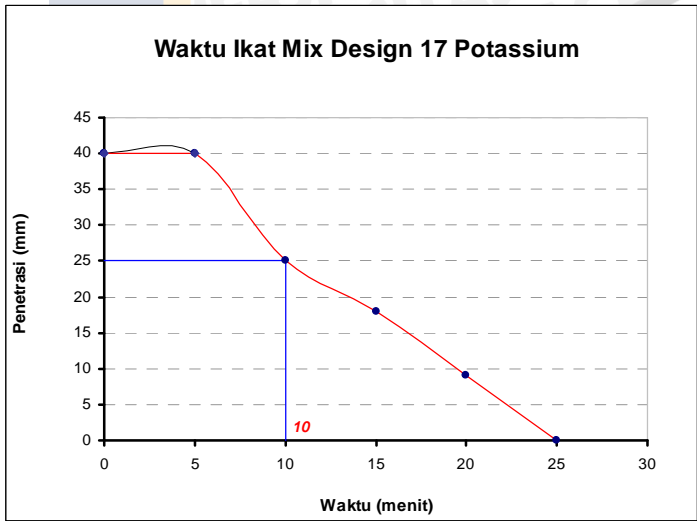
Waktu Ikat Mix Design 10 Potassium

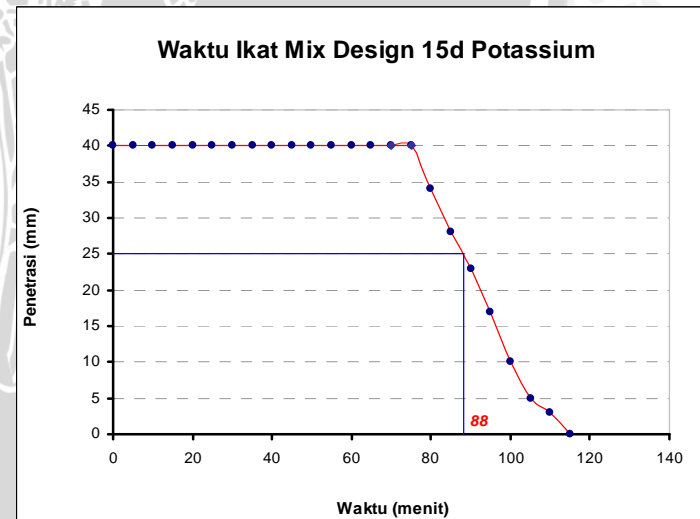
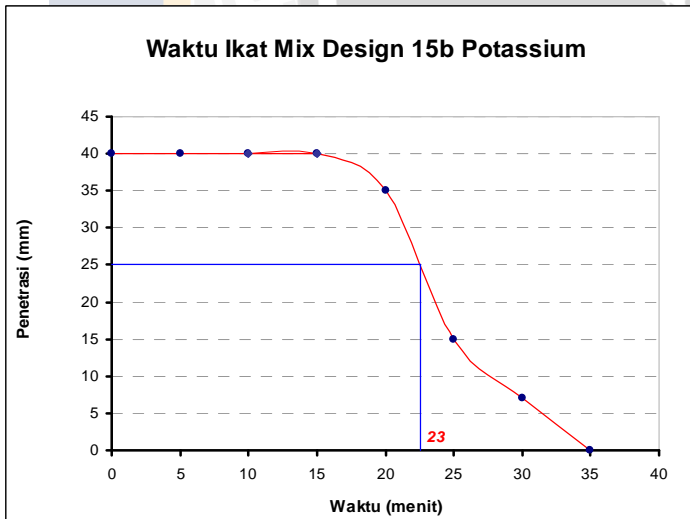
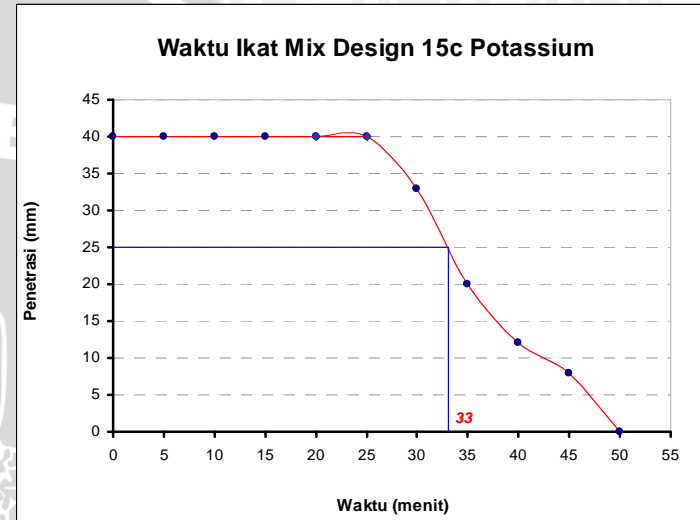
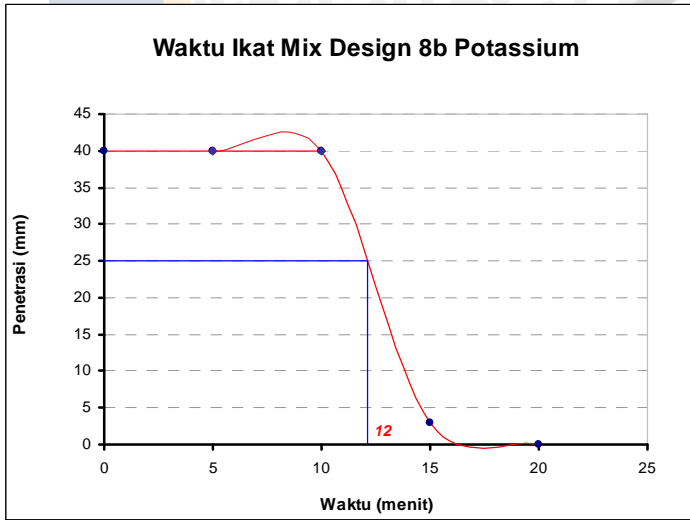


Waktu Ikat Mix Design 12 Potassium









Perbandingan *Initial Setting Time* Pasta Geopolimer Sodium dan Potasium

| <i>Mix Design</i> | Initial Setting Time (menit) | | Rasio |
|-------------------|-------------------------------------|-----------------|--------------|
| | Sodium | Potasium | |
| 1b | 27 | 12 | 2,3 |
| 2 | 27 | 15 | 1,8 |
| 3 | 31 | 18 | 1,7 |
| 4 | 57 | 23 | 2,5 |
| 5 | 23 | 15 | 1,5 |
| 6 | 24 | 14 | 1,7 |
| 7 | 22 | 14 | 1,6 |
| 8a | 23 | 14 | 1,6 |
| 9 | 27 | 14 | 1,9 |
| 1b | 27 | 12 | 2,3 |
| 10 | 27 | 10 | 2,7 |
| 11 | 21 | 8 | 2,6 |
| 16 | 27 | 13 | 2,1 |
| 15a | 33 | 17 | 1,9 |
| 14 | 28 | 17 | 1,6 |
| 13 | 28 | 17 | 1,6 |
| 8a | 23 | 14 | 1,6 |
| 12 | 38 | 17 | 2,2 |
| 17 | 26 | 10 | 2,6 |
| 18 | 27 | 12 | 2,3 |
| 8a | 23 | 14 | 1,6 |
| 19 | 32 | 19 | 1,7 |
| 20 | 32 | 21 | 1,5 |
| 8a | 23 | 14 | 1,6 |
| 8b | 18 | 12 | 1,5 |
| 1a | 27 | 12 | 2,3 |
| 1b | 27 | 12 | 2,3 |
| 1c | 27 | 12 | 2,3 |
| 1d | 27 | 12 | 2,3 |
| 15a | 33 | 17 | 1,9 |
| 15b | 41 | 23 | 1,8 |
| 15c | 43 | 33 | 1,3 |
| 15d | 120 | 88 | 1,4 |

UNIVERSITAS BRAWIJAYA

LAMPIRAN F

Perhitungan Molar Tiap *Mix Design* Mortar Geopolimer Potasium dan Sodium



Molar Oksida Tiap Mix Design Mortar Geopolimer Sodium

I. Kandungan kimia dari fly ash yang digunakan (% massa)

| | % |
|--------------------------------|-------|
| SiO ₂ | 65,88 |
| Al ₂ O ₃ | 4,27 |
| Na ₂ O | 0,92 |

II. % NaOH dalam larutan

| | % |
|---------------|--------|
| NaOH 8 molar | 25,153 |
| NaOH 10 molar | 30,744 |
| NaOH 12 molar | 35,783 |

III. Kandungan kimia dari Sodium Silikat (% massa)

| | % |
|-------------------|-------|
| SiO ₂ | 35,79 |
| Na ₂ O | 18,34 |
| H ₂ O | 45,87 |

IV. Nilai Mr beberapa oksida

| Oksida | gram |
|--------------------------------|--------|
| SiO ₂ | 60,09 |
| Al ₂ O ₃ | 101,96 |
| Na ₂ O | 61,98 |
| H ₂ O | 18,02 |
| NaOH | 40,00 |

| Mix Design | Konsentrasi Larutan NaOH (molar) | Fly Ash | | | Sodium Silikat | | | Sodium Hidroksida | | | Air | Total | | | | Rasio molar | | | | |
|------------|----------------------------------|------------------|--------------------------------|-------------------|------------------|-------------------|------------------|-------------------|------------------|------------------|------------------|-------------------|------------------|--------------------------------|------------------|-----------------------|-------------------------|----------------------|-------------------------|--|
| | | SiO ₂ | Al ₂ O ₃ | Na ₂ O | SiO ₂ | Na ₂ O | H ₂ O | Na ₂ O | H ₂ O | H ₂ O | H ₂ O | Na ₂ O | SiO ₂ | Al ₂ O ₃ | H ₂ O | $\frac{Na_2O}{SiO_2}$ | $\frac{SiO_2}{Al_2O_3}$ | $\frac{H_2O}{Na_2O}$ | $\frac{Na_2O}{Al_2O_3}$ | |
| | | 65,88% | 4,27% | 0,92% | 35,79% | 18,34% | 45,87% | 77,48% | 22,53% | | | | | | | | | | | |
| 1b | 8 | 3,289 | 0,126 | 0,045 | 0,511 | 0,254 | 2,182 | 0,108 | 0,108 | 1,424 | 0,493 | 0,406 | 3,800 | 0,126 | 4,206 | 0,107 | 30,242 | 10,361 | 3,231 | |
| 2 | 10 | 3,289 | 0,126 | 0,045 | 0,511 | 0,254 | 2,182 | 0,132 | 0,132 | 1,318 | 0,495 | 0,430 | 3,800 | 0,126 | 4,127 | 0,113 | 30,242 | 9,598 | 3,422 | |
| 3 | 12 | 3,289 | 0,126 | 0,045 | 0,511 | 0,254 | 2,182 | 0,153 | 0,153 | 1,222 | 0,498 | 0,452 | 3,800 | 0,126 | 4,055 | 0,119 | 30,242 | 8,980 | 3,594 | |
| 4 | 8 | 3,289 | 0,126 | 0,045 | 0,165 | 0,082 | 0,705 | 0,290 | 0,290 | 3,834 | 0,469 | 0,417 | 3,454 | 0,126 | 5,298 | 0,121 | 27,492 | 12,715 | 3,317 | |
| 5 | 8 | 3,289 | 0,126 | 0,045 | 0,204 | 0,101 | 0,873 | 0,270 | 0,270 | 3,560 | 0,472 | 0,415 | 3,493 | 0,126 | 5,174 | 0,119 | 27,804 | 12,453 | 3,307 | |
| 6 | 8 | 3,289 | 0,126 | 0,045 | 0,238 | 0,118 | 1,018 | 0,252 | 0,252 | 3,323 | 0,474 | 0,414 | 3,527 | 0,126 | 5,067 | 0,117 | 28,075 | 12,226 | 3,299 | |
| 7 | 8 | 3,289 | 0,126 | 0,045 | 0,357 | 0,178 | 1,527 | 0,189 | 0,189 | 2,492 | 0,482 | 0,411 | 3,646 | 0,126 | 4,690 | 0,113 | 29,023 | 11,419 | 3,269 | |

| | | | | | | | | | | | | | | | | | | | |
|-----|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|-------|
| 8a | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,490 | 0,407 | 3,766 | 0,126 | 4,314 | 0,108 | 29,972 | 10,599 | 3,240 |
| 9 | 8 | 3,289 | 0,126 | 0,045 | 0,495 | 0,246 | 2,115 | 0,116 | 0,116 | 1,534 | 0,491 | 0,406 | 3,784 | 0,126 | 4,256 | 0,107 | 30,117 | 10,471 | 3,235 |
| 10 | 8 | 3,289 | 0,126 | 0,045 | 0,524 | 0,260 | 2,240 | 0,101 | 0,101 | 1,329 | 0,493 | 0,406 | 3,813 | 0,126 | 4,163 | 0,106 | 30,351 | 10,266 | 3,228 |
| 11 | 8 | 3,289 | 0,126 | 0,045 | 0,536 | 0,266 | 2,291 | 0,094 | 0,094 | 1,246 | 0,494 | 0,405 | 3,825 | 0,126 | 4,126 | 0,106 | 30,446 | 10,182 | 3,225 |
| 12 | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,588 | 0,407 | 3,766 | 0,126 | 4,412 | 0,108 | 29,972 | 10,839 | 3,240 |
| 13 | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,392 | 0,407 | 3,766 | 0,126 | 4,216 | 0,108 | 29,972 | 10,358 | 3,240 |
| 14 | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,294 | 0,407 | 3,766 | 0,126 | 4,118 | 0,108 | 29,972 | 10,117 | 3,240 |
| 15a | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,196 | 0,407 | 3,766 | 0,126 | 4,020 | 0,108 | 29,972 | 9,876 | 3,240 |
| 16 | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,000 | 0,407 | 3,766 | 0,126 | 3,824 | 0,108 | 29,972 | 9,394 | 3,240 |
| 17 | 8 | 3,289 | 0,126 | 0,045 | 0,357 | 0,178 | 1,527 | 0,094 | 0,094 | 1,246 | 0,472 | 0,316 | 3,646 | 0,126 | 3,339 | 0,087 | 29,023 | 10,554 | 2,518 |
| 18 | 8 | 3,289 | 0,126 | 0,045 | 0,417 | 0,207 | 1,782 | 0,110 | 0,110 | 1,454 | 0,481 | 0,362 | 3,706 | 0,126 | 3,827 | 0,098 | 29,497 | 10,579 | 2,879 |
| 19 | 8 | 3,289 | 0,126 | 0,045 | 0,536 | 0,266 | 2,291 | 0,141 | 0,142 | 1,869 | 0,499 | 0,452 | 3,825 | 0,126 | 4,801 | 0,118 | 30,446 | 10,614 | 3,600 |
| 20 | 8 | 3,289 | 0,126 | 0,045 | 0,596 | 0,296 | 2,546 | 0,157 | 0,157 | 2,077 | 0,509 | 0,498 | 3,885 | 0,126 | 5,288 | 0,128 | 30,920 | 10,627 | 3,961 |
| 8b | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,490 | 0,407 | 3,766 | 0,126 | 4,314 | 0,108 | 29,972 | 10,599 | 3,240 |
| 1b | 8 | 3,289 | 0,126 | 0,045 | 0,511 | 0,254 | 2,182 | 0,108 | 0,108 | 1,424 | 0,493 | 0,406 | 3,800 | 0,126 | 4,206 | 0,107 | 30,242 | 10,361 | 3,231 |
| 1c | 8 | 3,289 | 0,126 | 0,045 | 0,511 | 0,254 | 2,182 | 0,108 | 0,108 | 1,424 | 0,493 | 0,406 | 3,800 | 0,126 | 4,206 | 0,107 | 30,242 | 10,361 | 3,231 |
| 1d | 8 | 3,289 | 0,126 | 0,045 | 0,511 | 0,254 | 2,182 | 0,108 | 0,108 | 1,424 | 0,493 | 0,406 | 3,800 | 0,126 | 4,206 | 0,107 | 30,242 | 10,361 | 3,231 |
| 15b | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,196 | 0,407 | 3,766 | 0,126 | 4,020 | 0,108 | 29,972 | 9,876 | 3,240 |
| 15c | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,196 | 0,407 | 3,766 | 0,126 | 4,020 | 0,108 | 29,972 | 9,876 | 3,240 |
| 15d | 8 | 3,289 | 0,126 | 0,045 | 0,476 | 0,237 | 2,036 | 0,126 | 0,126 | 1,661 | 0,196 | 0,407 | 3,766 | 0,126 | 4,020 | 0,108 | 29,972 | 9,876 | 3,240 |

Molar Oksida Tiap Mix Design Mortar Geopolimer Potasium

I. Kandungan kimia dari fly ash yang digunakan (% massa)

| | % |
|--------------------------------|-------|
| SiO ₂ | 65,88 |
| Al ₂ O ₃ | 4,27 |
| K ₂ O | 0,48 |

II. % KOH dalam larutan

| | % |
|--------------|--------|
| KOH 8 molar | 36,340 |
| KOH 10 molar | 44,071 |
| KOH 12 molar | 51,718 |

III. Kandungan kimia dari Potasium Silikat (% massa)

| | % |
|------------------|-------|
| SiO ₂ | 34,86 |
| K ₂ O | 20,48 |
| H ₂ O | 44,66 |

IV. Nilai Mr beberapa oksida

| Oksida | gram |
|--------------------------------|--------|
| SiO ₂ | 60,09 |
| Al ₂ O ₃ | 101,96 |
| K ₂ O | 94,20 |
| H ₂ O | 18,02 |
| KOH | 56,11 |

| Mix Design | Konsentrasi Larutan KOH (molar) | Fly Ash | | | Potasium Silikat | | | Potasium Hidroksida | | | Air | Total | | | Rasio molar | | | | | |
|------------|---------------------------------|------------------|--------------------------------|------------------|------------------|------------------|------------------|---------------------|------------------|------------------|------------------|------------------|------------------|--------------------------------|------------------|----------------------|-------------------------|---------------------|------------------------|--|
| | | SiO ₂ | Al ₂ O ₃ | K ₂ O | SiO ₂ | K ₂ O | H ₂ O | K ₂ O | H ₂ O | H ₂ O | H ₂ O | K ₂ O | SiO ₂ | Al ₂ O ₃ | H ₂ O | $\frac{K_2O}{SiO_2}$ | $\frac{SiO_2}{Al_2O_3}$ | $\frac{H_2O}{K_2O}$ | $\frac{K_2O}{Al_2O_3}$ | |
| | | 65,88% | 4,27% | 0,48% | 34,86% | 20,48% | 44,66% | 83,94% | 16,06% | | | | | | | | | | | |
| 1b | 8 | 3,289 | 0,126 | 0,023 | 0,497 | 0,186 | 2,124 | 0,111 | 0,111 | 1,211 | 0,499 | 0,321 | 3,786 | 0,126 | 3,946 | 0,085 | 30,137 | 12,307 | 2,552 | |
| 2 | 10 | 3,289 | 0,126 | 0,023 | 0,497 | 0,186 | 2,124 | 0,135 | 0,135 | 1,064 | 0,503 | 0,344 | 3,786 | 0,126 | 3,826 | 0,091 | 30,137 | 11,115 | 2,740 | |
| 3 | 12 | 3,289 | 0,126 | 0,023 | 0,497 | 0,186 | 2,124 | 0,158 | 0,158 | 0,919 | 0,507 | 0,368 | 3,786 | 0,126 | 3,708 | 0,097 | 30,137 | 10,086 | 2,926 | |
| 4 | 8 | 3,289 | 0,126 | 0,023 | 0,161 | 0,060 | 0,686 | 0,299 | 0,299 | 3,261 | 0,484 | 0,382 | 3,450 | 0,126 | 4,730 | 0,111 | 27,458 | 12,371 | 3,043 | |
| 5 | 8 | 3,289 | 0,126 | 0,023 | 0,199 | 0,075 | 0,850 | 0,278 | 0,278 | 3,028 | 0,486 | 0,375 | 3,488 | 0,126 | 4,641 | 0,108 | 27,762 | 12,365 | 2,987 | |
| 6 | 8 | 3,289 | 0,126 | 0,023 | 0,232 | 0,087 | 0,991 | 0,259 | 0,259 | 2,826 | 0,487 | 0,369 | 3,521 | 0,126 | 4,564 | 0,105 | 28,026 | 12,359 | 2,939 | |
| 7 | 8 | 3,289 | 0,126 | 0,023 | 0,348 | 0,130 | 1,487 | 0,194 | 0,194 | 2,120 | 0,493 | 0,348 | 3,637 | 0,126 | 4,293 | 0,096 | 28,950 | 12,338 | 2,770 | |

| | | | | | | | | | | | | | | | | | | | |
|-----|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|-------|
| 8a | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,498 | 0,327 | 3,753 | 0,126 | 4,023 | 0,087 | 29,873 | 12,315 | 2,600 |
| 9 | 8 | 3,289 | 0,126 | 0,023 | 0,482 | 0,181 | 2,059 | 0,120 | 0,120 | 1,304 | 0,499 | 0,323 | 3,771 | 0,126 | 3,982 | 0,086 | 30,015 | 12,311 | 2,574 |
| 10 | 8 | 3,289 | 0,126 | 0,023 | 0,511 | 0,191 | 2,181 | 0,104 | 0,104 | 1,130 | 0,500 | 0,318 | 3,800 | 0,126 | 3,915 | 0,084 | 30,242 | 12,304 | 2,533 |
| 11 | 8 | 3,289 | 0,126 | 0,023 | 0,522 | 0,196 | 2,231 | 0,097 | 0,097 | 1,060 | 0,500 | 0,316 | 3,811 | 0,126 | 3,888 | 0,083 | 30,335 | 12,302 | 2,516 |
| 12 | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,597 | 0,327 | 3,753 | 0,126 | 4,123 | 0,087 | 29,873 | 12,619 | 2,600 |
| 13 | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,398 | 0,327 | 3,753 | 0,126 | 3,924 | 0,087 | 29,873 | 12,010 | 2,600 |
| 14 | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,299 | 0,327 | 3,753 | 0,126 | 3,824 | 0,087 | 29,873 | 11,705 | 2,600 |
| 15a | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,199 | 0,327 | 3,753 | 0,126 | 3,724 | 0,087 | 29,873 | 11,400 | 2,600 |
| 16 | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,000 | 0,327 | 3,753 | 0,126 | 3,525 | 0,087 | 29,873 | 10,791 | 2,600 |
| 17 | 8 | 3,289 | 0,126 | 0,023 | 0,348 | 0,130 | 1,487 | 0,097 | 0,097 | 1,060 | 0,477 | 0,251 | 3,637 | 0,126 | 3,121 | 0,069 | 28,950 | 12,444 | 1,996 |
| 18 | 8 | 3,289 | 0,126 | 0,023 | 0,406 | 0,152 | 1,735 | 0,113 | 0,113 | 1,236 | 0,488 | 0,289 | 3,695 | 0,126 | 3,572 | 0,078 | 29,411 | 12,371 | 2,298 |
| 19 | 8 | 3,289 | 0,126 | 0,023 | 0,522 | 0,196 | 2,231 | 0,146 | 0,146 | 1,590 | 0,508 | 0,365 | 3,811 | 0,126 | 4,474 | 0,096 | 30,335 | 12,270 | 2,902 |
| 20 | 8 | 3,289 | 0,126 | 0,023 | 0,580 | 0,217 | 2,478 | 0,162 | 0,162 | 1,766 | 0,518 | 0,403 | 3,869 | 0,126 | 4,925 | 0,104 | 30,797 | 12,234 | 3,204 |
| 8b | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,498 | 0,327 | 3,753 | 0,126 | 4,023 | 0,087 | 29,873 | 12,315 | 2,600 |
| 1b | 8 | 3,289 | 0,126 | 0,023 | 0,497 | 0,186 | 2,124 | 0,111 | 0,111 | 1,211 | 0,499 | 0,321 | 3,786 | 0,126 | 3,946 | 0,085 | 30,137 | 12,307 | 2,552 |
| 1c | 8 | 3,289 | 0,126 | 0,023 | 0,497 | 0,186 | 2,124 | 0,111 | 0,111 | 1,211 | 0,499 | 0,321 | 3,786 | 0,126 | 3,946 | 0,085 | 30,137 | 12,307 | 2,552 |
| 1d | 8 | 3,289 | 0,126 | 0,023 | 0,497 | 0,186 | 2,124 | 0,111 | 0,111 | 1,211 | 0,499 | 0,321 | 3,786 | 0,126 | 3,946 | 0,085 | 30,137 | 12,307 | 2,552 |
| 15b | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,199 | 0,327 | 3,753 | 0,126 | 3,724 | 0,087 | 29,873 | 11,400 | 2,600 |
| 15c | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,199 | 0,327 | 3,753 | 0,126 | 3,724 | 0,087 | 29,873 | 11,400 | 2,600 |
| 15d | 8 | 3,289 | 0,126 | 0,023 | 0,464 | 0,174 | 1,983 | 0,130 | 0,130 | 1,413 | 0,199 | 0,327 | 3,753 | 0,126 | 3,724 | 0,087 | 29,873 | 11,400 | 2,600 |