

**LAMPIRAN 4****Hasil Uji Pengembangan (*Swelling*)**

---

- A. Data Pengembangan (*Swelling*) Tiap Variasi
- B. Pengembangan (*Swelling*) Tanah Asli
- C. Pengembangan (*Swelling*) Tanah Asli + 8% Abu Ampas Tebu + 4% Semen
- D. Pengembangan (*Swelling*) Tanah Asli + 8% Abu Ampas Tebu + 6% Semen
- E. Pengembangan (*Swelling*) Tanah Asli + 8% Abu Ampas Tebu + 8% Semen
- F. Grafik Perbandingan Pengembangan ( *Swelling* )



## SWELLING

### A. Data Pengembangan ( *Swelling* ) Tiap Variasi

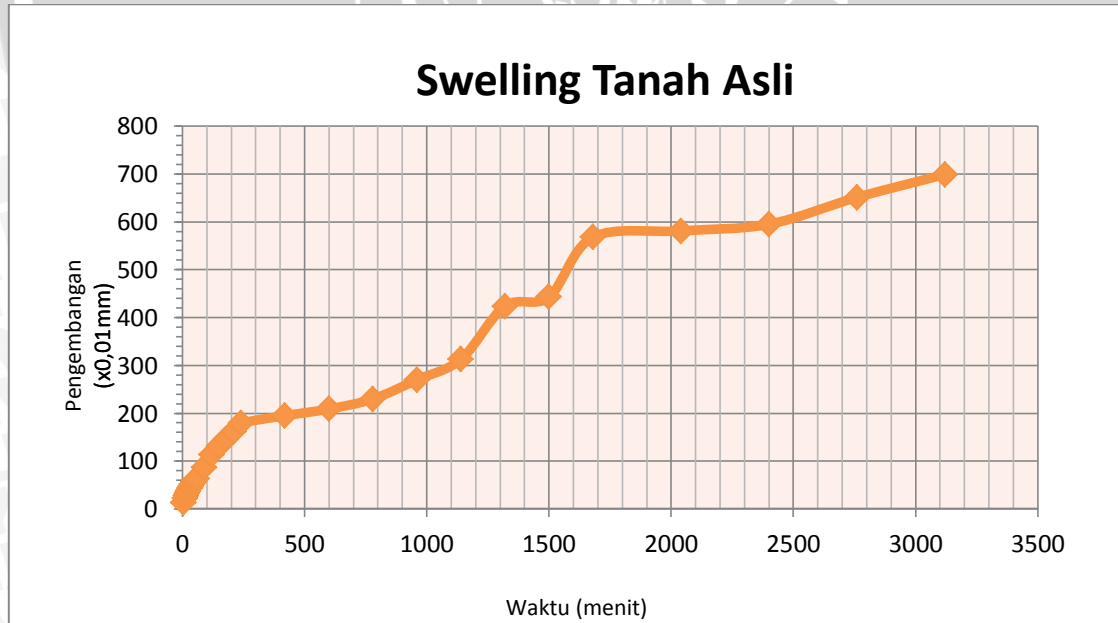
Ht = 113

| Menit | Pengembangan |             |             |             |
|-------|--------------|-------------|-------------|-------------|
|       | Tanah Asli   | 4%ppc+8%aat | 6%ppc+8%aat | 8%ppc+8%aat |
| 5     | 13           | 1.5         | 1           | 1           |
| 10    | 22           | 1.5         | 1.5         | 1           |
| 15    | 28           | 2           | 1.5         | 1           |
| 20    | 34           | 2.5         | 2           | 2           |
| 25    | 38           | 3           | 2           | 2           |
| 30    | 43           | 3           | 3           | 2           |
| 35    | 47           | 3.5         | 3           | 2.5         |
| 40    | 51           | 4           | 3.5         | 3           |
| 45    | 56           | 5           | 4           | 3.5         |
| 50    | 59           | 6.5         | 5.5         | 4           |
| 55    | 61           | 6.5         | 6           | 4.5         |
| 60    | 63           | 7           | 6.5         | 4.5         |
| 90    | 87           | 8           | 7.5         | 5.5         |
| 120   | 114          | 9           | 7.5         | 6           |
| 150   | 132          | 11          | 9           | 6.5         |
| 180   | 146          | 12.5        | 11          | 7           |
| 210   | 162          | 13          | 12          | 7.5         |
| 240   | 179          | 15          | 13.5        | 8           |
| 420   | 195          | 20          | 15          | 10          |
| 600   | 209          | 23          | 17          | 11.5        |
| 780   | 230          | 25          | 18.5        | 13          |
| 960   | 270          | 27.5        | 20          | 15          |
| 1140  | 313          | 29          | 22          | 17          |
| 1320  | 424          | 31.5        | 25          | 18.5        |
| 1500  | 443          | 33          | 27          | 20          |
| 1680  | 568          | 35          | 29          | 22.5        |
| 2040  | 581          | 37.5        | 31.5        | 24          |
| 2400  | 595          | 39          | 33          | 26.5        |
| 2760  | 651          | 41.5        | 35.5        | 29          |
| 3120  | 699          | 43          | 38          | 33          |

| PROSEN PENGEMBANGAN |             |             |             |
|---------------------|-------------|-------------|-------------|
| Tanah Asli          | 4%ppc+8%aat | 6%ppc+8%aat | 8%ppc+8%aat |
| 0.1150              | 0.0133      | 0.0088      | 0.0088      |
| 0.1947              | 0.0133      | 0.0133      | 0.0088      |
| 0.2478              | 0.0177      | 0.0133      | 0.0088      |
| 0.3009              | 0.0221      | 0.0177      | 0.0177      |
| 0.3363              | 0.0265      | 0.0177      | 0.0177      |
| 0.3805              | 0.0265      | 0.0265      | 0.0177      |
| 0.4159              | 0.0310      | 0.0265      | 0.0221      |
| 0.4513              | 0.0354      | 0.0310      | 0.0265      |
| 0.4956              | 0.0442      | 0.0354      | 0.0310      |
| 0.5221              | 0.0575      | 0.0487      | 0.0354      |
| 0.5398              | 0.0575      | 0.0531      | 0.0398      |
| 0.5575              | 0.0619      | 0.0575      | 0.0398      |
| 0.7699              | 0.0708      | 0.0664      | 0.0487      |
| 1.0088              | 0.0796      | 0.0664      | 0.0531      |
| 1.1681              | 0.0973      | 0.0796      | 0.0575      |
| 1.2920              | 0.1106      | 0.0973      | 0.0619      |
| 1.4336              | 0.1150      | 0.1062      | 0.0664      |
| 1.5841              | 0.1327      | 0.1195      | 0.0708      |
| 1.7257              | 0.1770      | 0.1327      | 0.0885      |
| 1.8496              | 0.2035      | 0.1504      | 0.1018      |
| 2.0354              | 0.2212      | 0.1637      | 0.1150      |
| 2.3894              | 0.2434      | 0.1770      | 0.1327      |
| 2.7699              | 0.2566      | 0.1947      | 0.1504      |
| 3.7522              | 0.2788      | 0.2212      | 0.1637      |
| 3.9204              | 0.2920      | 0.2389      | 0.1770      |
| 5.0265              | 0.3097      | 0.2566      | 0.1991      |
| 5.1416              | 0.3319      | 0.2788      | 0.2124      |
| 5.2655              | 0.3451      | 0.2920      | 0.2345      |
| 5.7611              | 0.3673      | 0.3142      | 0.2566      |
| 6.1858              | 0.3805      | 0.3363      | 0.2920      |

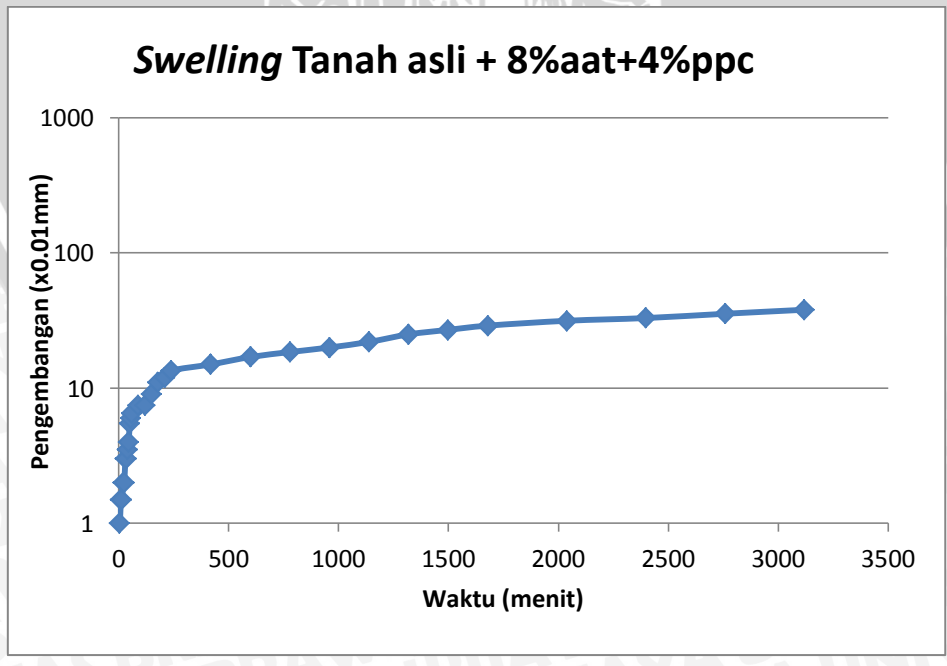
**B. Swelling Tanah Asli**

| Waktu<br>(menit) | Pengembangan<br>(x0,01mm) | Proses Pengembangan<br>(%) | Waktu<br>(menit) | Pengembangan<br>(x0,01mm) | Proses Pengembangan<br>(%) |
|------------------|---------------------------|----------------------------|------------------|---------------------------|----------------------------|
| 5                | 13                        | 0.115                      | 180              | 146                       | 1.292                      |
| 10               | 22                        | 0.195                      | 210              | 162                       | 1.434                      |
| 15               | 28                        | 0.248                      | 240              | 179                       | 1.584                      |
| 20               | 34                        | 0.301                      | 420              | 195                       | 1.726                      |
| 25               | 38                        | 0.336                      | 600              | 209                       | 1.850                      |
| 30               | 43                        | 0.381                      | 780              | 230                       | 2.035                      |
| 35               | 47                        | 0.416                      | 960              | 270                       | 2.389                      |
| 40               | 51                        | 0.451                      | 1140             | 313                       | 2.770                      |
| 45               | 56                        | 0.496                      | 1320             | 424                       | 3.752                      |
| 50               | 59                        | 0.522                      | 1500             | 443                       | 3.920                      |
| 55               | 61                        | 0.540                      | 1680             | 568                       | 5.027                      |
| 60               | 63                        | 0.558                      | 2040             | 581                       | 5.142                      |
| 90               | 87                        | 0.770                      | 2400             | 595                       | 5.265                      |
| 120              | 114                       | 1.009                      | 2760             | 651                       | 5.761                      |
| 150              | 132                       | 1.168                      | 3120             | 699                       | 6.186                      |



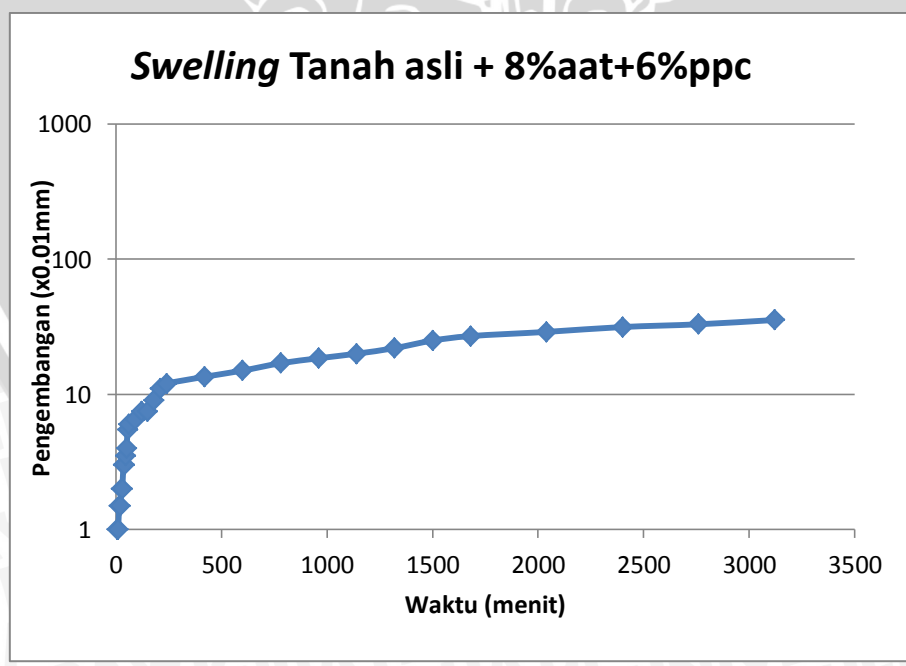
**C. Swelling Tanah Asli + 8% AAT + 4% PPC**

| Waktu (menit) | Pengembangan (x0,01mm) | Proses Pengembangan (%) | Waktu (menit) | Pengembangan (x0,01mm) | Proses Pengembangan (%) |
|---------------|------------------------|-------------------------|---------------|------------------------|-------------------------|
| 5             | 1.5                    | 0.013                   | 180           | 12.5                   | 0.111                   |
| 10            | 1.5                    | 0.013                   | 210           | 13                     | 0.115                   |
| 15            | 2                      | 0.018                   | 240           | 15                     | 0.133                   |
| 20            | 2.5                    | 0.022                   | 420           | 20                     | 0.177                   |
| 25            | 3                      | 0.027                   | 600           | 23                     | 0.204                   |
| 30            | 3                      | 0.027                   | 780           | 25                     | 0.221                   |
| 35            | 3.5                    | 0.031                   | 960           | 27.5                   | 0.243                   |
| 40            | 4                      | 0.035                   | 1140          | 29                     | 0.257                   |
| 45            | 5                      | 0.044                   | 1320          | 31.5                   | 0.279                   |
| 50            | 6.5                    | 0.058                   | 1500          | 33                     | 0.292                   |
| 55            | 6.5                    | 0.058                   | 1680          | 35                     | 0.310                   |
| 60            | 7                      | 0.062                   | 2040          | 37.5                   | 0.332                   |
| 90            | 8                      | 0.071                   | 2400          | 39                     | 0.345                   |
| 120           | 9                      | 0.080                   | 2760          | 41.5                   | 0.367                   |
| 150           | 11                     | 0.097                   | 3120          | 43                     | 0.381                   |



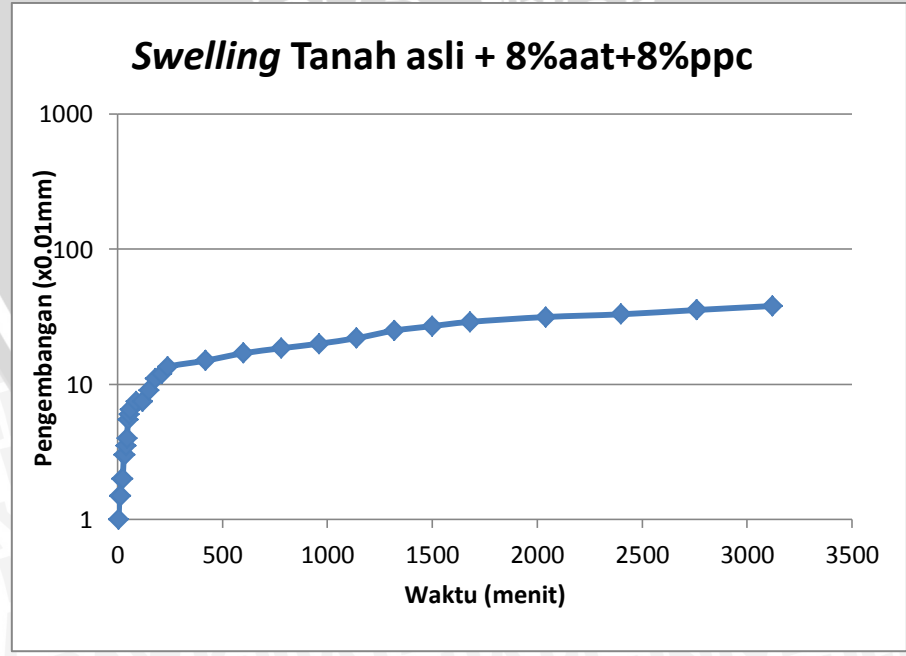
**D. Swelling Tanah Asli + 8% AAT + 6% PPC**

| Waktu (menit) | Pengembangan (x0,01mm) | Proses Pengembangan (%) | Waktu (menit) | Pengembangan (x0,01mm) | Proses Pengembangan (%) |
|---------------|------------------------|-------------------------|---------------|------------------------|-------------------------|
| 5             | 1                      | 0.009                   | 180           | 11                     | 0.097                   |
| 10            | 1.5                    | 0.013                   | 210           | 12                     | 0.106                   |
| 15            | 1.5                    | 0.013                   | 240           | 13.5                   | 0.119                   |
| 20            | 2                      | 0.018                   | 420           | 15                     | 0.133                   |
| 25            | 2                      | 0.018                   | 600           | 17                     | 0.150                   |
| 30            | 3                      | 0.027                   | 780           | 18.5                   | 0.164                   |
| 35            | 3                      | 0.027                   | 960           | 20                     | 0.177                   |
| 40            | 3.5                    | 0.031                   | 1140          | 22                     | 0.195                   |
| 45            | 4                      | 0.035                   | 1320          | 25                     | 0.221                   |
| 50            | 5.5                    | 0.049                   | 1500          | 27                     | 0.239                   |
| 55            | 6                      | 0.053                   | 1680          | 29                     | 0.257                   |
| 60            | 6.5                    | 0.058                   | 2040          | 31.5                   | 0.279                   |
| 90            | 7.5                    | 0.066                   | 2400          | 33                     | 0.292                   |
| 120           | 7.5                    | 0.066                   | 2760          | 35.5                   | 0.314                   |
| 150           | 9                      | 0.080                   | 3120          | 38                     | 0.336                   |



**E. Swelling Tanah Asli + 8% AAT + 8 % PPC**

| Waktu (menit) | Pengembangan (x0,01mm) | Proses Pengembangan (%) | Waktu (menit) | Pengembangan (x0,01mm) | Proses Pengembangan (%) |
|---------------|------------------------|-------------------------|---------------|------------------------|-------------------------|
| 5             | 1                      | 0.009                   | 180           | 7                      | 0.062                   |
| 10            | 1                      | 0.009                   | 210           | 7.5                    | 0.066                   |
| 15            | 1                      | 0.009                   | 240           | 8                      | 0.071                   |
| 20            | 2                      | 0.018                   | 420           | 10                     | 0.088                   |
| 25            | 2                      | 0.018                   | 600           | 11.5                   | 0.102                   |
| 30            | 2                      | 0.018                   | 780           | 13                     | 0.115                   |
| 35            | 2.5                    | 0.022                   | 960           | 15                     | 0.133                   |
| 40            | 3                      | 0.027                   | 1140          | 17                     | 0.150                   |
| 45            | 3.5                    | 0.031                   | 1320          | 18.5                   | 0.164                   |
| 50            | 4                      | 0.035                   | 1500          | 20                     | 0.177                   |
| 55            | 4.5                    | 0.040                   | 1680          | 22.5                   | 0.199                   |
| 60            | 4.5                    | 0.040                   | 2040          | 24                     | 0.212                   |
| 90            | 5.5                    | 0.049                   | 2400          | 26.5                   | 0.235                   |
| 120           | 6                      | 0.053                   | 2760          | 29                     | 0.257                   |
| 150           | 6.5                    | 0.058                   | 3120          | 33                     | 0.292                   |



### F. Grafik Perbandingan Pengembangan ( Swelling )

