Characteristic Asphalt Concrete Wearing Course (ACWC) Using Variation Lime Filler

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Abstract. This research uses lime filler Sukaraja expected to add durability layers of concrete pavement is asphalt damage caused by the weather and load traffic. This study attempts to know how much value characteristic Marshall on a mixture of concrete asphalt using lime filler. This research uses experimental methods that is with a pilot to get results, thus will look filler utilization lime on construction concrete asphalt variation in filler levels 2 %, 3 %, 4 %. The results showed that the use of lime filler will affect characteristic a mixture of concrete asphalt. The more filler chalk used to increase the value of stability. On the cretaceous filler 2 % value of stability is 1067.04 kg. When lime filler levels added to the levels of filler 4 %, the value of stability increased to 1213.92 kg. The flexibility increased the number of filler as levels lime 2 % to 4 % suggests that are conducted more stiff mix.

1. Introduction

Asphalt Concrete is one type of layers construction for flexible pavement. A mixture of Asphalt Concrete consisted of Coarse aggregate, Fine aggregate, Filler, and by using asphalt as a belt. Filler commonly called filler material can be obtained from the breakdown of rocks naturally or artificially. Filler commonly used is the type of stone dust filler.

One of the filler used is lime extinguished (hydrated lime). Lime is one of the mineral much used by the industrial sector or construction and farm, among others to building materials, stabilization highway material, Lime for agriculture. Physically lime is a body white and fine. A starter lime is limestone. Limestone containing calcium carbonate (CaCO₃), the chemical or the properties of materials a base containing lime is different from one place to another. Even in one place is not necessarily same. Lime is economically since their prices cheap. Limestone used as filler in this research obtained from the results of villagers Sukapura mining in Sukaraja, West Java.

According to Peter E. Sebaaly (2006) [6], The advantages use of lime out as filler in concrete pavement in Hot Mix Asphalt include:

1. Improving the survival of concrete pavement is asphalt against exfoliation stripping the water.
2. Reduce or hinder oxidizing asphalt process.
3. Fix the properties of mechanical mixture as resistance against grooves (rutting) and exhaustion (fatigue) on asphalt pavement.
4. Leveraging performance a mixture of asphalt concrete by raising a bond between the asphalt and aggregate.

Hence and attempted to do something research on the use of lime as filler on a mixture of Asphalt Concrete a surface coating especially a kind ACWC. To research will be emphasises the
extent to which the influence of variation lime filler levels characteristic mixture of Asphalt Concrete, which in turn can be seen characteristic mixed with respect to changes filler the cretaceous levels, and it is expected that the lime can be used as a alternative filler in highway construction. This report aims to review the influence of the use of variation lime filler levels to characteristic a mixture of Asphalt Concrete (ACWC).

2. Experimental

The research method are arranged to give easy in the implementation of the research so that a walk more precise, effective, and efficient. Testing Course aggregate use of broken stone in a dry state. The Fine Aggregate, worn materials that sharp surface, and clean of dirtyes or other unwanted materials. The fine aggregate composed of sand clean, fine materials the breakdown of stone or combination of them in a dry state. Asphalt used in this study asphalt type Asphalt Penetration 60/70.

Before held mixing so gradations mix to be used should be determined first. Filler used is lime with variation lime 2 %, 3 %, and 4 % to the total aggregate. Estimates the asphalt in a mixture of the asphalt steady estimated by means of determined steady empirically with the equation ( Pb) as follows:

\[ Pb = 0.035 \times CA + 0.045 \times FA + 0.18 \times \text{filler} + K \]  

Description :

CA = Percent aggregate suspended sieve no.8
FA = Aggregate escaped sieve no.8 and suspended sieve no.200
filler = percent aggregat at least 75 % escaped no.200
k = constant (0.5 - 1.0) to laston

The matrix sample of done systematically with recording all data resulting from series of testing from start to finish with still consider validation data collected. The determination of Optimum Asphalt Content determination of asphalt levels steady using charts by plotting the values characteristic of the results of the Marshall Testing.

3. Results and Discussion

3.1. The Result Testing Materials

| No. | Testing       | Result Testing | Specification | Unit |
|-----|---------------|----------------|---------------|------|
| 1   | Specific Gravity | 1.75          | -             | gr/cc |
Table 2. Characteristic of Marshall

| Lime %  | Asphalt Contents (%) |
|--------|----------------------|
| 4.5    | 5.0                  |
| 5.5    | 6.0                  |
| 6.5    | 7.0                  |
| 7.5    | 8.0                  |

| Density | 2 | 2.177 | 2.223 | 2.272 | 2.290 | 2.304 | 2.308 | 2.314 | 2.310 |
|---------|---|-------|-------|-------|-------|-------|-------|-------|-------|
| 3       | 2.199 | 2.234 | 2.298 | 2.308 | 2.317 | 2.323 | 2.325 | 2.326 |
| 4       | 2.214 | 2.267 | 2.321 | 2.331 | 2.330 | 2.331 | 2.340 | 2.340 |

| VMA     | 2 | 20.568 | 19.289 | 17.912 | 17.648 | 17.525 | 17.762 | 17.924 | 18.455 |
|---------|---|--------|--------|--------|--------|--------|--------|--------|--------|
| 3       | 19.516 | 18.611 | 16.664 | 16.697 | 16.788 | 16.945 | 17.269 | 17.600 |
| 4       | 18.703 | 17.143 | 15.582 | 15.617 | 16.061 | 16.413 | 16.458 | 16.861 |

| VITM    | 2 | 13.049 | 10.655 | 8.070  | 6.733  | 5.537 | 4.781 | 3.931 | 3.507 |
|---------|---|--------|--------|--------|--------|-------|-------|-------|-------|
| 3       | 11.918 | 9.888  | 6.960  | 5.673  | 4.708  | 3.848 | 3.174 | 2.545 |
| 4       | 11.051 | 8.284  | 5.499  | 4.469  | 3.932  | 3.288 | 2.280 | 1.683 |

| VFWA    | 2 | 36.565 | 44.997 | 55.057 | 61.840 | 68.406 | 73.088 | 78.090 | 81.000 |
|---------|---|--------|--------|--------|--------|--------|--------|--------|--------|
| 3       | 38.941 | 46.872 | 59.880 | 66.053 | 71.967 | 77.290 | 81.619 | 85.551 |
| 4       | 40.929 | 51.838 | 64.735 | 71.387 | 75.524 | 79.968 | 86.153 | 90.022 |

| Stability | 2 | 876.960 | 941.760 | 997.920 | 1067.040 | 1045.440 | 1041.120 | 920.160 | 773.280 |
|-----------|---|---------|---------|---------|----------|----------|----------|---------|---------|
| 3       | 924.480 | 1062.720 | 1144.800 | 1200.960 | 1166.400 | 1054.080 | 924.480 | 799.200 |
| 4       | 928.800 | 1067.040 | 1157.760 | 1213.920 | 1175.040 | 1062.720 | 933.120 | 812.160 |

| Flow     | 2 | 3.600  | 3.733  | 3.800  | 3.873  | 3.930  | 3.997  | 4.190  | 4.430  |
|----------|---|--------|--------|--------|--------|-------|-------|-------|-------|
| 3       | 3.480 | 3.593  | 3.657  | 3.727  | 3.807  | 3.987  | 4.107  | 4.217  |
| 4       | 3.273 | 3.313  | 3.400  | 3.637  | 3.700  | 3.817  | 3.923  | 4.130  |

3.2. The relationship between Lime Filler Content of Hot Mix Asphalt

3.2.1. Density. With the additional Lime Filler content into a mixture of accompanied by increasing the Asphalt in a mixture indicated can raise the density of a mixture of Asphalt Concrete. The main cause to high density is mineral content delicate in this Lime Filler on a mixture of that makes density aggregate bituminous between with a high and cause of the nature of interlocking particles aggregate with increase asphalt.

![Figure 1](chart.png)

Figure 1. Chart The relationship of Lime Filler Content with Density

3.2.2. Void in The Mix (VITM). Void in the Mix is the percentage of air cavities in a mix of the aggregate and asphalt through compaction. The testing suggests that additional lime into the mix likely to cause value VITM decline. This happened because cavity is occupied by more filler.
3.2.3. **Void in Mineral Aggregate (VMA).** VMA is the percentage cavity is between the aggregate in a mixture of Asphalt Concrete expressed in (%) against the volume of a mixture of Asphalt Concrete. VMA tend to decrease far lime filler content. This happened because the lime filler content make space available to accommodate the volume of asphalt and volume air cavities required in a mixture of the less.

3.2.4. **Void Filled With Asphalt (VFWA).** VFWA is cavity unfilled asphalt on a mixture of after being process density expressed in percent against the grain aggregate cavity (VMA). Factors that can affect VFWA include the asphalt, gradations aggregate, compaction energy, and heating asphalt. From the testing suggests that value VFWA tend to increase in line with the number of lime filler content. This happened because lime filler content is absorb asphalt and fill a more cavity.
3.2.5. *Stability*. Stability is capability pavement layers receives the load traffic without changed a fixed form (permanent deformation) wavelike, rutting, and experienced bleeding. The value of stability influenced by asphalt cohesion, the asphalt content, internal friction, the nature of interlocking of aggregate particles, shape and texture surface and aggregate gradations. From the testing suggests that the stability obtained tend to increased by adding lime filler content.

![Figure 5. The relationship of Lime Filler Content with Stability](image)

3.2.6. *Flow*. Flow been the large deformation that happened one another pavement due to the traffic. From the tests showed that the more lime filler content on a mixture of asphalt concrete this value flow the less. This happened because the lime filler content created a cocktail be meeting that deformation due to the reduced.

![Figure 6. Chart The relationship of Lime Filler Content with Flow](image)

3.2.7. *Marshall Quotient (MQ)*. Marshall Quotient (MQ) is the result for between stability and flow. The value MQ is The mixed flexibility suggests that is the value MQ on a mixture of the more stiff the mix, similarly if the less value MQ so the malleability and plastisitas mix will be bigger. From the testing suggests that value mq tends to be up along with increasing lime filler content. This hapened because the lime filler content created a cocktail into a solid and rigid. It can be seen from the form of a curve open down so it can be additional lime filler content too high, MQ value could reduce, because it reduces cohesion between asphalt and aggregate.
Figure 7. Chart The relationship of Lime Filler Content with Marshall Quotient (MQ)

4. Conclusion
   Based on results and analysis characteristic a mixture of asphalt concrete ACWC using variation lime filler content indicated increasing a mixture of asphalt concrete ACWC expressed in characteristic as follows:
   1. Stability in mixture of using lime filler lime tend to increased receive an steady then fell. Stability highest levels of asphalt finish in 6 % with lime filler 4 %.
   2. The value of mix fleksibility expressed in the Marshall Quotient (MQ), suggests that value tend to increases the rising lime filler content into a mixture of asphalt concrete. The research obtained that mix will be more stiff worth MQ that tends to increases the rising variation lime filler into the mix.

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