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Preloved Clothes Fiber, As a Filler Material for Flexible Pavement

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Abstract: Clothing is one of the basic human needs, but clothing waste is currently increasingly accumulating due to the fast fashion trend due to the consumer lifestyle in society. Until now there has been no proper handling of clothing waste so it is just thrown away without further processing and pollutes rivers and seas. Realizing the massive impact that can be generated from clothing waste, it is necessary to use it to manage clothing waste into a useful material, one of which is by using used clothing fibers as a mixture for making hot mix for flexible pavement. The method used in this experiment uses the bina method. genus in 2010 by comparing the VIM, VMA and VFA values of the hot mix asphalt mixture which was added to sample 1 by adding used clothing ash (2%), sample 2 by adding used clothing fiber (2%) and sample 3 without the same addition. very. From the results of this experiment, it was found that for the volumetric requirements of the mixture based on the 2010 Bina Marga specifications, flexible pavement mixtures with the addition of used clothing fibers cannot meet the VIM indicators of 3.5-5%, VMA of at least 15% and VFA of at least 65%. This type of mixture can only be used as road pavement with low traffic flow for environmental roads, residential roads or village roads.

Keywords: Preloved clothes, Filler, Flexible Pavement

INTRODUCTION

Clothing is one of the basic human needs, but clothing waste is currently increasingly accumulating due to the fast fashion trend due to the consumer lifestyle in society. Until now there has been no proper handling of clothing waste so it is just thrown away without any further processing and pollutes rivers and the sea. Realizing the massive impact that can be generated from clothing waste, it is necessary to use it to manage clothing waste into useful materials, one of which is by using used clothing fibers as a mixture for making hot-mix asphalt.

Currently in Indonesia, most of the road infrastructure still uses flexible pavement. Asphalt is one of the materials used in road infrastructure, where this asphalt has the advantage of comfort for road users with flexible pavement construction. The choice of Flexible Pavement mixture material must be in accordance with ASTM (American Standard Testing and Material). The quality of the asphalt and the suitability of the good aggregate gradation really determine the quality of Flexible Pavement construction.

Apart from reducing used clothing waste, this research also aims to determine the effect of using used clothing fibers on the quality of hot-mix asphalt which can be seen from the durability of road pavement mixed with used clothing fibers against shifting, asphalt durability, flexibility, and the strength of the asphalt pavement to accept repeated deflections from vehicle load, shear resistance for anti-slip ability on road pavement and water resistance.

Indah Marlina Ardianti, et all (2018), stated that the Optimum Asphalt Level (KAO) of Jaya Aspal Polymer modified asphalt was 5.8%, while the penetration type of 60/70 asphalt was 6.3%. The characteristic score for a 60/70 penetration asphalt mixture will be smaller than an asphalt mixture that has been modified by adding additional ingredients, namely Taftpack-Super, while the stability and Marshall Question (MQ) scores for 60/70 penetration asphalt tend to be higher than Jaya Aspal Polymer. The highest mixture stability score is the KAO asphalt mixture with asphalt penetration of 60/70 by adding Taftpack-Super10%, namely 2017.864 Kg with a solidity score of 2.259.

Eka Hadi et all (2014), The addition of Sasobit to the asphalt mixture increases the stability value, reduces the percentage of asphalt used, and reduces exhaust emissions resulting from the asphalt mixing process. However, mixtures with the addition of Sasobit also have disadvantages in that the mixture becomes stiffer and harder so it can be more susceptible to damage due to cracking when compared to mixtures without Sasobit.

METHODOLOGY

Volumetric Asphalt Mixture

Volumetric asphalt mixture is the volume of the mixed test object that has gone through the compaction process. The components of the asphalt mixture consist of the volume of voids between minerals (VMA), the bulk volume of the solid mixture, the volume of the solid mixture without voids, the volume of voids filled with asphalt (VFA), the volume of voids in the mixture (VIM), the volume of asphalt absorbed by the aggregate.

1. Void In Mix (VIM)

Void In Mix (VIM) is the total volume of air that is between the aggregate particles covered in asphalt in a mixture that has been compacted, and is expressed in percent of the bulk volume (Puslitbang, 2000). Void In Mix or also called voids in the mixture are used to determine the size mixed voids in percent. The resulting air voids are determined by the arrangement of the aggregate particles in the mixture and the non-uniformity of the aggregate shape.

$$\mathbf{VIM = 100 \times \frac{Gmm - Gmb}{Gmm}}$$

2. Void In Mineral Aggregate (VMA)

It is a cavity between aggregate grains in an asphalt mixture that has been compacted and the effective asphalt is expressed as a percentage of the total volume of the mixture. Continuously graded aggregates provide small voids between VMA granules and produce high stability but cause damage. The definition of VMA based on Puslitbang, 2000 is the volume of voids between the aggregate particles of a mixture that has been compacted, expressed as a percent of the total volume of the test object. To find out VMA in a mixture visually is difficult because the mixing process has occurred, so it can only be calculated using an equation to find the VMA value.

$$\mathbf{VMA = 100 - \frac{Gmb}{GSB} \times 100\ (100 + pb) \times 100}$$

This VMA value can be visualized by the condition of a transparent tube vessel filled with aggregate with a size of 12.5 mm to 4.75 mm, then continued by filling the fine aggregate with a filter below 4.75 mm up to a sieve of 0.0075 mm in the form of fine aggregate. and stone ash and also filler.

3. Void In Filled with Asphalt (VFA)

According to the Research and Development Center, 2000, the definition of VFA is the part of the cavity between mineral aggregates (VMA) which is filled with effective asphalt expressed in percent.

And in general, according to Silvia Sukirman, 1999, voids filled with asphalt mixture are the percentage of voids between VMA aggregate particles that are filled with asphalt, but do not include asphalt absorbed by the aggregate. To get the VFA value, the following equation is determined:

$$VFA = \frac{100\ (VMA - VIM)}{Gmm}$$

RESULT AND DISCUSSION

Table 1. shows the comparison of the amount of coarse aggregate, fine aggregate and also the asphalt content used in the mixture, where the addition of used clothing ash and used clothing fiber was added to 2% of the total mixture in each sample, namely 26 grams. The materials used are pictured in figure 1.

Tabel 1. Asphalt and aggregate content in the mixture

Sampel	Nilai Pb	Aspahlt	Coarse Agregat	Sand Agregat
Sampel 1	14.4883	167.8596	691.534068	340.606332
Sampel 2	14.4883	173.8596	687.514068	338.626332
Sampel 3	14.4883	179.8596	683.494068	336.646332

Figure 1. Coarse Agregat, Sand Agregat, preloved clothes Ash and Preloved Clothes Fiber

Moreover, after conducting series of laboratory tests, the figure 2 shows the brikets after been tested. While the results of the calculation tests, the VMA, VFA and VIM values for each mixture were obtained as shown in table 2 below.

Figure 2. Bricket after Marshal Test

Tabel 2. VMA, VFA and VIM values from sample testing results

No. Benda Uji		1 (Preloved clothes ash 2%)	2 (Preloved clothes fiber 2%)	3 (no additional ingredients)
a.	% asphalt to aggregate	14.48	14.48	14.48
b.	% asphalt to the mixture	13.99	14.49	14.99
c.	% Void In Filled with Asphalt (VFA)	96.170	95.548	95.075
d.	% voids in mineral aggregate (VMA)	14.545	15.163	15.765
e.	% voids in mixture (VIM)	10.057	8.582	7.721
f	Stability (with test sample correction)	668.00	853.00	775.00
g	Flow	29.00	81.00	2.00
h	Marshall Quotient	23.03	10.53	387.50

1. Void In Mix (VIM)

The percent VIM requirement value is determined based on the type of surface layer chosen if used for the Asphalt Concrete (AC) layer or commonly known as asphalt concrete, the VIM value is between 3.5 to 5%, this requirement is based on Bina Marga 2010. The results obtained from testing of 3 samples shows that the VIM value of the three samples is above 5%, namely between 7-10%, so that the air voids as an indicator of the durability of the asphalt mixture are greater than required. Air cavities in the mixture that are too small can cause bleeding. The smaller the air cavities, the more impermeable the asphalt mixture will be to water, but air cannot enter the asphalt layer so the asphalt becomes brittle and brittle. The larger the air cavity and the lower asphalt content will result in fatigue more quickly.

2. Void In Mineral Aggregate (VMA)

According to Bina Marga 2010, the minimum VMA value required is 15%. The VMA value of the three samples tested was less than 15%, namely between 14 and 15%. The VMA value will increase along with the increase in asphalt cover or open graded aggregate used. From this mixing there are cavities between minerals that are not filled, these cavities are called cavities between aggregate grains in the mixture. This asphalt mixture will easily come off so this layer is not watertight, oxidation easily occurs and the pavement layer becomes damaged.

3. Void In Filled with Asphalt (VFA)

The VFA from the experimental results ranges from 95 to 96 percent of the voids between the VMA aggregate particles which are filled with asphalt, but does not include the asphalt absorbed by the aggregate. The minimum VFA value included in the 2010 Bina Marga requirements is 65%, this is due to the even gradation and can be filled with asphalt.

4. Stability, Flow dan Marshall Quotient

The stability test results obtained were > 800 kg for samples with the addition of used clothing fibers, and the other 2 samples did not meet the stability requirements, while for the Flow value all samples were > 2, so they met the requirements. From the calculation results for the MQ (Marshall quotient) value, only sample 3 (no addition of other ingredients) met the requirements because the results were above the requirement of 200 kg.

CONCLUSION

1. For the volumetric mix requirements based on the 2010 Bina Marga specifications, flexible pavement mixes with the addition of used clothing fibers cannot meet the VIM indicators of 3.5-5%, VMA of at least 15% and VFA of at least 65%.
2. This type of mixture can only be used as road pavement with low traffic flow for environmental roads, residential roads or village roads.

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