A STUDY ON THE UTILIZATION OF RED BRICK WASTE AS FILLER ON ASPHALT CONCRETE AC-WC

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ABSTRACT: Asphalt concrete is a type of road pavement that consists of coarse aggregate, medium aggregate, fine aggregate, asphalt, and filler. This research utilizes red brick waste from the demolition remains of unused construction building as filler with a maximum grain size of 0.074 mm. The purpose of this research is to discover the effect of red brick waste as filler towards asphalt concrete density and Marshall test parameter result. The method used in this research is an experimental study of AC-WC asphalt concrete using filler made of red bricks. Based on density test and Marshall test with immersion time between 30 minutes to 24 hours, the result shows that density value experiences an increase from 2.344 to 2.441, while VMA value experiences a decrease from 17.692 to 17.369, VFA value experiences an increase from 77.567 to 79.330, VIM value experiences a decrease from 3.652 to 3.576, stability value experiences a decrease from 1093.220 to 1002.763, flow value experiences a decrease from 4.467 to 3.800 and Marshall quotient experiences an increase from 244.720 to 265.863. Based on the test results, it can be concluded that the value obtained is still above the AC-WC asphalt specification minimum value. Therefore, red bricks can be used as filler for AC-WC asphalt concrete mixture.

Keywords: AC-WC, Concrete Asphalt, Filler, Red Brick.

1. Introduction

There are several important factors that must be considered from asphalt mixtures, out of which are the ability to withstand loads without experiencing damage (stability), the ability to last without suffering decay over service time (durability), flexibility, endurance towards weariness (fatigue resistance), surface agitation or shear resistance, waterproofness, and workability. One of the factors that influence the quality of asphalt mixtures is the filler material that has a function to fill pores. On industries focusing on highway constructions (asphalt mixing plant) generally use filler materials that are easier to obtain, more economic, and are able to support the mechanical characteristic of the asphalt concrete mix. According to the acting regulations that fillers are made out of cements, from the explanations given above, this research attempts to discover the use of red brick waste as a filler material. The main reason why this research chooses to use red brick waste as a filler material is due to it being easier to access, such as from the remains of demolished old building or production-defective red bricks.

The reviews performed in this research are studies regarding previous research and experimental research that have been carried out in the Construction Material Laboratory of Civil Engineering of National Institute of Technology (ITN) Malang. Experimental tests that are carried out comprise of material tests towards asphalt, filler (red brick), fine aggregate, medium aggregate, and coarse aggregate. Based on test data of asphalt mixture constituent material, a design for asphalt mixture composition using red brick filler is made. After mixture design is available, the next thing to do is to construct a cylindrical test object with a diameter of 10 cm and thickness of 5 cm where samples made after frying are compressed with bituminious compactor apparatus with collision amount set to 2 x 75, then test object is left for 24 hours. The test performed here will be density test and Marshall test.

According to density test and Marshall test with immersion time between 30 minutes to 24 hours, the result shows that density value experiences an increase from 2.344 to 2.441, while VMA value experiences a decrease from 17.692 to 17.369, VFA value experiences an increase from 77.567 to 79.330, VIM value experiences a decrease from 3.652 to 3.576, stability value experiences a decrease from 1093.220 to 1002.763, flow value experiences a decrease from 4.467 to 3.800 and Marshall quotient experiences an increase from 244.720 to 265.863. Based on the test results, it can be concluded that the value obtained is still above the AC-WC asphalt specification minimum value. Therefore, red bricks can be used as filler for AC-WC asphalt concrete mixture. Through knowledge and technology transfer (KTT), in the future, the result of this research would be applied as guidance regarding the utilizing of red brick waste since the KTT is considered as a shortcut to improve technology capability (Handoko et al, 2014; 2016; 2017;2017).

2. Literature Review

According to research carried out regarding HRS – WC mixture with a standard filler substitution made of baked clay originating from Gunung Sarik in Padang, it is concluded that the asphalted mixture made has fulfilled the road pavement specification qualification (Adibroto, 2014). Research using marble waste as a filler indicates that on a 100% marble concentration level, VIM level increased from 4.5% to 4.8%, flow value increased from 3,5 mm to 3.7 mm, VMA value increased from 15.8% to 15.9%, VFB value increased from 70% to 71%. Stability value decreased from 2040 kg to 1840 kg. The results of refusal density test of asphalt mixture on KAO are 3.15% (0% marble waste), 3.40% (50% marble waste), and 96.65% (100 marble waste) with a minimum requirement of 75%. The durability value of Asphalt Concrete – Binder Course (AC – BC) on KAO are 98.20% (0% marble waste), 97.95% (50% marble waste), and 96.65% (100% marble waste) with a minimum requirement of 75% (Zulkifli et al, 2009). Marshall immersion using filler comprised of 1% coconut shell charcoal powder added with 1% husk ash and 5% stone ash shows the results of Retained Strength Index (RSI) to be 90.29%, stability value for the 30-minute immersion to be 1380 kg and the 24-hour immersion to be 1246 kg. Based on the test results, on general, it can be concluded that the use of filler made of 1% coconut shell charcoal poder added with 1% husk ash and 5% stone ash in AC - WC mixture indicates to be a well-performing mixture (Zulfikar et al, 2013).

The production of asphalt concrete coat (Laston) serves a purpose to obtain a form of surface layers or binders on road pavements that are able to provide measurable carrying capacity as well as waterproof coating layers that can protect the constructions underneath. Asphalt concrete is a type of road pavement that consists of aggregates and asphalts, with or without added materials. Asphalt concrete layers are the topmost type of pavement which are a mixture of bitumens along with uniformly graded aggregates and are suitable for roads that are passed by heavy vehicles. Asphalt concrete must have several characteristics in the process of mixture, which are stability, durability, flexibility, fatigue resistance, surface agitation or shear resistance, waterproofness, and workability. These 7 asphalt concrete characteristics can never be fulfilled by only one type of mixture.

2.1 Aggregate

Coarse aggregates which have rounded grains are easier to condense but have lower stability level, as for the angular shaped grains, they are harder to condense but have higher stability level. Coarse aggregates must be able to withstand abrasion when they are used as wearing course mixture, and for that Los Angeles Abration test value has to be fulfilled. Fine aggregates are aggregates having grain size smaller than No. 8 filter (2.36 mm). These aggregates can increase mixture stability through grain interlocking, fine aggregates can also fill in the voids between the grains. These materials can consist of fragmented stone grains, or natural sands, or a mixture of both.

2.2 Filler

Filler are extremely fine materials, which are minimum 75% of what passes No. 200 filler (0.074). In practices, the function of fillers is to increase the viscocity of asphalts and to reduce sensitivity towards temperature. Increasing the filler composition in a mixture will result in the increase of mixture stability but also in the decrease of void air concentration (air cavities). Thereby, the composition of filler in a mixture is limited to 4 – 10% of total asphalt concrete weight, because if the concentration of filler in a mixture is too high, this will cause the mixture to get brittle and crack upon receiving traffic weight load. But, if the filler concentration is too low, then this will cause the mixture to get soft on a hot weather.

3. Research Methods

The design for this research is made to prepare for future research, which means that in the implementation of this research is in accordance with what is initially planned. The design for this research is grouped into two stages, namely literature study and experimental study.

For research needs of both experiment analysis and the overall study, several materials are needed, which are:

a. Fine Aggregate: Lumajang sands (Selok Awar – awar Village, Pasirian District, Lumajang Regency)
b. Medium Aggregate: Dampol, Benerwojo Village, Kejayan District, Pasuruan Regency (PT. Multi Razulka Sakti, Bululawang, Malang)
c. Coarse Aggregate: Dampol, Benerwojo Village, Kejayan District, Pasuruan Regency (PT. Multi Razulka Sakti, Bululawang, Malang)
d. Asphalt: Penetration Graded Asphalt 60/70 (PT. Pertamina)
e. Filler: Red brick waste (Demolition remains on lecture class building and hotspot area of ITN Malang)

4. Result and Discussion

Determining the optimum asphalt is to establish the effective asphalt concentration needed in a mixture to make test objects. This is decided from the parameters of VMA, VIM, stability, flow, and MQ tests that fulfill the standard requirements for a mixture. This section consists of analysis and interpretation or discussion of analysis. The test result on asphalt concentration spans that are tested from 5% to 7%. Therefore, the optimum asphalt concentration in an asphalt concrete mixture for this research is 6.04% ≈ 6%.

4.1 Analysis of Red Brick Waste Usage for Filler Towards Concrete Asphalt Density

Void in Mineral Agregate (VMA) is the cavity between aggregate grains in asphalt mixture that has been condensed as well as the effective asphalt stated in total mixture volume percentage. Void in Mix (VIM) is the total air volume present among aggregate particles that are covered in asphalt in a condensed mixture, and are stated in bulk volume percentage. Based on the test result, it can be concluded that the usage of red brick waste can an impact towards the asphalt concrete density value with a decrease in VMA and VIM percentage value. The VMA value with red brick waste filler on test object immersion time between 30 minutes and 24 hours, respectively, are 17.692% and 17.369%. While the VIM value with red brick waste filler on test object immersion between 30 minutes and 24 hours, respectively, are 3.952% and 3.576%. This proves that the presence of red brick waste filler in an asphalt concrete mixture can affect the air cavity level to decrease and the density to increase.

4.2 Analysis of Red Brick Ash Waste Usage for Filler towards Marshall Parameter Test

Test object with immersion time of 30 minutes and 24 hours have stability value of, respectively, 1093.220 kg and 1002.763 kg. The stability value of this asphalt concrete mixture shows to have met the minimum standard of 800 kg. As for flow test with immersion time of 30 minutes and 24 hours, shows a result of, respectively, 4.467 mm and 3.80 mm. This flow value of asphalt concrete mixture is corresponding to the minimum standard limit of 3 mm. Marshall Quetient (MQ) is the division of stability test with flow test of the asphalt concrete mixture. As a result, the MQ value with immersion time of 30 minutes and 24 hours are, respectively, 244.720 kg/mm and 265.863 kg/mm. The standard MQ value is 200 kg/mm, which means the MQ value on this test meets the standard. Marshall parameter test performed on the asphalt concrete mixture shows that the red brick ash waste filler indicates several positive influence towards the performance or capacity of the mixture.

5. Conclusion

Based on the performed research, several conclusions can be made:

- The waste from red bricks can be used as filler for asphalt concrete mixture (AC-WC).
- Based on Density and Marshall test with immersion time of 30 minutes to 24 hours, it is obtained that the density is increased, the VMA is decreased, the VFA is increased, the VIM is decreased, the stability is decreased, the flow is decreased, and the Marshall Quotient is increased.
- From all the increment and decrement values, they meet the minimum required specification of asphalt concrete AC-WC.

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