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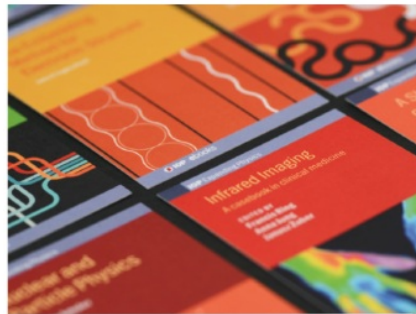
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ANALYSIS of THE RATIO of COARSE AGGREGATE to POROUS ASPHALT MIXTURE

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Abstract. The purpose of the study is finding out the optimal use of coarse aggregates so as to obtain porous asphalt pavements that have high water absorption (porosity) but have a balance in stability and flexibility. The porous asphalt mixture has a double water absorption (drainage system), which is on the surface that flows out of the shoulder of the road and permeates the pores or the porous asphalt mixture cavity itself. In this research study focused on finding out the optimal use of coarse aggregates so as to obtain porous asphalt pavements that have high water absorption (porosity). From the research, it is gotten the average results between the differences in the use of coarse aggregate diameter and Marshall volumetric characteristics indicate that for the Optimum Asphalt Level values, all meet the specifications of genera that produce KAO values of 7.3 percent. From the graphical observations, it can be concluded that all volumetric calculations and asphalt characteristics using coarse aggregate diameter differences concluded that the use of coarse aggregates 2 centimeter in diameter met the specifications of porous asphalt with a mean value: VMA = 48.12 percent, VIM = 4.86 percent, STABILITY = 897 Kilogram, WEAK = 3.54 millimeter, and MQ = 260.11 Kilogram / millimeter.

1. Introduction

"In the process of working on pavement which has started to be done in Indonesia, there are many types of pavement such as: laston AC pavements (BC, WC, Base, and Sub Base), HRS layers (AC or BC), porous asphalt, conventional pavement" [1]. "Of the many types of pavement above, one of which is asphalt porous which has The characteristics b erongga high as nearly 85% of the constituent is coarse aggregate so that the high void content in this mix is expected to be one of the ways to overcome the problem of drainage, which continues to be a major problem due to lack of road drainage land" [2]. "In addition to overcoming the problem of water absorption (drainage system), porous asphalt also has a high value of impurity because of the amount of coarse aggregates that add rough road surface which can reduce the risk of slipping the wheels of vehicles that cross the road in wet conditions" [3]. "The porous asphalt mixture has a double water absorption (drainage system), which is on the surface that flows out of the shoulder of the road and permeates the pores or the porous asphalt mixture cavity itself" [4]. "This is what distinguishes porous asphalt mixtures from conventional pavement, which on the surface of conventional pavement cannot penetrate water (watertight) so that the process of drying water on these pavements is long and causes puddles that can trigger damage to pavement" [5]. This research study entitled "Analysis of Comparison of Coarse Aggregate Diameter of Porus Asphalt Mixes" is focused on knowing the optimal use of coarse aggregates so as to obtain porous asphalt pavements that have high water absorption (porosity) but have a balance in stability and flexibility.

2. Literature review

"With the large percentage of coarse aggregate content in porous asphalt mixture causes low Marshall stability value, this is different from other concrete asphalt mixes which have balanced aggregate proportions so that they have a tight gradation" [2]. "However, it does not mean that the value of stability on porous asphalt is low so that the pavement is easily damaged, by increasing the



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use of its filler levels with open gradations that can increase the value of its stability”[6]. “Porous asphalt is a hot asphalt mixture made with air pore levels of more than 25% of the mixture. This porous asphalt in addition to being focused on high porosity values (cavity) is also focused on the coefficient of friction of porous asphalt pavement”.“With the value of the air pores in the porous asphalt mixture is high, which is between 25-35%, so in this plan, the use of aggregates is sought to have optimal values to maintain this pavement from the occurrence of crack, bleeding, and floating”[8]. This porous asphalt pavement analysis uses coarse aggregate with a 1cm, 1.5cm, and 2cm diameter variant with 6% filler content using *portland* cement , while the asphalt itself is asphalt with 60/70 pen with levels of 4%, 6% , and 8 % “obtained from PT.TRIPLE S in the Kediri city area”[9].

2.1.Agregat

“In the use of aggregate in porous asphalt pavement is the same as other laston, namely split stone, sand, filler, and asphalt as the binding material, the difference is the proportion of its use”[10]. “On this porous asphalt the use of coarse aggregate material reaches 80% of the weight of the mixture so that the high cavity content (pores) is obtained”[11].

3. ResearchMethod

Research sequence Analysis of Comparison of Rough Aggregate Diameter to Porus Asphalt Stability is by looking for references related to porous asphalt pavement, then preparing aggregates and asphalt and testing at the university’s technical laboratory. “In the aggregate test, which includes wear, porosity, filter, specific gravity, while on asphalt tested ductility, penetration, flash point and burn, softening point, and asphalt penetration” [12]. “After all the tests have been carried out, the next step is planning the mix design and then proceeding to make the test object, beforehand, first determine the initial asphalt content (Pb) as a reference for making the test object. the initial asphalt level (Pb) is obtained from the formula:

$$Pb = 0.035 (\% CA) + 0.045 (\% FA) + 0.18 (\% FF) + constants (0.5-1.0) \text{ " [13].}$$

After obtaining the initial asphalt level (Pb) then making the specimen with the use of coarse aggregates of 1cm, 1.5cm, and 2cm in diameter with 6% filler and 4%, 6%, and 8% asphalt in each coarse aggregate diameter. After becoming the next test object the test object is tested with parameters and volumetric asphalt to produce stability, flow, and Marshall Qoutient values.

4. Discussion and analysis

From the results of the examination , the aggregate test results were obtained , which in this aggregate test included “abras⁴n test, water absorbing power and specific gravity, aggregate adhesion with asphalt”[14]. The results can be seen in table 1.

Table 1 : Aggregate Test

Test	Results	Criteria
Abrasion	27.43%	<40%
Absorption And	absorb = 2.569	2.5 - 2.7
Specific Gravity	Bj = 1.69	1-2%
Asphalt Bonding Power In Aggregate	96%	≥ 95.0%

Source: “Public Works Department”

After obtaining the aggregate test results, the next step is testing the characteristics of asphalt.In testing the asphalt the characteristics of testing include: “specific gravity test, asphalt penetration level

test, flash and burn point test, and aggregate attachment test with aggregate”[15]. The results of this test are written in table 2.

Table 2 : Test The Asphalt Pen 60/70

Test	Results	Criteria
Penetration Level Test	losing weight 61,39 without losing weight 68,36	pen 60/70
Asphalt Specific Gravity Test	1,013	1.01-1.04
Flash Point Test And Burn	on: 295 ° burn: 310 °	-
Level Of Stickiness	96%	≥ 95%

Source: “SNI 03-1737-1989”

After obtaining the aggregate and asphalt test results, then testing the Marshall characteristics , “in the Marshall test apart from the Marshall characteristics calculation obtained from the Marshall test instrument consisting of stability and melting values”[16], there is also Marshall volumetric calculation which is obtained by the value from VIM, VMA, and VFB.From the results of the calculation values of Marshall and Volumetric Marshall characters, it has become a reference in determining the use of the best proportion of coarse aggregates of a certain diameter.

4.1 Determination of KAO

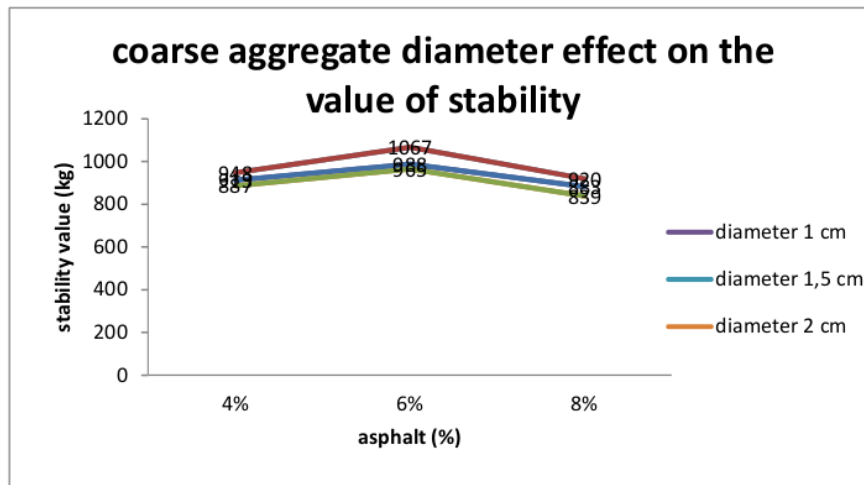
Determination of KAO (Optimum Asphalt Level) is intended to find the use of the maximum percentage of the use of bitumen content in a mixture.In table 3. The results of the KAO determination are seen from the average use of coarse aggregate diameter differences.

Table 3.Determination of KAO With The Average Use of Coarse Aggregate Differences

Dimeter Aggregate	Asphalt				
	(%)				
Cm	Vma (%)	Vim (%)	Stability (Kg)	Flow (Mm)	Mq (Kg / Mm)
1	32.02	5.56	928.00	3.72	250.48
1.5	41.11	6.00	978,33	3.83	259,77
2	48.12	4.86	897	3.54	260.11
KAO				7.3%	

4.2 Value of stability

In a good pavement the required stability value is at least 800 kg, remembering that the vehicle load that intersects the road varies so that a boundary is needed so that there is no damage or change in shape on the pavement layer due to the burden of the vehicle passing through it."The value of stability occurs because of the presence of inter-grain shifts and locking between particles, and the binding

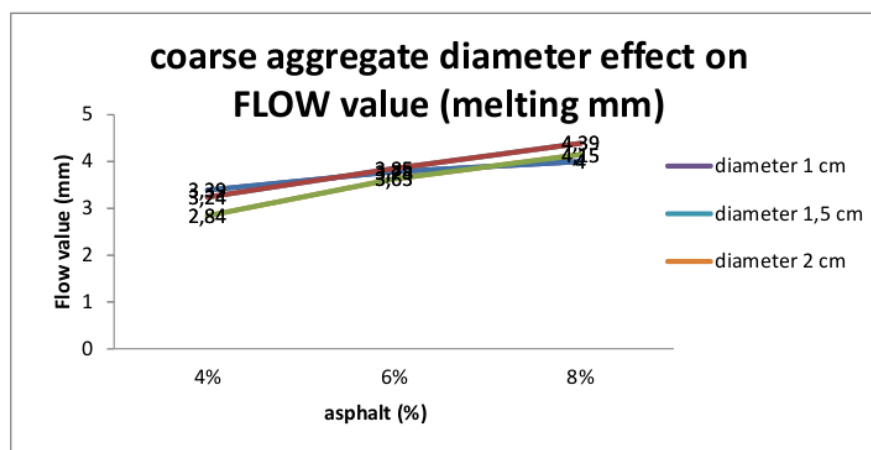


capacity of the asphalt layer"[13]. The results of the calculation of the stability of the porous asphalt pavement mixture with differences in the use of coarse aggregate diameter with variations in the asphalt content of 4%, 6%, and 8% are contained in graph 1.

Graph 1.The Effect of The Relationship Between The Use of Coarse Aggregate Diameter Differences To The Value Of Stability.

4.3 Value of melt (Flow)

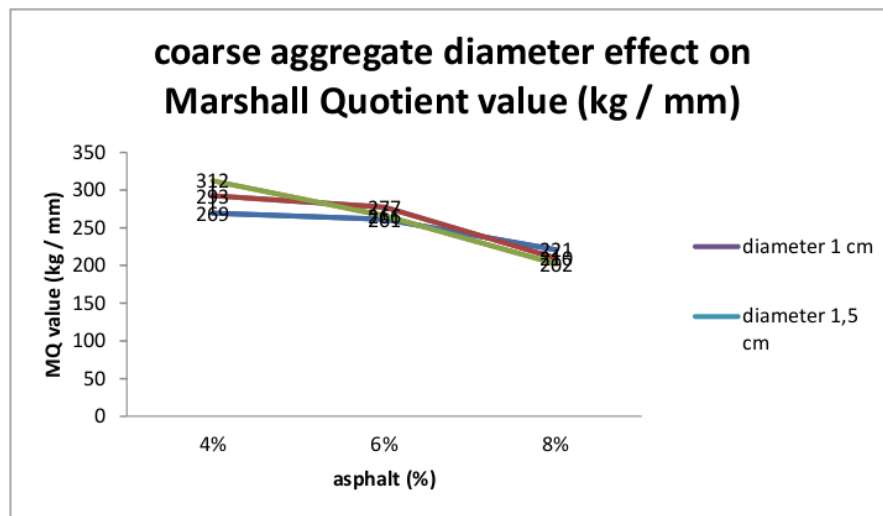
Melt(Flow) shows the elasticity of a hot paved layer, if the value of flow is high then the likelihood of blending is high, and vice versa if the value of flow is low then the possibility of cracking is high. So there is a requirement for the level of melt grade in a porous asphalt mixture of between 2-4 mm. The results of the calculation of flow values can be seen in graph 2.



Graph 2. Effect of the relationship between the use of coarse aggregate diameter differences to the value of melt (flow).

4.4 Marshall Quotient (MQ)

This Marshall Quotient (MQ) value is obtained from the stability value which is influenced by the value of melt. Where Marshall Quotient is a value that shows the stiffness in a porous asphalt mixture, the value of the Marshall Quotient calculation is shown in graph 4.



Graph 3. The Effect of The Relationship Between The Use of Coarse Aggregate Diameter Differences To The Marshall Quotient (MQ) Value.

5. Conclusions

After the results of volumetric research and calculations and Marshall characteristics carried out in the university's engineering laboratory, the following conclusions were obtained:

- Judging from the table, the average results between the differences in the use of coarse aggregate diameter and Marshall volumetric characteristics indicate that for the KAO values, all meet the specifications of genera that produce KAO values of 7.3%.
- From the graphical observations, all volumetric calculations and asphalt characteristics using coarse aggregate diameter differences concluded that the use of coarse aggregates 2 cm in diameter met the specifications of porous asphalt with a mean value: VMA = 48.12%, VIM = 4.86%, STABILITY = 897 Kg, WEAK = 3.54 mm, and MQ = 260.11 Kg / mm

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