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Analysis of the Effect of Variations in Mud Content on Stability and Flow Values in Asphalt Concrete Mixtures Layer Aus (AC-WC)

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ABSTRACT

Aggregat mud affect the weakening of asphalt adhesion and bonds between aggregate grains which will cause damage more quickly before reaching the design age, one of which is the formation of holes in the road surface layer.The purpose of this study was to measure the effect of variations in silt content on the stability and flow values of Asphalt-coated concrete mix (AC-WC). All tests were carried out using the Marshall test method and each test object became the basis for calculations to analyze the stability and flow values of the AC-WC asphalt concrete mixture with variations in silt content of 0%, 5%, 10%, 15% and 20%. The optimal bitumen content used is 6.7%. Furthermore, marshall testing was carried out on variations in silt content in the aggregate to obtain stability and flow values, stability values tended to decrease from 1048.64 kg to 798.96 kg, this affected the minimum stability value of ≥ 800 kg and flow values tended to increase from 1.54 mm to 3.05 mm, but the discharge value still meets the required limit of ≥ 3 mm with a mud content of 13%. Based on the results of the ANOVA analysis obtained from the test, the stability value shows a significant decrease in the level of stability and the flow value shows an insignificant effect on the proportion of sludge.

I. Introduction

Stone split that comes from rice fields or mountains mostly contain clay/mud, which will result in crushed stone mixed with clay or dust. It is not realized that this can damage the asphalt mix pavement in a short time. There are many damaging factors for mixed asphalt pavements, but the cause that is often considered influential and contributes the most to damage is material contamination from clay or mud. The dust generated from the mud affects the bond between asphalt and aggregate. They assume that the dust collector is capable of removing the dust, even though the dust prefers to stick to the aggregate, and can only be removed when washing is done. Setting the dust suction on the dust collector will reduce the grain size portion of the No. filter. 100 and No. 200 [1]. Road damage can occur because the material or aggregate used in the asphalt mixture does not meet the planned specifications, including specifications for the physical properties of aggregate cleanliness, namely by providing a limit on the type and amount of unwanted material such as mud that is present or attached to on aggregate.

Aggregate is part of the asphalt mixture, an aggregate material used for main road pavement construction to withstand traffic loads. Aggregate material used as asphalt mixture, aggregate must pass various predetermined tests. Aggregates that contain impurities (mud, vegetation and soft particles) are often found, these impurities greatly affect the durability of road pavements, therefore the dirt content in specification materials must be limited [2]. Mud comes from soil erosion which is

carried by surface runoff to canals/rivers mixed with sand, in large quantities. Mud can have an effect on weakening asphalt adhesion and accelerating weathering or aggregate destruction due to oxidation and infiltration of water and mud particles into the mixture. The situation will get worse if mud forms in a layer that covers the aggregate particles because it causes the area covered by the asphalt to increase and produces a thicker asphalt layer [3].

Asphalt and accelerated weathering or breakdown of aggregates due to oxidation and infiltration of water and silt particles into the mix. This condition will accelerate the degradation of pavement performance which generally uses mixed asphalt pavement materials. For this reason, it is necessary to conduct research that measures the effect of immersing river water containing silt on asphalt concrete so that further treatment can be considered if this condition occurs in the field [4]. Mud water that seeps into the road pavement can cause changes in the shape of the road surface layer which causes road performance services to decrease [5].

In addition, research on the effect of mud on the characteristics of Asphalt-Wear Concrete mixtures (AC-WC) has been carried out [6]-[7] Dirty aggregate will have an adverse effect on the performance and durability of the pavement. Mud on the aggregate causes the asphalt to become less sticky, causing ravelling which will form holes on the road sections. The mechanical properties of the asphalt mixture do not only depend on the strength, shape and size of the aggregate, but also depend on the cleanliness of the aggregate containing mud, because in general mud affects the pavement layer which is easily oxidized so that the layer becomes brittle or brittle quickly. affects the adhesion of asphalt and the coating of granules to the aggregate which causes a decrease in the value of stability and flow in the asphalt mixture for the surface [8] Pavement layer stability is the ability of the pavement layer to accept traffic loads without deforming changes such as waves, grooves or bleeding. While flow is the change in an asphalt mixture that occurs due to a load to the collapse limit expressed in millimeters or 0.1 inches. The flow value will increase with increasing asphalt content.

Based on the description above, it is therefore necessary to conduct a study on the analysis of the effect of mud variations on the stability and flow values of the AC-WC asphalt concrete mixture to see the effect of the quality of the asphalt concrete mixture. The benefits expected from the results of this study, it can be seen that the maximum sludge content that can still be tolerated so that the specifications for asphalt concrete mixture AC - WC, for constant stability ≥ 800 kg and for fixed flow values ≥ 3 mm according to the General Specifications of Bina Marga [9]-[10].

II. Method

A. Location dan Materials

This research was conducted at the Civil Engineering Laboratory of Polytechnic State Lhokseumawe. The materials used include coarse aggregate, medium aggregate and fine aggregate originating from the Saweuk Quarry and produced by PT Bugak Berawang Cemerlang (BBC). The mud material to be used in the Laston AC - WC mixture is obtained from the river of Alue-Raya in Lhokseumawe City.

B. Stages in Research

The mud material used is wet, the top of the mud is dirty, quite soft and black in color. This dirty sludge is then used to be mixed into the Laston AC-WC mixture. This research was conducted in several stages as follows:

- Testing of coarse aggregate, fine aggregate and filler material consisting of specific gravity test, unit weight test, aggregate sieve analysis, moisture content test and sludge test.
- Asphalt testing consists of specific gravity testing, penetration testing and softening point testing.
- After the aggregate and asphalt testing is carried out, then the mixture of the test objects for the AC-WC asphalt concrete mixture is made to obtain the KAO value and then the process for making the test objects with the AC-WC asphalt concrete mixture using mud of 0%, 5%, 10%, 15 % and 20%. The method used for testing the AC-WC asphalt concrete mix is the Marshall method to obtain Marshall parameters. The results of the Marshall test will yield

results in the form of Stability, Flow, VIM, VFB, VMA and Marshall Quotient (MQ) values. However, in this study, it will be analyzed for the stability and flow values of the AC-WC asphalt concrete mix with the planned mud variations.

- The last step that needs to be done is the Anova test (One-Way Anova) using the Statistical Product and Service Solution (SPSS) software version 16 to determine the difference in the mean of the five samples with variable mud content on stability and flow values. In this analysis, the hypotheses used are: Ho : The five mean distributions of stability data groups (0%, 5%, 10%, 15% and 20% mud content variations) are the same and Ha : The five stability data group distribution means (variations of mud content sludge 0%, 5%, 10%, 15% and 20%) are not the same. If significant $\sigma' > 0.05$ then Ho is accepted, Ha is rejected and if significant $\sigma' < 0.05$ then Ha is accepted, Ho is rejected [11].

III. Results and Discussion

A. Test Results for Physical Properties of Aggregate and Asphalt Materials

The results of examining the physical properties of the material show that the aggregate from the Saweuk Quarry which is processed into crushed stone by PT Bugak Berawang Cemerlang (BBC) meets the required limits, except for the fine aggregate absorption examination of 4.297% > max 3% indicating that the aggregate has a larger pores and material inspection in coarse aggregate and fine aggregate that pass No. sieve. 200 (0.075 mm) of 1.34% ≤ 1% for coarse aggregate and 11.47% ≤ 8% for fine aggregate, both types of aggregates indicate the high content of foreign materials contained in the aggregate. As for the results of examining the physical properties of asphalt, the results obtained are specific gravity of asphalt 1.023, penetration of 66.93 ^{0} C, softening point of asphalt 51.67 ^{0} C and adhesiveness of asphalt to aggregate of 98%. Examination of the physical properties of the asphalt used, namely penetration after it is known based on testing and linked to the literature, the asphalt used meets the requirements of the General Specifications of Bina Marga [9]-[10]. Therefore, this asphalt can be used as a mixture of asphalt concrete wearing course (AC-WC) layers.

B. Results of Optimum Asphalt Content (KAO)

Based on Marshall parameters with variations in asphalt Pb content of 4.6%, 5.1%, 5.6%, 6.1%, 6.6% and 7.1%. Then it is evaluated so that the optimum asphalt content is obtained in the range that meets all parameters of the asphalt mixture. The optimum asphalt content obtained is from the shortest intersection of the VIM and VFB lines.

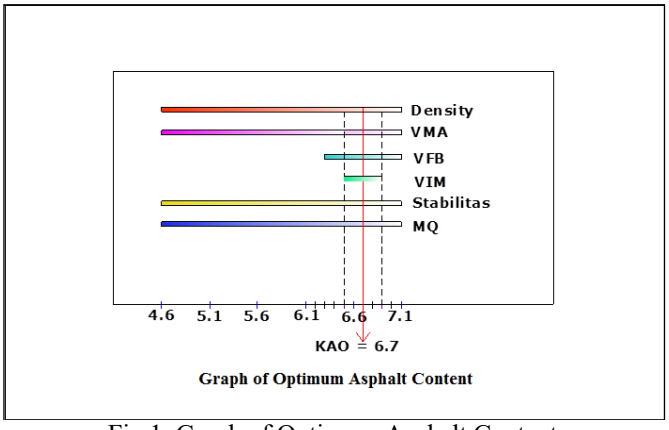

Fig.1. Graph of Optimum Asphalt Content

Based on Figure 1. the optimum bitumen content is obtained at 6.7%. The results of Marshall's experiment found that the stability value of asphalt concrete mixture met the requirements for all variations of optimum asphalt content, namely > 800 kg. Based on the graph of the relationship between stability and variations in asphalt content, it can be seen that there was an increase in stability values starting at asphalt content of 4.6% to 5.6%, namely 1122.6 kg to 1193.35 kg. however, at an asphalt content of 5.6% to 6.1% the stability value is the same, namely 1193.35 kg

and at an asphalt content of 6.6% to 7.1% the stability value decreases, namely 1189.88 to 1167.99 . The situation above illustrates that excessive amounts of asphalt will result in bleeding (collection of asphalt on the pavement surface) which, with the friction of vehicle tires, will accelerate the peeling of asphalt from the aggregate resulting in holes. While the results of the flow values for all variations in asphalt content from 4.6% to 7.1% do not meet the requirements set, namely > 3 according to the General Specifications of Bina Marga [9]-[10].

C. Determination of Marshall Value with Variation of Mud Content

The results of the test specimens at the optimum bitumen content were 6.7% with variations in the percentage of sludge. Marshall parameter values of asphalt concrete mix in KAO with variations in sludge percentage of 5%, 10%, 15%, and 20% are shown in table 1 below:

Table 1. Marshall parameter values of asphalt concrete mix at 6.7% KAO with mud variations

Parameters Marshall	Variation of the Proportion of Silt Content in The Aggregate (%)					Specification
	0	*5*	*10*	*15*	*20*	
Stabilitas (kg)	1048,64	1026,30	951,73	857,85	798,96	≥800
Flow (mm)	1,54	2,34	2,67	2,85	3,05	≥3

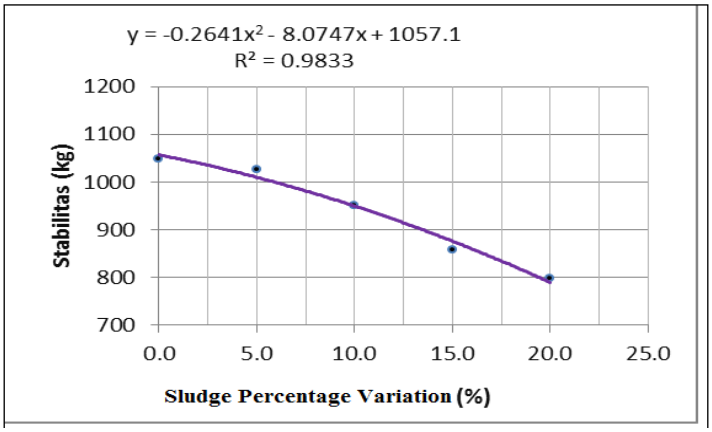

Fig. 1. Graph of the relationship between variations in mud content and stability.

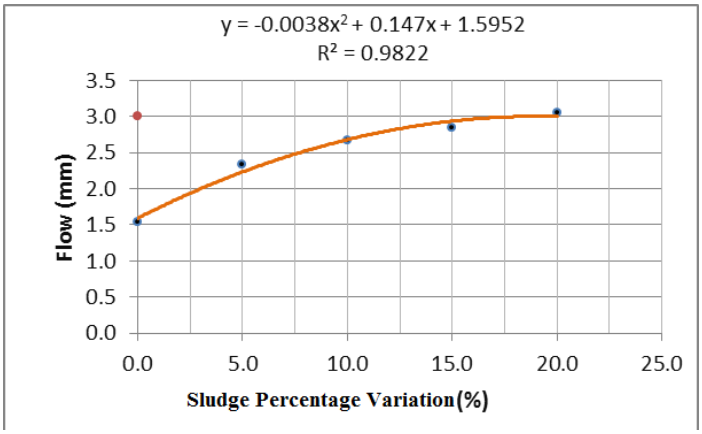

Fig. 2. Graph of the relationship between variations in mud content and flow

Figure 2. The relationship between variations in silt content and stability shows the results of Marshall's research that asphalt concrete mixture at optimum asphalt content of 6.7% with variations in silt content in aggregate with 2 x 75 collision compaction obtained stability values tend to decrease from 1048.64 kg to 798, 96 kgs. The minimum value of stability is ≥ 800 kg. Based on the results graph, it shows that at variations in silt content from 0% to 20%, the stability value tends to decrease. This result indicates that the greater the percentage of silt content attached to the

aggregate, the lower the stability value. stability minimum of 800 kg can still be achieved at silt content = 19.457% obtained from the non-linear equation y = -0.264x2- 8.074+1057 with a value of R2 = 0.983, this means that 98.3% stability is affected by silt content while 1.7% the rest is influenced by other factors outside the study. Meanwhile, in Figure 3, the flow value of the asphalt concrete mixture at the optimum asphalt content with 2 x 75 impact compaction obtained the lowest value of 1.54 mm. The results showed that the flow value of 0% to 20% mud content tended to increase from 1.54 mm to 3.05 mm, but the flow value still met the required limit of ≥ 3 mm at 13% mud content obtained from the equation non-linear y = -0.264x2- 8.074+1057 with a value of R2 = 0.982, this means that 98.2% of the flow is affected by silt content while the remaining 1.8% is influenced by other factors outside the study.

D. Results test ANOVA on stability and flow values with mud variations

ANOVA is a statistical technique that allows us to know whether two or more population means will have the same value by using data from samples of each population. Analysis of variance is also used to test three or more populations. The purpose of the ANOVA test is one way, namely to compare more than two averages, while the use is to test generalization abilities. That is from the significance of the results of the study (one way ANOVA). If it is proven to be different, it means that the two samples can be generalized, meaning that the sample data can be considered to represent the population [11]. The following table calculates stability and flow using Anova (One-Way Anova).

Table 2. ANOVA analysis of stability values with sludge content

ANOVA

Stabilitas	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	137879.067	4	34469.767	7.892	0.004
Within Groups	43676.667	10	4367.667		
Total	181555.733	14			

Table 3. ANOVA analysis of flow values with mud content

ANOVA

Flow	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.176	4	1.044	3.171	0.063
Within Groups	3.292	10	329		
Total	7468	14			

Based on the results of the ANOVA test on the stability value of the asphalt concrete mix, a significant value for stability was obtained, namely 0.004 < = 0.05 . this means that Ho is rejected and Ha is accepted. In other words, there is a significant difference in the stability values of the five mean mud content distribution data. The calculated flow value uses ANOVA (One-Way ANOVA). Based on the results of the ANOVA test on the flow value of the asphalt concrete mixture, a significant value for flow was obtained, namely 0.063 > σ = 0.05 . this means that Ha is rejected and Ho is accepted, in other words there is no significant difference in the flow values of the five mean data distributions of sludge content.

IV. Conclusion

Analysis of the stability and flow of asphalt concrete mixtures with variations in the percentage of silt can be drawn several conclusions. (based on result and discussion).

1. The material used is crushed stone aggregate processed from the PT Bugak Berawang Cemerlang (BBC) stone crusher for this study based on the physical properties of the aggregate meeting the required specifications except for the fine aggregate absorption value of 4.297% ≥ max 3%, and on inspection Coarse and fine aggregate materials that passed sieve No. 200 (0.075 mm) were 1.34% ≤ 1% for coarse aggregate and 11.47% ≤ 8% for fine aggregate. Therefore, it is necessary to wash the aggregate.

2. The results of the marshall parameter values were obtained from variations in asphalt Pb content of 4.6%, 5.1%, 5.6%, 6.1%, 6.6% and 7.1% to obtain an optimum asphalt content (KAO) of 6.7%.
3. Based on the lineart regression analysis, it concludes that the influence of variations in aggregate silt content on stability and flow in the Laston mixture is very strong. This can be seen from the coefficient of determination (r2) > 0.983 for the stability value, and the coefficient of determination (r2) > 0.982 for the flow value in the Laston mixture. Meanwhile, based on ANOVA analysis (One-Way ANOVA) with a significance level of 5% (α = 5%), the average distribution of the five stability data groups (variation of mud content) obtained a significant value of 0.004 <0.05. This proves that by changing the treatment, namely by varying the silt content in the aggregate, there is a difference in stability in the asphalt concrete mixture, and the flow value in the asphalt concrete mixture is obtained with a significant value of 0.063 > 0.05. This proves that there was no change in the treatment of the five mean distributions of the data flow group (variations of mud content).

References

[1] Sutoyo. 2011. "Strategi Merancang Pekerjaan Campuran Beraspal Panas (Hotmix) yang Kuat dan Awet dalam Upaya Meningkatkan Kinerja Perkerasan Jalan yang Handal," Majalah Teknik Jalan dan Transportasi. Vol.115 No.11, pp. 38-41.

[2] Razak, A.B., Hasdaryatmin, D., 2018., Uji Karakteristik Campuran AC-WC Dengan Kandungan Lumpur Pada Agregat., Prosiding Seminar Hasil Penelitian (SNP2M)., pp.31-36.

[3] Suripin. 2001. Pelestarian Sumber Daya Tanah dan Air. Andi : Yogjakarta.

[4] Effendi, H. 2009. Tinjauan Daya Tahan Lama Terhadap Air Sungai Berlumpur Pada Campuran Beton Aspal, Thesis Magister Sister dan Teknik Transportasi. http://etd.repository.ugm.ac.id /penelitian/detail/25213., Diakses 12 Februari 2023

[5] Yandriano, Y., Rofi. B.H., Irawati., 2021., Analysis of Quality Decrease of AC-BC Hot Asphalt Mix On The Effect of Midy Water Immersion., Jurnal Smart Teknologi., Vol.3 (1)., pp.1-21. ISSN: 2774-1702, http://jurnal.unmuhjember.ac.id/index.php/JST .

[6] Sofyan. M. Saleh (2018). "Karakteristik Campuran Aspal Beton AC-WC dengan Substitusi Buton Rock Asphalt Terhadap Rendaman Air Berlumpur" Jurnal Teknik Sipil, Fakultas Teknik, Universitas Syiah Kuala, Banda Aceh.

[7] Hendy Bowoputro, Amelia K. Indriastuti, Asrizal Fahmi Hatta. (2009)."Pengaruh Temperatur dan Perendaman Lumpur Lapindo Terhadap Nilai Stabilitas Campuran Aspal Beton (Laston)". Jurnal Rekayasa Sipil/Vol.3, No 3 . Fakultas Teknik , Universitas Brawijaya Malang.

[8] Subagja, A. 2009. Petunjuk Pedoman Kerja Pratikum Laboratorium Uji Bahan. Lab Uji bahan Jurusan Teknik Sipil Polban: Bandung

[9] Spesifikasi Umum. 2010. Dokumen Pelelangan Nasional Penyediaan Pekerjaan Konstruksi. Direktorat Jenderal Bina Marga.

[10] Direktorat Jenderal Bina Marga. (2018). Spesifikasi Umum Bina Marga 2018 Untuk Pekerjaan Kontruksi. In Direktorat Jenderal Bina Marga. Kementrian PUPR, Direktoral Jenderal Bina Marga.

[11] Harinaldi. 2005. Prinsip – Prinsip Statistik. Erlangga : Jakarta