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MODEL ADDITION ASBUTON FOR SLURRY SEAL REVIEW OF CONSISTENCY TEST, SETTING TIME AND INDIRECT TENSILE STRENGTH IMPLEMENTATION ROAD NATIONAL SECTION GEMPOL – LIMITS CITY BANGIL KM. 34+160 - 43+550

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ABSTRACT

Slurry seal is made by mixing evenly with fine graded aggregates, mineral fillers, water and other advanced materials to emulsified asphalt. The addition of asbuton is intended to improve the quality of the slurry seal mixture and increase the resistance of the slurry seal to the weight of transportation passing through. The tests made by type III slurry seal are consistency, setting time and Indirect Tensile Strength tests. The test specimen test is based on the Special Spec for Slurry Seal Planning at Bina Marga (2018). Shows the value of the study of increasing the percentage of water 14% additional asbuton amounted to 17% consistency scattering evenly ≤ 3 cm consistency calculation is certainly comparable by the provisions of Bina Marga. The addition of asbuton makes the setting time increase harder by 10 minutes than the stable mixture without the addition of asbuton, the Indirect Tensile Strength value results tend to rise to the point of the optimum residual asphalt content of 7.5%. The addition of 17% asbuton made the Indirect Tensile Strength value increase to 11.07 kpa compared to without asbuton addition (9.35 kpa).

Keywords: Slurry Seal, Setting Time, Konsistensi, Indirect Tensile Strength.

Introduction

Road performance will inevitably deteriorate with the repetition of the traffic load it serves, weather or poor quality materials. In addition, road users expect speed (travel time) because it is related to more efficient travel costs and road users may also demand aesthetics and environmental cleanliness (free of noise and pollution).

Maintenance is generally carried out after damage to the pavement surface is visually observed, such as potholes, curling, grooves or cracks. Expecting unstable conditions leads to high maintenance costs. The maintenance model of waiting until the pavement is damaged or commonly called reactive maintenance is inefficient and expensive. Based on the demands of road users and in an effort to optimize road management, road maintenance should be carried out preventively. Preventive maintenance is the application of treatments before significant deterioration occurs. In general, preventive maintenance extends the life of the pavement and is usually scheduled.

One method of preventive maintenance or preservation is the Slurry Seal technique. This mixture technology has long been used in developed countries, but in Indonesia this technology is still rarely used, even though this mixing technique is environmentally friendly because the mixing and application is done in a cold state.

is done in a cold state. One of the obstacles to the use of Slurry Seal technology is the availability of slurry sealers. As for the inspection of Slurry Seal, it intends to consider its reliability by laboratory scale with the value of simplicity of activity over applications in the field that are done manually. In an effort to obtain a good quality mixture of Slurry Seal, a modification is needed, in this study carried out with asbuton additives, in this case referring to the reference SNI 4798; 2011, cationic emulsion asphalt specifications.

The reality in the field is that when the pavement gets the weight of the transportation that passes through, the upper surface arrangement of a material obtains a compressive force, although the lower layer will obtain a tensile force, therefore it is necessary and resistance about an aggregate to get a tensile force by using the Indirect Tensile Strength tool.

When a vehicle wheel load slows down and stops or moves, it will cause a compressive force that causes deflection and at that time the lower top layer will react and a tensile force occurs, due to this tensile force which is one of the causes of cracking, in this case cracking occurs from below and propagates to the surface. This is where the function of Indirect Tensile Strength which is a process will read the value of the tensile force by the asphalt concrete mixture. From the background above, the purpose of this research is to analyze the value of the consistency test and the value of the setting timer on the addition of asbuton in the slurry seal mixture, as well as to analyze the value of the addition of asbuton in the slurry seal mixture on the value of Indirect Tensile Strength.

Research Methods

The method used in this research is the experimental method. This research was conducted in the Laboratory of the Balai Besar Pelaksanaan Jalan Nasional East Java - Bali, Jalan Raya Waru number 20 Sidoarjo. The location of this research was carried out on the Gempol National Road - Bangil City Limits Km, 34 + 160 to Km 43 + 550 in Cangkring Malang Village, Beji District, Pasuruan Regency, Province East Java.

Primary data in this study includes as observations of stability calculations using cone consistency means, observations of binding time (setting time), and Indirect Tensile Strength test results. The secondary data of this examination includes examination of asphal emulsion, examination of asbuton, and planning of asphal emulsion from PT Grasindo Sidoarjo. Data analysis obtained from the test results were analyzed to determine the value of the consistency test, the value of the setting time test.

The test variables carried out in this study are consistency testing to determine water content, setting time testing and Indirect Tensile Strength test. At this stage all data obtained from the test results are analyzed to determine the amount of consistency test value, the amount of setting time test value and the amount of Indirect Tensile Strength test value on the addition of asbuton in the slurry seal mixture

Results and Discussion

The study of emulsified asphalt was obtained from the test data of PT Grasindo, Sidoarjo itself. CSS-1h type emulsified asphalt is used as emulsified asphalt. During the inspection, it was found that the emulsified asphalt used met the cold asphalt standards based on the specified requirements. The hard asphalt test results are presented in Table 1. as follows

Table 1. Results of Inspection of CSS-1h Emulsified Asphalt

No	Testing Type	Testing Method	Testing Results	Specifications*)	Unit

1	Saybolt furol viscosity at 25oC	SNI 03-6721-2002	26.32	20-100	Detik
2	24-hour storage stability	SNI 03-6828-2002	0.24	Max. 1	%
3	Particle electric charge	SNI 03-3644-1994	Positif	Positif	-
4	Retained sieve analysis No. 20	SNI 03-3643-2002	0	Max. 0.1	% lolos
5	Distillation of residual content	SNI 03-3642-1994	59.14	Min. 57	%
6	Residual penetration	SNI 06-2456-1991	72.67	40-906	0.1 mm
7	Residual ductility	SNI 06-2432-1991	68	Min. 40	Cm
8	Solubility of residue in C2HCl3	SNI 06-2438-1991	97.898	Min. 97.5	%

Source: PT Grasindo, Sidoarjo

As in the research of I Wayan Muliawan, 2011, the specific gravity data of CSS-1h type asphalt was found to be 1.014igr/cm3. Thus, the results of asphalt research. Thus, the results of the asphalt emulsion research carried out show that the asphalt emulsion used meets the requirements of the applicable regulations.

Aggregate Inspection Results

The material used in this test was sourced from PT.Grasindo which includes fine aggregate (FA). The aggregates tested were coarse aggregate (CA), medium aggregate (MA), fine aggregate (FA) and naturallsandl (NS). Visually according to Figure VII, the aggregates sourced from PT.Grasindo have a square character (angler) and coarse texture. The material observation counts are outlined in Table 2.-Table 5 below:

Table 2. Coarse Aggregate (CA) inspection results

No	Type of Inspection	Results	Unit	Specifications
1	Absorption	2,659 %	%	max. 3%
2	Bulk specific gravity	2,550 gr/cc	gr/cc	min. 2.5 gr/cc
3	SSD specific gravity	2,618 gr/cc	gr/cc	min. 2.5 gr/cc
4	Apparent specific gravity	2,736 gr/cc	gr/cc	-

Table 3. Inspection results of Medium Aggregate (MA)

No	Type of Inspection	Results	Unit	Specifications
1	Absorption	2,680 %	%	max. 3%
2	Bulk specific gravity	2,627 gr/cc	gr/cc	min. 2.5 gr/cc
3	SSD specific gravity	2,697 gr/cc	gr/cc	min. 2.5 gr/cc
4	Apparent specific gravity	2,826 gr/cc	gr/cc	-

Table 4. Fine Aggregate (FA) inspection results

No	Type of Inspection	Results	Unit	Specifications
1	Absorption	2,093 %	%	max. 3%
2	Bulk specific gravity	2,665 gr/cc	gr/cc	min. 2.5 gr/cc
3	SSD specific gravity	2,720 gr/cc	gr/cc	min. 2.5 gr/cc
4	Apparent specific gravity	2,881 gr/cc	gr/cc	-

Table 5. Natural Sand (NS) inspection results

No	Type of Inspection	Results	Unit	Specifications
1	Absorption	2,104 %	%	max. 3%
2	Bulk specific gravity	2,579 gr/cc	gr/cc	min. 2.5 gr/cc
3	SSD specific gravity	2,633 gr/cc	gr/cc	min. 2.5 gr/cc
4	Apparent specific gravity	2,784 gr/cc	gr/cc	-

The cement fiiller examination was taken in the form of secondary data from the research of Emrizal, 2009.

Table 6. Filler inspection results

No	Type of filler	Specific gravity
1	Cement	1.153 gr/cm3
2	Asbuton	1.045 gr/cm3

Source: BBPJN East Java-Bali Testing Lab (2023)

Slurry Seal Gradation Planning

Planning the gradation of the slurry seal mixture is based on ASTM D3910 Type III. This research utilizes type III specifications because this type is used to repair damage to the road due to cracks and oxidation while improving the firmness of the road surface. Table 7. shows the gradation plan applied as follows:.

Table 7. Slurry Seal Mix Gradation Planning

Sieve Size (mm)	Lower limit (%)	Upper limit (%)	Plan gradation (%)
3/8" (9,5 mm)	100	100	100
No.4 (4,75 mm)	70	90	82,5
No.8 (2,36 mm)	45	70	51,5
No.16 (1,18 mm)	28	50	35
No.30 (600 µ)	18	33	26
No.50 (330 µ)	12	25	17,5
No.100 (150 µ)	7	17	10
No.200 (75 µ)	5	10	7,5

The plan for gradation of the mix in the study is the value obtained from the study. N. Oikonomou (2007)

Estimation of Residual Asphalt Content

So the percentage of residual asphalts uses a grade between 6.5% - 8.5% because the percentage of the first asphalts deposits of 7% is used as an analytical guideline for the pre-wetting test. For the initial residual asphalt content, the initial Emulsified Asphalt Content of the overall weight of the mix was estimated. The emulsified asphalt used is Cationic Slow Setting 1-h Emulsified Asphalt (CSS-1h) produced by PT Grasindo, Sidoarjo, East Java, where the residual percentage is 65% (secondary data from test results). Thus the Asphal Emulsion content in the mixture is 7/0.65 x 100% = 10.8% to the whole mixture.

Slurry Seal Testing Results

Because this examination starts with a mix consistency test then continues testing the setting time and Indirect Tensile Strength of the slurry seal mixture by the test entity printed on the test piece mold. This consistency test using a consistency cone tool is intended to determine the level of workability and as a control for making slurry seal mixture test objects. Furthermore, it will get the optimum water content (consistency testing) in the slurry seal mixture which will later be used in planning the manufacture of test objects for setting time and Indirect Tensile Strength.

Consistency Testing Results

Before this test is carried out, pre-wetting is first carried out by using a material that has been uniformly matched to the material arrangement, and then moistened until it is flat through the method of providing a variety of water contents. The water contents used in the pre-wetting test were 1%, 2%, 3%, 14%, 15% on dry aggregate weight. By visual inspection, it was found that with 5% pre-wetting content, the material was slightly wet but the water did not ooze out. The next step is to determine the actual moisture content, i.e. the water content that gives the calculation of the ideal stability of the mortar while carrying out the stability test. The consistency test results can be presented in Tables 8 to 10 below

Table 8. Consistency Test Results Residue Content of 7% Emulsified Asphalt

Test	Mixture Material Composition (%)					Test Result (cm)	Term
	Aggregates	Asbuton	Emulsified asphalt residue content	Pre-wetting Result	Water Addition		
I	100	17	7	5	14	2,3	2 -3 cm
V	100	17	7	5	14	2,6	
III	100	17	7	5	14	2,4	
IV	100	17	7	5	14	2,3	
V	100	17	7	5	14	2	

Table 9. Consistency Test Results Residue Content of 7.5% Emulsified Asphalt

Test	Mixture Material Composition (%)					Test Result (cm)	Term
	Aggregates	Asbuton	Emulsified asphalt residue content	Pre-wetting Result	Water Addition		
I	100	17	7,5	5	14	2,5	2 -3 cm
V	100	17	7,5	5	14	2,4	
III	100	17	7,5	5	14	2,4	
IV	100	17	7,5	5	14	2,6	
V	100	17	7,5	5	14	2,4	

Table 10. Consistency Test Results Residue Content of 8% Emulsified Asphalt

Test	Mixture Material Composition (%)					Test Result (cm)	Term
	Aggregates	Asbuton	Emulsified asphalt residue content	Pre-wetting Result	Water Addition		
I	100	17	8	5	14	2,6	2 -3 cm
V	100	17	8	5	14	2,7	
III	100	17	8	5	14	2,6	
IV	100	17	8	5	14	2,8	
V	100	17	8	5	14	2,8	

Setting Time Test Results

Setting time testing is a method to determine the time required by the asphalt emulsion to begin to bond to the slurry seal. The beginning of mixing is characterized by a brown color like mud to form a brown color close to black and when the setting is complete enough aggregate texture there are no brown spots or spots

Setting time is done by using white paper or tissue that is touched to the slurry seal mixture which is poured on a wooden mold with dimensions of 15.2 cm x 15.2 cm x 1 cm. Initial touching is done after 15 minutes or allowed to soak in the slurry seal texture, if there are no brown spots on the printed tissue sheet, then the surface sheet of the mixture is felt to have reacted, if there are brown spots, then the absorption process is repeated for 1/4 hour intervals. After 3 hours of absorption, the absorption interval was made ½ hour or longer. The results of setting time with a surface temperature of 290c can be seen in Table 11 below.

Table 11. Average Setting Time Test Results (minutes)

Composition of Stacking Materials*)						
Aggregates	Water	Cement	Asbuton	Residual Asphalt Emulsion Content (%)		
				7	7,5	8
100	14	0	0	100	105	135
100	14	2	17	90	95	125

*) calculated against the weight of aggregate

Figure 1. Tissue contact in Setting Time Test

Indirect Tensile Strength Test Calculation

The Indirect Tensile Strength test is intended to read the tensile strength quality of the mix. This test is intended to read the signs of transformation in the pavement sequence. In the Indirect Tensile Strength test also obtained indirect tensile strength count in pounds (lb). Furthermore, since the test count is indicated, a recapitulation of the indirect tensile strength value in KPa is carried out. The results of the Indirect Tensile Strength test can be presented in Table 12 below

Table 12. Average Setting Time Test Results (minutes)

Residual Asphalt Emulsion Content (%)	Mixed		Average Indirect Tensile Strength Value	
	Cement	Asbuton	(Kg/m2)	Kpa
7	0	0	837.5	8.22
7,5	0	0	953.3	9.35
8	0	0	827.7	8.12
7	2	17	1083.3	10.63
7,5	2	17	1128.4	11.07
8	2	17	1119.0	11.0

Analysis of Setting Time Test Results

Setting time is the time required by the asphalt emulsion when stirred with the aggregate until the asphal granules melt into a solid form and cover the aggregate continuously. In the slurry seal mixture made by adding asbuton. For this test focuses on the effect of adding asbuton until it produces a steady time in the mixture made.

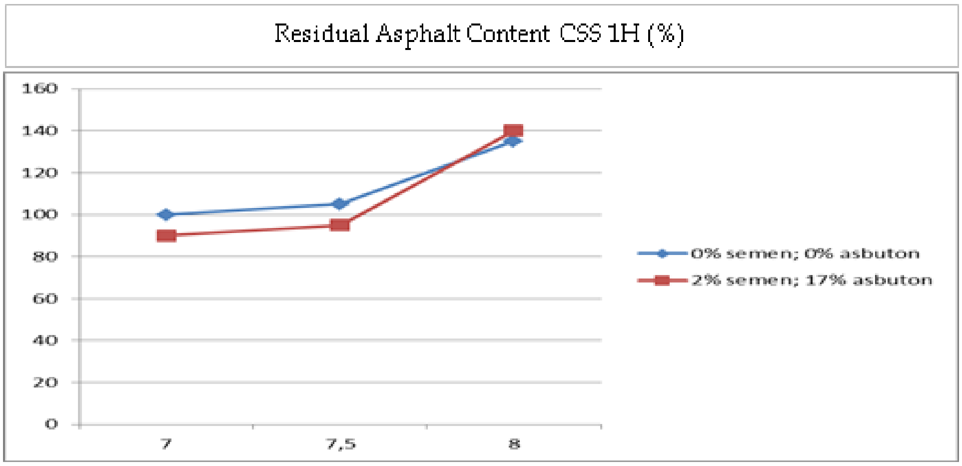

Figure 2. Graph of Relationship between Setting Time and Residual Asphalt Content

From Figure 2. above, the slurry seal mixture with the addition of asbuton as much as 17% obtained a faster but insignificant setting time when compared to normal conditions, but as asbuton added 2% cement the setting time became faster, this is because cement has the property of absorbing water. This shows the addition of cement can help the setting time process become faster.

In addition to the use of cement and asbuton, the increase in asphalt content will slow down the setting as well. As the percentage of asphalt increases, the slurry seal mixture becomes thinner and the bonding process between asphalt and stone takes longer.

Indirect Tensile Strength Analysis

The relationship between the Indirect Tensile Strength value and the residual asphalt emulsion content and the optimal asphalt deposition percentage value from the Indirect Tensile Strength test stability results based on the tensile strength that occurs, the calculation is as follows.

$Y = -8.413x2 + 126.5x - 452$,

$\frac{dy}{dx} = \sigma$

σ = - (2*8,413) + 126,5

$$KARO = \frac{126,5}{2X8,413} = 7,52$$

Then, the percentage of emulsified asphalt content reaches an optimum of 7.52%. As for the calculation of the mixture content can be seen in Table 13. Following

Table 13. Optimum Residual Asphalt Content Results Based on Testing Indirect Tensile Strength

No	Mixture (%)		Equation Graph of Highest Density Value	RAC (X) dy/dx =0	ITS (Kpa)
	Cement	Asbuton			
1	0	0	y = -0,0034x2 +0,0152x2+0,3717	X = 7,52 %	9,35
2	2	17	y = -0,0352x2+0,5726x-8e-06	X = 7,52 %	11,07

The relationship of Indirect Tensile Strength value with 7.52% residual asphalt emulsion shows that indirect tensile strength increases the Indirect Tensile Strength value from 9.35 Kpa to 11.07 Kpa.

The relationship between the Indirect Tensile Strength value and the residual asphalt emulsion content shows that the indirect tensile strength tends to increase until the maximum point and then decrease, the interpretation is that the strength of the specimen will certainly decrease when the profit of asphalt content exceeds the maximum. The addition of 17% asbuton was able to increase the Indirect Tensile Strength value from 9.35 kPa to 11.07 kPa. The maximum Indirect Tensile Strength value occurred in a slurry seal mixture with 2% cement and 17% asbuton added at 11.07 kpa.

Conclusion

Based on the results of the study, it can be concluded that for each slurry seal mixture made with the addition of cement and asbuton with a residual asphalt content of 7% to 8%, the mixture is obtained quite consistent with 5% prewetting and the addition of 14% water calculated from the dry weight of the aggregate. From the results of testing the spread of slurry seals from all mixtures on the base plate of the consistency cone test equipment obtained ≤ 3 cm. This is in accordance with the requirements of Bina Marga, (2018) of 2 to 3 cm. As the residual asphalt emulsion content increases from 7% to 8%, the setting time value increases and this occurs in all types of mixtures. The slurry seal mixture with the addition of asbuton as much as 17% obtained a faster setting time, as well as the addition of asbuton followed by the addition of 2% cement, the setting time became 10 minutes faster, because the water was absorbed by the cement. This shows that the addition of cement can accelerate the setting time. Indirect Tensile Strength values tend to increase up to the optimum residual asphalt content of 7.5%. The addition of 17% asbuton made the Indirect Tensile Strength value increase to 11.07 kPa compared to without asbuton addition (9.35 kpa).

References

Adnany, I. 2019. Penggunaan Asbuton Lawele Granular Asphalt. (LGA) dan Buton Granular Asphalt (BGA) Pada campuran Aspal Porus. Rekayasa Teknik Sipil, 2(1)

Badan Standardisasi Nasional. 2021. Aspal Buton Butir SNI 8863:2019, 8864:2019 Tentang Spesifikasi Asbuton Butir B 5/20, 50/30 untuk perkerasan jalan. Jakarta: BSN

Direktorat Jenderal Bina Marga. 2020. Spesifikasi Umum Bina Marga 2018 Revisi 2 Kementerian Pekerjaan Umum dan Perumahan Rakyat. Jakarta

Do, T. C. 2019. Mechanical characteristics of shear strength ratio used for moisture susceptibility evaluation of asphalt mixtures. International Journal of Pavement Engineering.

I Nyoman Arya Thanaya. 2019. Teknologi Campuran Aspal Emulsi Dingin. Denpasar.

Kafabihi, afwan, dan Wedyantadji, Bambang. 2020. Penggunaan aspal buton pada campuran AC-WC (asphalt conrete wearing course). Student Jurnal gelagar, 2(2), 36-44

Tjaronge, M. W, Irmawaty, Rita dan Hustim, Muralia. 2020. Effect of Buton Granular Asphalt Gradation and cement as filler on Performance of Cold Mix Asphal Using Limestone Agregate. Jurnal of Engineering Science and Technology, 15(1), 419-433.

Tisara Sita. 2021. Teknologi Pada Preservasi Perkerasan Lentur Slurry Seal. Balai Besar Pelaksanaan Jalan Nasional Jawa Tengah –D.I.Y.