



Analysis of The Residual Strength Value of AC-WC Asphalt Mixture by Immersion in Asphalt Mixture with LDPE Plastic Waste Substitution

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ABSTRACT

The residual stability value is the stability value of the soaked asphalt mixture, this study aims to obtain the residual strength stability value in the Asphalt Concrete – Wearing Course (AC-WC) mixture which is added LDPE plastic waste as a substitute for aggregate. The results of the study obtained stability values from all immersion variations tested to meet the bina marga specification standards, which are greater than 800 kg, for 0-hour immersion of 1445 kg, 15-minute immersion variation of 1409 kg, 30-minute immersion variation of 1381 kg, 60-minute immersion variation of 1340 kg, and in 360-minute immersion variation the stability value was obtained of 1304 kg. AC-WC asphalt mixture using added LDPE plastic waste has a residual stability value after soaking for 360 minutes (6 hours) of 90.3%, meeting the residual stability value required by SNI 8139: 2015 and bina marga specifications which state that the residual stability value after soaking for at least 360 minutes (6 hours) the decrease must not be measured from 90%.

1. INTRODUCTION

Asphalt concrete (AC) or asphalt concrete layer (laston) is one type of flexible pavement that is widely used in Indonesia. Laston which is known in Indonesia consists of *asphalt concrete wearing course (AC WC)*, *asphalt concrete binder course (AC BC)*, and *asphalt concrete base (AC base)*. AC BC asphalt mixture is a binder layer with a rougher gradation than AC WC but smoother than AC base. Laston is usually used in areas that experience high deformation such as mountainous areas, toll gates or in areas near traffic lights and areas with heavy traffic. Plastic in asphalt will have a good influence on the properties of asphalt. Marshall's test results on paved mixtures containing plastics showed that adding up to 3% plastic content to asphalt increased the stability, fill weight, density of compacted aggregate (CAD) and *Marshall Quotient* of HRA mixtures. As the addition of plastic to asphalt increases, the permanent deformation value

of the mixture from the wheel track test results decreases and leads to an increase in dynamic stability. Based on the description above, this study utilizes LDPE Plastic Waste type plastic bags as one of the added ingredients in the asphalt mixture by conducting a strength test with the immersion method against the AC-WC mixture.

On the other hand, the existence of plastic is increasingly abundant, it is estimated that around 500 billion – 1 trillion plastics are used in the world every year. If these garbage are stretched out, it can book the surface of the earth at least up to 10 times. It is estimated that each person spends 170 plastic bags annually. More than 17 billion plastic bags are distributed free of charge by supermarkets around the world every year.

Based on the description above, the purpose of this study is: To determine the value of the residual strength index of *the Asphalt Concrete-Wearing*

Course (AC-WC) mixture by using LDPE plastic waste as an added material.

2. RESEARCH METHODS

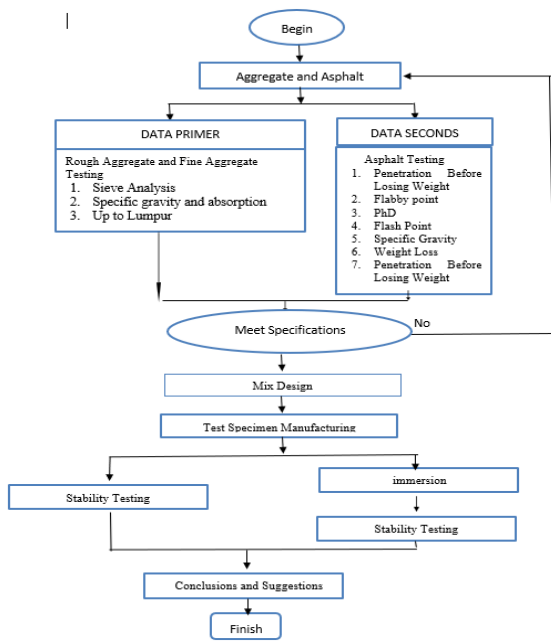


Figure 1. Research design

3. RESULTS AND DISCUSSION

a. Determination of Mixed Gradation

The proportion of combined aggregates is obtained from the comparative value of the aggregate composition of the plan multiplied by the percent pass value in the sieve analysis. Furthermore, the proportion of combined aggregates that have been obtained is adjusted to the value of the specification interval. After that, the combined aggregate as well as the specification interval are plotted into the graph.

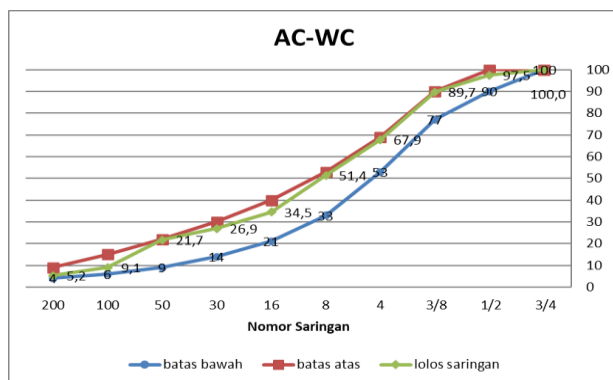


Figure 2. Gradation

b. Mix Design

Based on the composition of the aggregate obtained, test specimens were made with variations in the content of buton retona blend 55 asphalt content of 6.25% of the total weight of the mixture while for the plastic content used of 0%, 1%, 2%, 3% and 4% of the total weight of the mixture. The number of specimens for each variation

in LDPE plastic content is 3 pieces so that the total test specimens for the whole are 15 pieces. The following table shows each material composition in weight and in percent obtained from aggregate proportions based on the results of sieve analysis.

Table 1. Mix Design

Description				
Up to Optimum Aspal		Satuan	6,25%	
Buton Asphalt Weight		gr	75	
Kadar Limbah Plastik		%	4%	
Berat Limbah Plastik LDPE		gr	45	
Sieve Size	Combined Gradation		Aggregate Weight	
BS	(mm)	% Passes	% Retained	
37,5	1. 1/2			gr
25	1			gr
19	3/4	100,00		gr
12,5	1/2	97,47	2,53	gr
9,5	3/8	89,75	7,73	gr
4,75	4	67,86	21,89	gr
2,36	8	51,36	16,50	gr
1,18	16	34,53	16,83	gr
0,6	30	26,94	7,58	gr
0,3	50	21,75	5,20	gr
0,15	100	9,06	12,68	gr
0,075	200	5,25	3,81	gr
Filler			5,2	gr
Sum				gr
Weight of Test Specimen				gr
				1080
				1200

c. The Relationship of Flow Value to Imersion Time

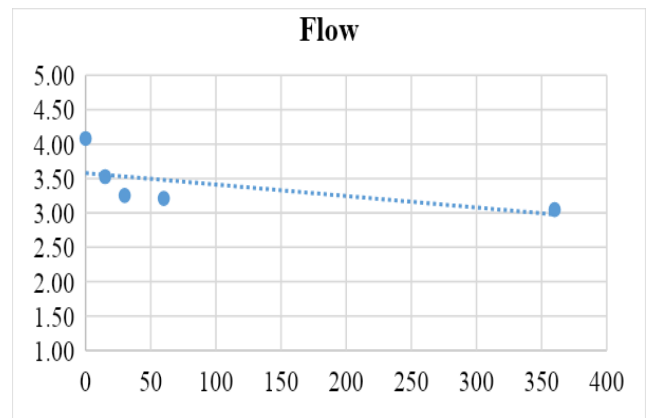


Figure 3. Relationship of Flow value to Immersion Time

From the graph above The flow value obtained from the reading of the marshal tool with the following results, for the 0-hour Immersion Variation a flow value of 4.08 mm, a 15-minute Immersion Variation of 3.53 mm, a 30-minute immersion variation obtained a value of 3.25 mm, a 60-minute immersion variation of 3.21 mm and a 360-mmin immersion variation of 3.05 mm. From the data obtained, it shows that all immersion variations meet the specifications at the flow value, which is between 3 to 5 mm.

d. Relationship of Stability Value with Immersion Time

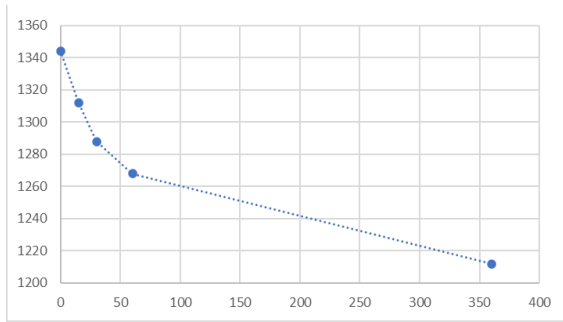


Figure 4. Stability Relationship with Immersion Time

The test results show that the stability value of all immersion variations tested meets the minimum standard, which is greater than 800 kg, namely for the 0-hour Immersion Variation of 1344 kg, the 15-minute Immersion Variation of 1312 kg, the 30-minute Immersion Variation of 1288 kg, the 60-minute Immersion Variation of 1268 kg, and in the 360-minute Immersion Variation the stability value is obtained at 1212 kg. In this case the effect of immersion of the test specimen affects the stability value of the test specimen, The longer the specimen is immersed, the stability value on the specimen decreases.

e. Stable Value of Mixed Waste

Based on the results of the Marshall test by testing test specimens that do not experience immersion and test specimens that experience immersion with a duration of 15, 30, 60 and 360 minutes, results are obtained.

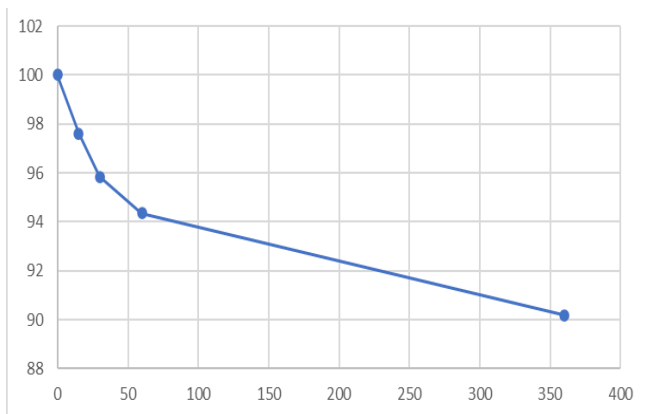


Figure 5. Residual Stability Value

It can be seen from the figure above that the duration of soaking will result in a decrease in the value of IKS. This is because the influence of water will reduce the bond strength between the aggregate and asphalt, so that the stability value is reduced.

From the graph, it shows that the AC-WC mix with added LDPE Plastic Waste meets the appropriate Highway Specifications and SNI 8139: 2015 which states that the residual strength value of the asphalt

mixture does not decrease by less than 90% if soaked for 6 hours.

4. CONCLUSION

From the results of the discussion in the previous chapter, it can be concluded as follows:

AC-WC Asphalt mixture using added materials of LDPE plastic waste has a residual stability value after soaking for 360 minutes (6 hours) of 90% meets the residual stability value required by SNI 8139: 2015 that the residual stability value after soaking for 360 minutes (6 hours) the decrease should not be measured from 90%.

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