Adding Latex And Fly Ash In Asphalt Concrete - Wearing Course Mixture

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Abstract. The road surface layer must be able to withstand the loads and be resistant to changes in conditions and the surrounding environment, so good-quality pavement mix planning is required. Latex as an additive is expected to improve the characteristics of road pavement, while fly ash from coal contains pozzolan elements, which function as a cavity filling material. The research method was experimental and carried out at Materials Laboratory, State Polytechnic of Sriwijaya. In this study, variations in asphalt content of 5%, 6%, and 7% were used; filler content of 6%, and latex content of 8%; 8.5%; and 9%. The most optimum latex content that meets all the general standards of Bina Marga Specifications, Revision 2, 2018, is 9% latex content with a stability value of 2239.51 kg, a flow value of 3.86 mm, a VIM value of 4.31%, a VFA value of 74.96%, the VMA value is 16.81%, and the Marshall Quotient value is 580.29 kg/mm. Thus, the use of latex and fly ash in Asphalt Concrete - Wearing Course pavement mixtures can significantly improve Marshall characteristics, making it a good option in planning strong and durable road pavements in accordance with specification standards.

Keywords: Asphalt, Latex, Fly Ash, Road

1 Introduction

Road construction continues to develop overtime. Road is land transportation that is very necessary in everyday life. The traffic volume that increase everytime, can cause damage to the road surface due to traffic loads that exceed its capacity. Therefore, the quality of the road pavement mixture which has high resistance is very important. This aims to ensure that the road can withstand the heaviest vehicle loads.

The best performance of a pavement layer can be obtained by combining various asphalt properties in one mixture, so that they support each other to achieve optimal results. It is hoped that improving the quality of the asphalt mixture by using latex as an asphalt mixture and fly ash as a filler will increase the overall characteristics of the road pavement. The addition of latex in the asphalt mixture and the use of fly ash as a filler is expected to increase the stability and flow values of the Asphalt Concrete - Wearing Course layers. This research aims to determine the performance of Asphalt

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Concrete - Wearing Course layers with the addition of natural rubber (latex) and fly ash in road construction on Marshall characteristic values.

2 Literature Review

2.1 Road Pavement

According to Saodang (2005), road pavement is a construction layer installed on the subgrade of the road body on the traffic lane that aims to receive and withstand direct loads from traffic [5].

2.2 Asphalt

According to Hardiyatmo (2013), asphalt is defined as material resulting from the filtering of crude oil and is the result of the petroleum industry. Asphalt is a material for adhesives that is dark brown to black in color, with the dominant constituent element being bitumen. Asphalt is a material that, at room temperature, is solid to slightly dense and is thermoplastic. So, asphalt will melt if heated to a certain temperature and freeze again if the temperature drops.

2.3 Latex

Latex comes from the sap released by several types of rubber trees and is a colloidal solution containing rubber particles. At low temperatures, the rubber will crystallize. As the temperature increases, the rubber will expand. A decrease in temperature will restore this expanded state. This is the reason why rubber is elastic.

2.4 Fly Ash

Fly ash is a type of solid waste produced by industries that use coal as fuel for their production processes. In the view of Tahir, Anas (2009, page 264), fly ash is the result of organic residue produced during coal combustion, which is formed through changes in mineral materials during the combustion process. When coal is burned in a power plant, two types of ash are formed, namely fly ash and bottom ash [9].

3 Research Methodology

The stage of this research begin with the preparation stage, by collecting any materials used in the research. The material used is solid asphalt (Pen. 60/70) which comes from PT. Hakaaston; coarse aggregate sizes of 1/2 and 1/1, which come from Lahat; fine aggregate, which comes from Tanjung Raja; filler in the form of type 1 cement from PT. Semen Baturaja; latex comes from East OKU; and fly ash comes from PT. Bukit Asam Tbk, Tanjung Enim. Then material testing, test object manufacturing stage, and test object testing stage, carried out at the Material Testing Laboratory of the Civil

Engineering Department, State Polytechnic of Sriwijaya. The standards for this test refer to the General Specifications for Bina Marga Revision 2, 2018.

4 Test Results Data

4.1 Test Data For The Physical Properties Of Coarse and Fine Aggregates

The coarse aggregate used in this research came from Lahat, and the fine aggregate used in this research came from Tanjung Raja. The test data for the physical properties of aggregates carried out on coarse aggregate 1/2 and 1/1 that shown at Table 1, and fine aggregate in the form of sand that shown at Table 2.

Table 1. Test Data For The Physical Properties Of Coarse Aggregate.

Test Name	Data Results of Coarse Aggregate	
	1/2	1/1
Sieve Analysis	8,042	6,504
Bulk Specific Gravity	2,570	2,543
SSD Specific Gravity	2,602	2,581
Absorption (%)	1,244	1,492
Water Content (%)	0,888	0,273
Mud Content (%)	0,197	0,453

Table 2. Test Data For The Physical Properties Of Fine Aggregate.

Test Name	Data Results
Sieve Analysis	3,728
Bulk Specific Gravity	2,432
SSD Specific Gravity	2,518
Absorption (%)	3,907
Water Content (%)	3,659
Mud Content (%)	0,891

4.2 Test Data For The Physical Properties Of Filler

Test data for the physical properties of filler that shown at Table 3.

Table 3. Test Data For The Physical Properties Of Filler.

Test Name	Specific Gravity of Portland Cement	Specific Gravity of Fly Ash
Data Results	3,019 (gr/cm^3)	3,033 (gr/cm^3)

4.3 Test Data For The Physical Properties Of Asphalt

Test data for the physical properties of asphalt that shown at Table 4.

Table 4. Test Data For The Physical Properties Of Asphalt.

Name Test	Specific Gravity of Asphalt	Softening Point of Asphalt	Penetration	Ductility
Data Resuls	1,034	49,5°C	60/70 mm	143,675 cm

4.4 Test Data For Marshall Test

Test data for Marshall Test with latex content of 8% ; 8,5% ; 9%, and fly ash content of 7% as filler in asphalt mixtures can be seen at Table 5.

Table 5. Test Data For Marshall Test With Lateks And Fly Ash As Filler.

Stability (kg)			
Asphalt Content	Latex Content		
	8 %	8,5 %	9 %
5 %	2042,25	2092,71	2073,47
6 %	2101,94	2137,07	2104,59
7 %	2166,93	2198,84	2186,00
Flow (mm)			
Asphalt Content	Latex Content		
	8 %	8,5 %	9 %
5 %	2,81	2,95	3,10
6 %	3,01	3,15	3,26
7 %	3,21	3,41	3,53
VIM (%)			
Asphalt Content	Latex Content		
	8 %	8,5 %	9 %
5 %	3,90	3,99	4,05
6 %	4,05	4,20	4,41
7 %	4,41	4,45	4,71
VFA (%)			
Asphalt Content	Latex Content		
	8 %	8,5 %	9 %
5 %	69,39	70,13	70,98
6 %	72,14	73,21	74,43
7 %	70,25	71,29	73,28
VMA (%)			
Asphalt Content	Latex Content		
	8 %	8,5 %	9 %
5 %	15,01	15,08	15,48
6 %	15,46	15,57	16,40
7 %	15,07	15,39	16,20
Marshall Quotient			

Asphalt Content	Latex Content 8 %	8,5 %	9 %
5 %	727,99	709,39	668,36
6 %	699,02	678,51	645,05
7 %	674,29	645,64	619,73

Stability Data Analysis. Based on Figure 1, the stability value increased to a latex content of 8.5% and decreased to a latex content of 9%. The optimum value is at a latex content of 8.5% with value of 2251.34 kg. In this analysis, the stability values for all variations meet the general standards of Bina Marga Specifications, Revision 2, 2018.

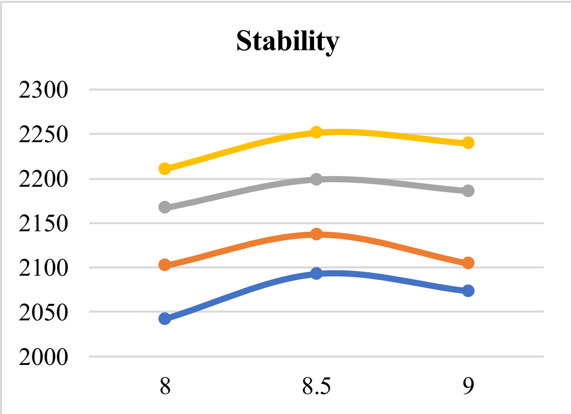

Fig. 1. Graph Of Stability Analysis in Marshall Test

Flow Data Analysis. Based on Figure 2, when the latex content is added to the asphalt mixture, the flow value increases to a latex content of 9%. The higher of flow value made the road pavement become more plastic. If the flow value is low, the asphalt mixture will be stiff. In this analysis, the flow values for all variations meet the standards.

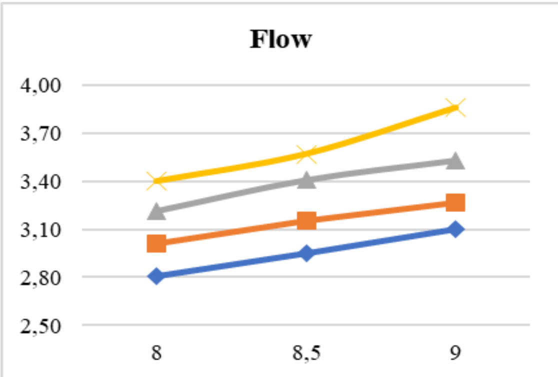

Fig. 2. Graph of Flow Analysis in Marshall Test

VIM Data Analysis. Based on Figure 3, the VIM value will increase if content of the asphalt and latex increase too. A higher VIM value causes the voids in the mixture to become larger, thereby accelerating asphalt aging and reducing the durability of asphalt concrete. In this analysis, the VIM values for all variations meet the standards.

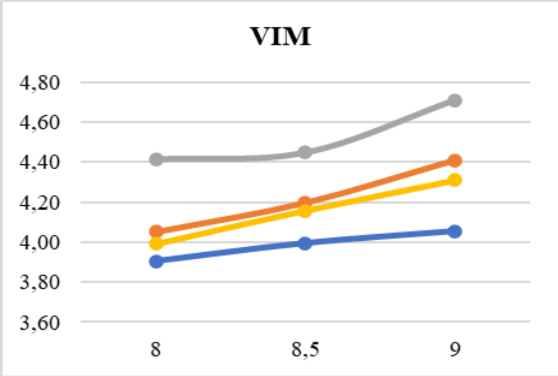

Fig. 3. Graph of VIM Analysis in Marshall Test

VFA Data Analysis. Based on Figure 3, adding latex content in the asphalt mixture made the VFA value to increase. Asphalt's surface will be rising at high temperatures if the VFA value is too high, and the mixture will become porous if the VFA value is too low. In this analysis, the VFA values for all variations meet the standards.

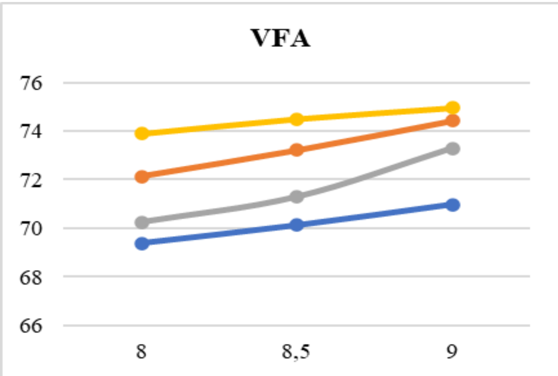

Fig. 4. Graph of VFA Analysis in Marshall Test

VMA Data Analysis. Based on Figure 5, the higher latex content made the VMA value to increase. This causes the density of the mixture to increase because the voids between the aggregates are smaller, so the binding of the aggregates by the asphalt becomes better. In this analysis, the VMA values for all variations meet the standards.

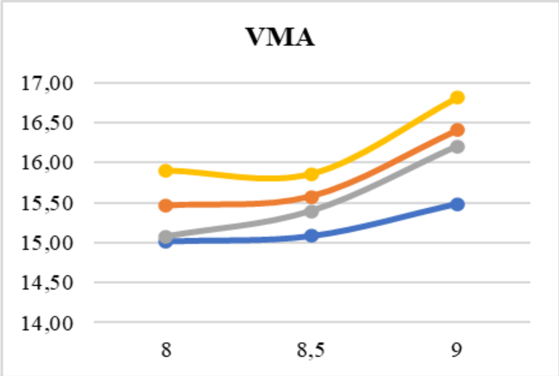

Fig. 5. Graph of VMA Analysis in Marshall Test

Marshall Quotient Data Analysis. Based on Figure 6, adding latex content in asphalt mixture made Marshall Quotient value tending to decrease to a latex content of 9%. A high Marshall Quotient value causes a high stiffness of a mixture, but a lower Marshall Quotient value results in a more flexible asphalt mixture.

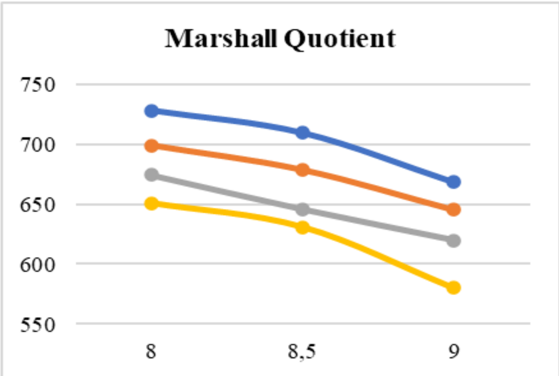

Fig. 6. Graph of Marshall Quotient Analysis in Marshall Test

5 Conclusion

Based on Marshall Test Result, which was carried out using variations in asphalt content of 5%, 6%, and 7%, the most optimal latex content was obtained in accordance with all standards of Bina Marga Specifications, Revision 2, 2018, namely 9% latex content with stability of 2239.51 kg, flow of 3.86 mm, VIM of 4.31%, VFA of 74.96%, VMA of 16.81%, and a Marshall Quotient value of 580.29 kg/mm. The tests using latex and fly ash additives were stated to be able to increase the Marshall characteristic value of the Asphalt Concrete-Wearing Course Layers.

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