JURNAL MULTIDISIPLIN MADANI (MUDIMA)
Homepage: https://journal.formosapublisher.org/index.php/mudima
ISSN: 2808-5639 (Online)
Research Article

Volume 4, No 6, June (2024)	DOI: https://doi.org/10.55927/mudima.v4i6.10026	Page: 887-892

Marshall Characteristics Test on Asphalt Concrete Mixtures – Wearing Course Using Modified Asbuton

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ARTICLE INFO

Keywords: Marshall Characteristics, Modified Asbuton (Premixed), AC-WC

Received : *4 April*
Revised : *19 May*
Accepted : 25 *June*

ABSTRACT

Indonesia is a country rich in natural resources, one of which is natural asphalt found on Buton Island, Southeast Sulawesi, known as Buton asphalt (Asbuton). With the increasing development activities in Indonesia, the government is striving to reduce dependency on asphalt imports and optimize the utilization of Buton asphalt, particularly throughout Indonesia. Preblended Asbuton is a type of modified Buton asphalt that has begun to be widely used in various asphalt mixtures. This research aims to: (1) Obtain an optimal asphalt content (KAO) that is good and meets specifications; (2) Obtain Marshall characteristic values (Stability, Flow, VIM, VMA, VFB, density, and MQ) in the Asphalt Concrete - Wearing Course mixture using modified Buton asphalt (preblended) as a binder. Based on the research results, the Marshall characteristic values for the AC-WC Buton asphalt mixture are: VIM (Void in Mix) = 4.18%, VMA (Void Mineral Aggregate) = 16.80%, VFB (Void Filled With Bitumen) = 74%, density = 2.270 gr/cm³, Stability = 1400 kg, Flow = 3.350 mm, MQ (Marshall Quotient) = 410 kg/mm, KAO = 5.85%, and it meets the Asphalt Mixture Specifications with Buton Asphalt (Bina Marga Revision 1, 2018)

INTRODUCTION

Asphalt itself has a significant influence on determining the quality and performance of an asphalt mixture. Indonesia is a country rich in natural resources, one of which is natural asphalt found on Buton Island, Southeast Sulawesi, known as Buton asphalt (Asbuton). The natural asphalt found on Buton Island is the largest reserve in the world. To date, there are seven types of Buton asphalt, including those that have been modified, namely B 5/20 Buton Granular Asphalt (BGA), B 50/30 Lawele Granular Asphalt (LGA), Preblended Performance Grade (PG) 70, Preblended PG 76, Preblended, Cold Paving Hot Mix Asbuton (CPHMA), and pure Asbuton (Kabo et al., 2019).

With the increasing development activities in Indonesia, the government is striving to reduce dependency on asphalt imports and optimize the utilization of Buton asphalt, particularly throughout Indonesia. The technology for Buton asphalt is continuously being developed, both in terms of quality assurance and its application (Setiowati & Putra, 2023).

In North Sulawesi, several areas have utilized Buton asphalt technology in road construction work, such as overlay or patching road work. Bitung City is one of the cities where, in 2020, road overlay work was carried out using a preblended asphalt mixture. Preblended Buton Asphalt (preblended) is a modified asphalt resulting from mixing penetration 60 petroleum asphalt with filtered granular Buton asphalt, with bitumen content ranging from 60% to 90%. However, the use of Buton Asphalt is still relatively small compared to the use of other types of asphalt.

Based on the background above and to support the optimization of Buton asphalt usage, the author will conduct research on the use of modified Buton asphalt, specifically the preblended type, as a binder in asphalt concrete – wearing course mixtures. This research aims to determine the characteristic values based on the Marshall method, obtain an optimal asphalt content (KAO) that is good and meets specifications, and obtain the Marshall characteristic values (Stability, Flow, VIM, VMA, VFB, density, and MQ) in the asphalt concrete – wearing course mixture.

METHODS

This research uses experimental methods by carrying out various forms of testing in the laboratory. The tests carried out include abrasion, sieve analysis (gradation), specific gravity, bulk density, making test samples and marshalling. The requirements used and used as benchmarks in this research are SNI (Indonesian National Standard), AASHTO (American Association of State Highway and Transport Official) and General Specifications for Highways Revision 1 of 2018.

The type of research carried out is using quantitative research with data collection techniques in the form of experimental activities. All supporting data in this research was obtained from the results of experiments or tests in the laboratory and the data was then analyzed to obtain final results as conclusions.

Research Flow

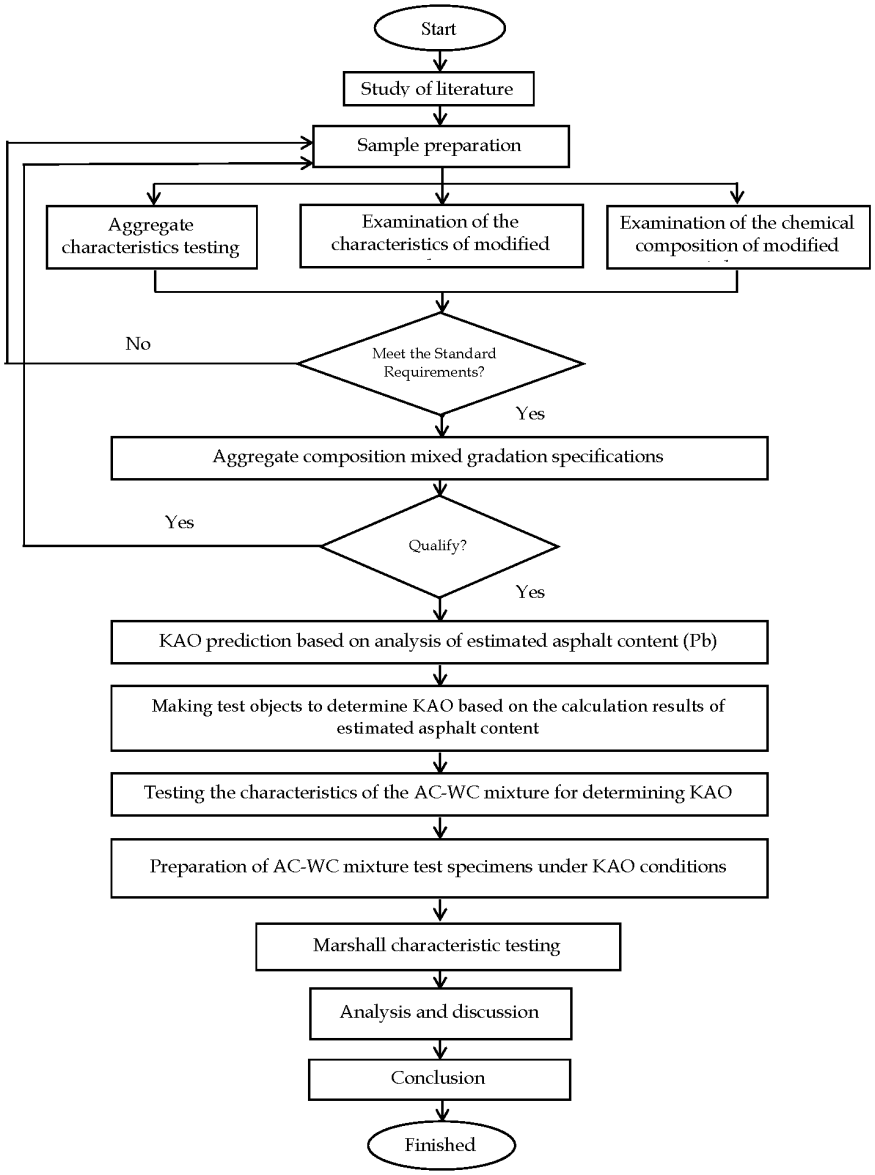


Figure 1. Research Flow

RESULTS AND DISCUSSION

In this planning, the proportion of use of each aggregate fraction will be determined, namely, crushed stone 13-19, 5-13, stone ash and filler. Declare that the aggregate combination meets the specifications and percentage of AC-WC asphalt mixture.

Crushed Stone 13-19	= 16%
Crushed Stone 5-13	= 36%
Rock ash	= 47%
PC	= 1%
	= 100%

After the aggregate combination results are obtained and have met the specifications, the next step is to determine the estimated planned asphalt content (Pb) that will be used.

From the results of the data obtained, calculations are made using the following formula:

Pb = (0.035 x 56.28) + (0.045 x 37.06) + (0.18 x 6.66) + 0.5

= 5.34 rounded up to 5.5% Variation in asphalt content:

The variation in asphalt content that will be used to make test specimens is based on the Pb value = 5.5%, made down by two points and up by two

numbers from the Pb value with a difference in the range of 0.5.

0.5 – 0.5 – Pb – 0.5 – 0.5

(4.5%), (5%), (5.5%), (6%), (6.5%)

After obtaining variations in asphalt content to be used, the next step is to calculate the distribution of aggregate requirements per fraction that will be used in making test objects based on the results of the aggregate sieve analysis, which can be seen in Table 1.

Table 1. Aggregate Requirement Per Variation in Asphalt Content

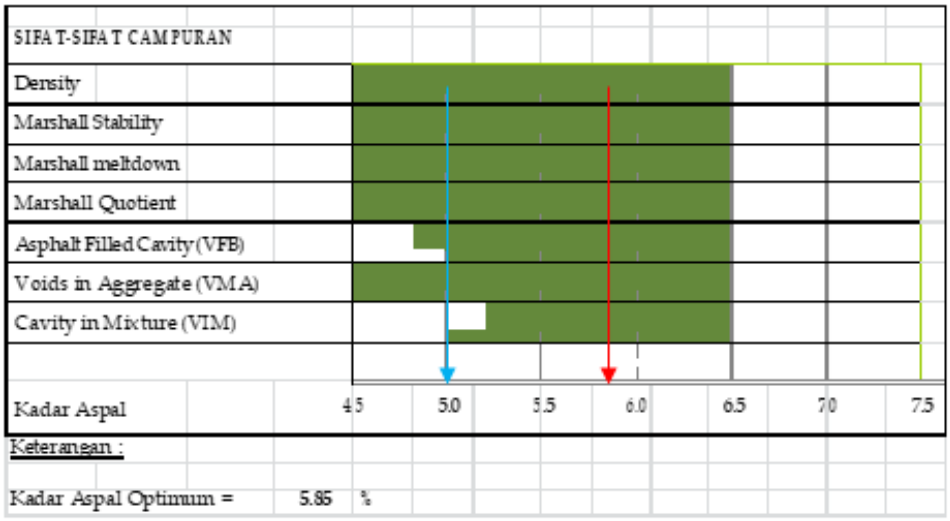
	4.50	Cumulative	5.00	Cumulative	5.50	Cumulative	6.00	Cumulative	6.50	Cumulative
1"	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
3/4"	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
1/2"	104.54	104.5	103.99	104.0	103.44	103.4	102.90	102.9	02.3	102.3
3/8"	82.87	187.4	82.43	186.4	82.00	185.4	81.57	184.5	81.13	183.5
#4	280.00	467.4	278.54	465.0	277.07	462.5	275.60	460.1	74.1	457.6
#8	177.56	645.0	176.63	641.6	175.70	638.2	174.77	634.8	73.8	631.5
#16	113.94	758.9	113.35	754.9	112.75	751.0	112.15	747.0	11.5	743.0
#30	90.69	849.6	90.22	845.2	89.74	840.7	89.27	836.3	88.79	831.8
#50	85.32	934.9	84.87	930.0	84.43	925.1	83.98	920.2	83.53	915.3
#100	102.71	1037.6	102.17	1032.2	101.64	1026.8	101.10	1021.3	00.5	1015.9
#200	31.99	1069.6	31.82	1064.0	31.66	1058.4	31.49	1052.8	31.32	1047.2
LOLOS 200	64.37	1134.0	63.97	1128.0	63.57	1122.0	63.17	1116.0	62.77	1110.00
TOT AGR	1134.0		1128.0		1122.0		1116.0		110.	
PC		12.0		12.0		12.0		12.0		12.0
ASPAL		54		60		66		72		78
Tot Mix		1200.0		1200.0		1200.0		1200.0		1200.0

After the Marshall data has been plotted on a graph, it will be easier to see the range of asphalt content that meets the requirements which can then be plotted on a bar chart to determine the optimum asphalt content. The asphalt content range can be seen in Table 2.

Table 2. Asphalt Content Range

6.50	1.5	6.5	**2.5**	6.5	**3.5**	6.5	**4.5**	6.5	**5.5**	6.5	**6.5**	6.5	**7.5**
6.2	1.5	5.1	**2.5**	5.8	**3.5**	5.1	**4.5**	5.1	**5.5**	5.1	**6.5**	4.6	**7.5**
6.2	1.5	5.1	**2.5**	5.8	**3.5**	5.1	**4.5**	5.1	**5.5**	5.1	**6.5**	4.6	**7.5**
6.2	1.5	5.1	**2.5**	5.8	**3.5**	5.1	**4.5**	5.1	**5.5**	5.1	**6.5**	4.6	**7.5**
6.2	1.5	5.1	**2.5**	5.8	**3.5**	5.1	**4.5**	5.1	**5.5**	5.1	**6.5**	4.6	**7.5**
5.20	1.5	4.5	**2.5**	4.80	**3.5**	4.5	**4.5**	4.5	**5.5**	4.5	**6.5**	4.5	**7.5**
VIM		VMA		VFB		Quotient		Flow		Stability		Density	

Table 3. Bar Chart Optimum Asphalt Content (KAO)



Based on Table 3, the optimum asphalt content (KAO) of Premixed Asbuton is 5.85%. These results were obtained in an interesting way center line from the lowest asphalt content to the highest asphalt content that meets specifications, namely from the range of 5.2% to 6.5%.

Table 4. Marshall Characteristic Values

No.	Description	Unit	Test Result	Specification	
				MIN.	MAX.
1	Asphalt Content	%	**5.85**	-	-
3	Bulk Density	gr/cm3	**2.270**	-	-
4	Cavity in mixture (VIM)	%	**4.18**	3.0	5.0
5	Cavity in mixture (VIM)	%	**16.80**	15.0	-
6	Asphalt filled voids (VFB)	%	**74.0**	65.0	-
7	Stability Marshall	kg	**1400.0**	1000	-
8	Marshall meltdown	mm	**3.350**	2.0	4.0
9	Marshall Quotient	kg/mm	**410.0**	250	-

From all the tests that have been carried out, it shows that the AC-WC mixture using Modified Asbuton (Pramix) has a good Marshall Characteristics value and meets the provisions of the Bina Marga Specifications Revision 1 of 2018.

The data results also show that the stability and flow values are quite large, indicating that the mixture using Premixed Asbuton has the ability to withstand good loads, in other words, Buton asphalt has high quality.

Judging from how much it is used, Asbuton can be said to be quite economical because based on research results on an asphalt content of 5.5%, the Marshall values obtained are good and meet specifications. These results also support research from Sumiati et al (2019), that using Pre-mixed Asbuton can save on the use of asphalt and apart from that the Marshall value results meet specifications.

And based on the results of research that has been carried out, using Asbuton as a material in road infrastructure work is very appropriate, because the large Asbuton deposits that exist will be useful in fulfilling asphalting works in Indonesia. Seeing the decreasing availability of oil bitumen in the world, it is not closed

It is possible that in the future other countries will use Asbuton as a material in road works, considering that Indonesia is the largest producer of natural asphalt in the world. For this reason, the government continues to work together to optimize the use of Asbuton as a matter of national interest first, before exporting it to other countries.

CONCLUSION

Based on the analysis of the Asphalt Concrete – Wearing Course (AC-WC) mixture using Pre-mixed Buton Asphalt, the following conclusions can be drawn:

1. The Optimum Asphalt Content (OAC) for Pre-mixed Buton Asphalt obtained from the tests is 5.85%.
2. The Marshall characteristic values of the AC-WC Buton Asphalt mixture obtained from this test with the OAC of Pre-mixed Buton Asphalt are as follows: a. VIM (Void in Mix) value is 4.18%. b. VMA (Void Mineral Aggregate) value is 16.80%. c. VFB (Void Filled With Bitumen) value is 74%. d. Density value is 2.270 g/cm³. e. Stability value is 1400 kg. f. Flow value is 3.350 mm. g. MQ (Marshall Quotient) value is 410 kg/mm.

Thus, the Marshall characteristic values of the Asphalt Concrete – Wearing Course (AC-WC) mixture using Modified Buton Asphalt (Pre-mixed) as a binder have met the requirements of the General Specifications of Bina Marga Revision 1 of 2018 for asphalt mixtures with Buton Asphalt.

REFERENCES

Alamsyah, A. A., & Darmawan, A. A. (2024). Pengaruh Variasi Pemadatan Terhadap Karakteristik Marshall dengan Menggunakan Wood Ash Sebagai Filler pada Campuran Laston. *Jurnal Ilmiah Universitas Batanghari Jambi*, *24*(1), 564–570. https://doi.org/10.33087/jiubj.v24i1.4734

AASTHO T 290. Standard Method of Test For Theorectical Gravity Mix Maximum (GMM).

Bela, K. R. (2024). Analysis of Durability Values of HRS-WC and AC-WC Asphalt using Rounded Aggregate Material with Medium Compaction. *Publikasi Riset Orientasi Teknik Sipil (Proteksi)*, *6*(1), 30–38. https://doi.org/https://doi.org/10.26740/proteksi.v6n1.p30-38

Dotulung, V., Lalamentik, L. G. J., & Palenewen, S. C. N. (2023). Analisis Variasi Gradasi Agregat Gabungan Terhadap Karakteristik. *Tekno*, *21*(85). https://doi.org/https://doi.org/10.35793/jts.v21i85.49815

Kabo, D. R. G., Tjaronge, M. W., Djamaluddin, A. R., & Aly, S. H. (2019). Stability And Indirect Tensile Strength Of Asbuton Mixture With Additional Gondorukem (Regina Colophonia). *International Journal of Civil Engineering and Technology (IJCIET)*, *10*(09), 166–173. http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=10&IType=9

Setiowati, R., & Putra, M. F. (2023). Struktur Biaya Produksi Aspal Buton Untuk Kebutuhan Infrastruktur Sebagai Substitusi Impor. *Jurnal Teknologi Dan Manajemen*, *21*(1), 35–42. https://doi.org/10.52330/jtm.v21i1.94

Yamin, H. R. A., Pravianto, W., & Dewita, H. (2014). Asbuton Pracampur Antara Harapan dan Kenyataan Asbuton Premix Between Hope and Reality. *Poli Rekayasa*, *10*, 31–41.