Comparison of Characteristics of Laston Mixed Using Conventional Asphalt and Modified Polymer Asphalt

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COMPARISON OF CHARACTERISTICS OF LASTON MIXED USING CONVENTIONAL ASPHALT AND MODIFIED POLYMER ASPHALT

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Abstract. The durability of the pavement is inseparable from the nature of the material, especially asphalt as a binder. Currently the asphalt used for road pavement has not been able to overcome various problems of damage at the beginning of the design life, especially those caused by high temperatures, heavy loads and heavy traffic. According to Hary Christady (2015), there are 4 types of pavement construction commonly used, namely: flexible pavement, rigid pavement, composite pavement and unpaved road. The consideration of the type of pavement selected depends on the available development funds, maintenance costs, the volume of traffic served and the availability of time for road construction. Asphalt pavement layers must have good strength and durability. The pavement layer stacking material consists of: aggregate and asphalt as a binder. The ratio of the mixture of aggregate and asphalt depends on the needs of the type of pavement to be used. For road pavements, the materials used for pavement must be able to support traffic loads and withstand the effects of air, water and temperature changes, and must meet the specified requirements.

INTRODUCTION

The durability of the pavement is inseparable from the nature of the material, especially asphalt as a binder. The high level of paraffin in the asphalt is also the cause of the decrease in tackiness, softening point and flexibility in asphalt concrete pavements. So we need a new breakthrough step by modifying the existing asphalt, namely by adding a polymer material that is able to improve the performance of stickiness, softening point and flexibility, consideration of polymer materials that are able to anticipate the conditions mentioned above is elastomeric type polymer which has high flexibility which is expected to be able to synergize. with a continuously graded asphalt mixture, namely Asphalt Concrete Layer (Laston), or better known as AC (Asphaltic Concrete). Laston is an asphalt concrete mixture that has an aggregate arrangement with continuous gradations relying on interlocking bonds between the aggregate grains. Polymer asphalt is a material produced from the modification of natural polymers or synthetic polymers with asphalt. Modified polymer asphalt (or commonly abbreviated as PMA) has been developed over the last few decades. Generally with a small addition of polymer material (usually around 2-6%) can improve the results of better resistance to deformation, overcome cracks and increase high resistance to age damage resulting in a more durable road construction and can reduce maintenance costs or reduce costs. road repair. According to Hary Christady (2015), there are 4 types of pavement construction commonly used, namely: flexible pavement, rigid pavement, composite pavement and unpaved road. The consideration of the type of pavement selected depends on the available development funds, maintenance costs, the volume of traffic served and the availability of time for road construction.

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RESEARCH METHODS

Research Approach

This study uses a quantitative approach, experimental methods, and Research and Development (R&D) techniques. The research was carried out in several stages, starting from material preparation, material inspection, mix planning, up to Marshall Test and Wheel Tracking Machine Test.

Research Process

This stage includes an examination of the aggregate which includes coarse, fine aggregate, filler, asphalt testing and processed Asbuton.

a. Aggregate Check

Aggregate inspection is needed to determine the physical and mechanical characteristics of the aggregate before it is used as an asphalt mixture. The types of aggregate inspection can be briefly described as follows:

1. Aggregate wear testing with Los Angeles engine.
   This test is intended to determine the resistance of the aggregate to wear/abrasion. Aggregate wear is expressed as the percentage by weight of the material passing through the 1.70 mm (No. 12) sieve to the initial weight of the sample. Testing tools and procedures are adapted to SNI 03-2417-1991.
2. Testing the adhesion of aggregate to asphalt.
   The purpose of this test is to obtain the percentage of aggregate adhesion to asphalt. Aggregate adhesion to asphalt is expressed by the estimated percent of surface area that is still covered with asphalt. Research tools and procedures are adapted to SNI 03-2439-1991.
3. Testing of fine aggregate or sand containing plastic material in a sand equivalent manner.
   The purpose of this test is to obtain a comparison value between the sand scale readings and the mud reading scale on the sand equivalent test equipment expressed in percent. Testing tools and procedures are adapted to SNI 03-4428-1997.
4. Fine and coarse aggregate sieve analysis test.
   The main objective of the aggregate grain size analysis is to control the gradation in order to obtain a high-quality mixed construction. Testing tools and procedures are adapted to SNI 03-1968-1990.
5. Testing the specific gravity and water absorption of coarse aggregate.
   The purpose of this test is to obtain bulk density, surface density, apparent density, and the amount of absorption. Testing tools and procedures are adapted to SNI 03-1969-1990.
6. Testing the specific gravity and water absorption of fine aggregate.
   The purpose of this test is to obtain bulk density, surface density, apparent density, and the amount of absorption. The results of this test can be used in the work of quarry aggregate investigation and mix planning and quality control. Testing tools and procedures are adapted to SNI 03-1970-1990.

b. Asphalt Inspection

In this research, asphalt testing includes Pertamina pen 60/70 asphalt and JAP 57 . asphalt

1. Penetration testing
   Aims to get hard asphalt penetration figures. Includes preparation of test objects, equipment, and test methods to determine penetration of hard asphalt according to SNI-06-2456-1991. This test is an empirical measurement of asphalt consistency. Penetration is the entry of a penetration needle of a certain size, a certain load, and a certain time into the asphalt at a certain temperature.
2. Flash point and burn point testing with the Cleveland Open Cup.
   Aims to get a temperature scale where a short flash of < 5 seconds (flash point) is visible and a flash of at least 5 seconds (burn point) is visible on the asphalt surface according to SNI 06-2433-1991. Includes methods: preparation of test objects, equipment, testing methods to determine the flash point and burning point of asphalt using the Cleveland open cup tool. Flash point is the temperature at which a brief flash of less than 5 seconds is seen at a point above the asphalt surface. Burn point is the temperature at which a flame is visible for at least 5 seconds at a point on the asphalt surface.
3. Testing the softening point of asphalt and tar.

Aims to get the amount of softening point of asphalt and tar. Includes preparation of test specimens, equipment, test methods to determine the softening point of asphalt and tar materials ranging from 30oC to 200oC by ring and ball method according to SNI 06-2434-1991.

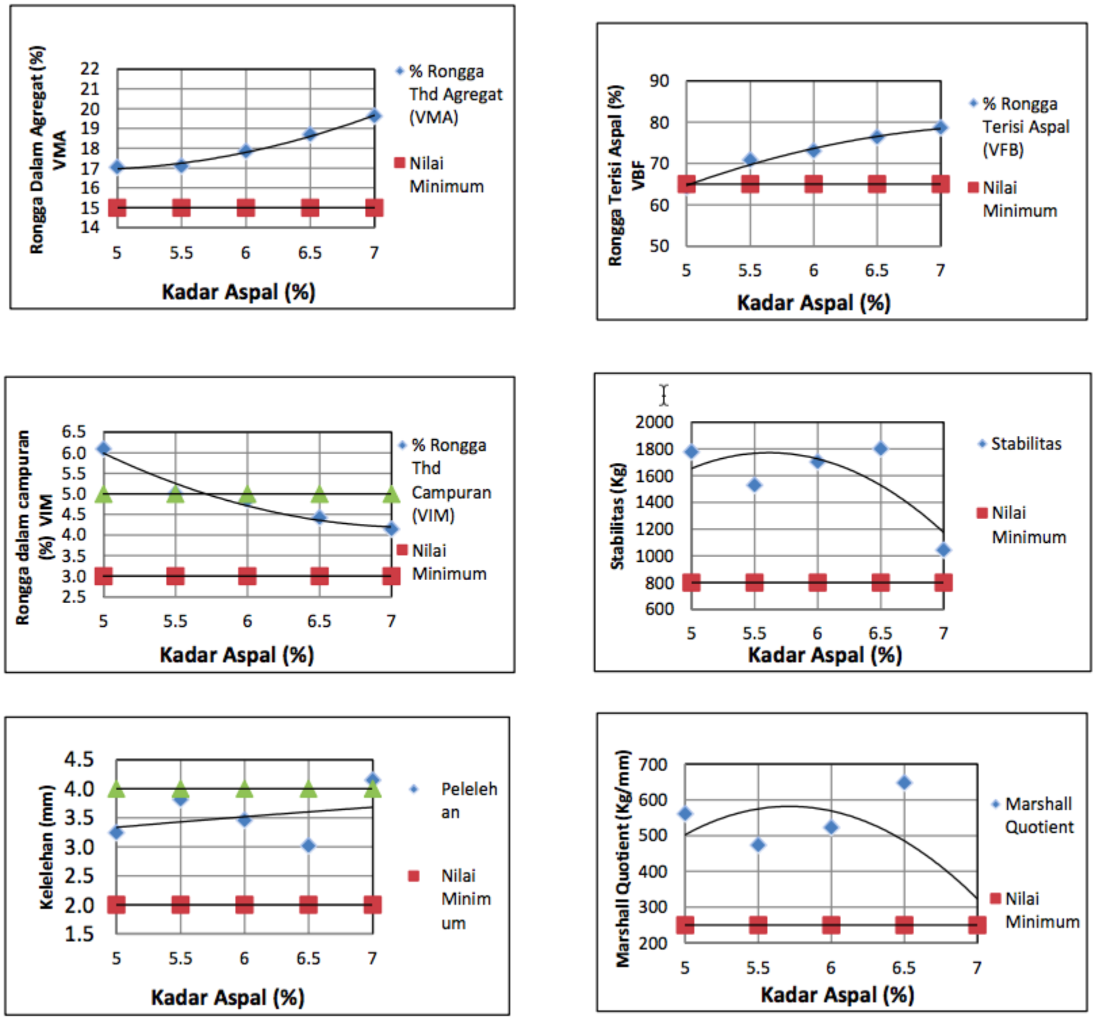
4. Testing the ductility of asphalt materials.
   To get the price / amount of ductility asphalt material. Includes the preparation of test objects, equipment and methods of testing the ductility of asphalt materials according to SNI 06-2432-1991. Asphalt ductility is the value of asphalt elasticity, which is measured from the longest distance, if between two molds containing hard bitumen which is pulled before breaking at a temperature of 25oC and at a speed of 50 mm/min.
5. Density testing of solid asphalt.
   Aims to get the value of the density of solid asphalt by using the formula for the specific gravity of the test results. Includes preparation of test objects, equipment and test methods to determine the specific gravity of solid asphalt and tar using a pycnometer according to SNI 06-2441-1991.
6. Solubility test in CCL4
   This examination was carried out to determine the asphalt content for hard asphalt and asphalt content in asphalt modified with Asbuton dissolved in CCL4 solvent. The test procedure is based on SNI 06-2438-1991.

c. Mix Planning with Marshall Method

The basic principle of the Marshall method is checking the stability and melting (flow), as well as density and pore analysis of the solid mixture formed. Test specimens or solid asphalt concrete briquettes are formed from certain mixed aggregate gradations, according to the mix specifications. The Marshall method was developed for the design of well graded asphalt concrete mixes. The compaction of the test sample must be carried out with a greater number of collisions as a simulation of secondary compaction by traffic, until the test object does not get denser. This absolute density is useful for ensuring that with the approach of compaction by traffic after several years of design life, the surface layer will not undergo plastic deformation. When this test is applied, the performance of hot mixed asphalt pavement will increase. (DPU, Guidelines for Planning Asphalt Mixture with Absolute Density Approach). The planning procedure is as follows:

1. Studying the desired mix aggregate gradation specifications from the job mix specifications.
2. Designing the proportions of each available aggregate fraction to obtain mixed aggregates with gradations according to item 1. The design is carried out based on the gradation of each aggregate fraction to be mixed. Based on the weight of each aggregate and the design proportion, the specific gravity of the mixed aggregate is determined. For Laston, planners can start at the desired gradient line by defining the gradient line between control points themselves.
3. Calculate the initial estimate of the optimum asphalt content (Pb) as follows:
   Pb = 0.035 (%CA) + 0.045 (%FA) + 0.18 (% filler) + K
4. Prepare the Marshal test object for the Marshall 1 test (2x75 impact). To obtain the optimum asphalt content, 15 specimens are generally made with 5 variations of asphalt content, each of which differs by 0.5%. For example, if Pb = 6.5%, then the test object is made at an asphalt content of 5.5%; 6.0%; 6.5%; 7.0% and 7.5%
5. Perform Marshal test, in accordance with SNI 06-2489-1991, to determine density, stability, melting, Marshal quotient, VIM, VMA, and VFA.
6. Graph the relationship between Asphalt Content and Marshall parameters as follows: Density, Stability, Meltability, Marshall quotient, VFA, VMA, VIM
7. Make a minimum of three additional test samples with the following asphalt content: one asphalt content at 5% VIM and two nearest asphalt content giving VIM above and below 5% with a difference in asphalt content of 0.5% each. Each replica of the asphalt content is made at least 2 pieces. Compact it until it reaches absolute density (according to the Procedure for Determining the Absolute Density of Asphalt Mixture, RSNI Bina Marga 1999).
8. The graph describes the range of asphalt content that meets the requirements in Table 2.5
9. Determine that the design asphalt content is near or at the midpoint of the asphalt content range that meets all the required parameters.
10. Make sure that the mix asphalt content range that meets all the criteria is close to 0.6% or more, so that it meets a fairly realistic production tolerance.

11. Make 6 Marshall test specimens at optimum asphalt content. The first three specimens were immersed in water at a temperature of 60 °C for 24 hours and carried out the test according to Pd.M-06 1997-03. The rest were carried out by Marshall testing in accordance with SNI 06-2489-1991.



Picture 1. Example of a graph of the relationship between asphalt content and Marshall parameters

d. Mixed Test

In the end, the two types of asphalt mixtures will be tested by Marshall at the optimum asphalt content which aims to determine the characteristics of the pavement. The values of density, VMA, VFB, VIM (Marshall), VFA, stability, melting, and Marshall quotient will be used as the basis for comparison of the two types of mixtures.

e. Analysis of Test Results

After Marshall testing was carried out on all test objects, then an analysis was carried out on the data obtained. From the test results obtained the values of density, stability, flow, VMA, VFA, VIM Marshall, VIM PRD. Then for each parameter listed in the mix requirements, the specification limits are drawn on a graph and a range of asphalt content that meets the requirements is determined. Usually the design asphalt content is close to the midpoint of the asphalt content range that meets all requirements. Ensure that the mixture meets all the criteria in the requirements specification. Then we compare the Marshall characteristics of each mixture.

f. Marshall Characteristic Calculation Analysis

After Marshall testing continued with the analysis of the data obtained. The analysis carried out is to obtain Marshall values which are used to determine the characteristics of the mixture of the two test objects, namely the test object using modified JAP 57 asphalt and the test object using Pertamina Pen 60/70 asphalt. The data obtained from laboratory research are as follows:

1. Dry weight/before soaking (grams).
2. Weight in SSD/saturated state (grams).
3. Weight in water (grams).
4. Stability watch reading (lbs).
5. Flow watch reading (mm).

RESULT AND DISCUSSION

1. Test result

The tests carried out in this study consisted of: Testing the quality of the material on the aggregate and asphalt material. Furthermore, testing of the mixture of Asphalt Concrete Wearing Course

- Mixed Materials test results

From the results of testing the physical properties of coarse aggregate to determine the feasibility of using aggregate as an asphalt mixture, it is carried out in the laboratory using the SNI testing method. The recapitulation of the results of testing the physical properties of the aggregate according to the test method used and the required specifications is presented in the table.

Table 1. Properties of Coarse Aggregate Materials

No	Karakteristik	Metode Pengujian	Sat	spesifikasi		Hasil
				Min.	Max.	
I	Agregat Kasar					
1	Berat Jenis Curah	SNI-03-1969-1990	t/m^3	2,5	-	2,588
2	Berat Jenis SSD	SNI-03-1969-1990	t/m^3	-	-	2,601
3	Berat Jenis Semu	SNI-03-1969-1990	t/m^3	-	-	2,622
4	Penyerapan Air	SNI-03-1969-1990	%	-	3	0,495
5	Abrasi Los Angeles	SNI-03-2417-1991	%	-	40	21,66
6	Indeks Kepipihan	SNI-M-25-1991-03	%	-	25	8,96
7	Indeks Kelonjongan	SNI-M-25-1991-03	%	-	25	8,04
8	Pelapukan	SNI-06-2456-1991	%	-	14	
9	Kelekatan Aspal	SNI-03-2439-1991	%	95	-	

Table 3. Properties of Fine Aggregate Materials

No	Karakteristik	Metode Pengujian	Sat	spesifikasi		Hasil
				Min.	Max.	
II	Agregat Halus					
1	Nilai Setara Pasir	SNI-03-4428-1997	%	60	-	
2	Kadar Lempung	SNI-3423-2008	%	-	1	
3	Angularitas <10cm	SNI-03-6877-2002	%	45	-	
4	Angularitas >10cm	SNI-03-6877-2002	%	40	-	
5	Berat Jenis Curah	SNI-03-1969-1990	t/m^3	2,5	-	2,535
6	Berat Jenis SSD	SNI-03-1969-1990	t/m^3	-	-	2,576
7	Berat Jenis Semu	SNI-03-1969-1990	t/m^3	-	-	2,642
8	Penyerapan Air	SNI-03-1969-1990	%	-	3	1,603

Table 2. Filler Material Properties

No	Karakteristik	Metode Pengujian	Sat	spesifikasi		Hasil
				Min.	Max.	
III	Filler					
1	Berat Jenis Curah	SNI-15-2531-1991	t/m^3	2,5	-	3,125

The asphalt used is asphalt produced by Pertamina which is hard asphalt type AC 60/70. The test results meet the specification requirements as an Asphalt Concrete-Wearing Course (AC-WC) mixed stacking material.

Table 4. Asphalt Material Properties

No	Karakteristik	Metode Pengujian	Sat	spesifikasi		Hasil
				Min.	Max.	
1	Penetrasi pada 25°C 100g, 5 detik	SNI 2456 : 2011	0,1mm	60	70	61
2	Viscositas Absolut 60°C	SNI 03-6440-2000	Pa.S	160	240	208
3	Viscositas 135°C	SNI 7729 : 2011	cSt	≥300		424,2
4	Titik lembek	SNI 2434 : 2011	°C	≥ 48		50,6
5	Daktilitas pada 25° C 5cm/detik	SNI 2434 : 2011	cm	≥ 100		140
6	Titik nyala (COC)	SNI 2433 : 2011	°C	≥ 232		326
7	Kelarutan dalam C_2HCl_3 Trichloroethylene	SNI 06-2438-1991	%	≥ 99		99,6
8	Berat jenis	SNI 2432 : 2011		≥ 1,0		1,035
Pengujian Residu Hasil TFOT						
9	Kehilangan Berat (TFOT)	SNI 06-2438-1991	%	≤ 0,8		0,0031
10	Viscositas Absolut 60°C	SNI 03-6440-2000	Pa.S	160	240	230
11	Penetrasi pada 25°	SNI 2456 : 2011	%	≥54		83,3
12	Daktilitas pada 25° C 5cm/detik	SNI 2434 : 2011	cm	≥ 100		140

Table 5. Properties of Anti-Peeling Ingredients

No	Karakteristik	Metode Pengujian	Sat	spesifikasi		Hasil
				Min.	Max.	
1	Viscositas 135°C (cSt)	SNI 2433:2011	°C	≥180		361
2	Titik nyala (°C)	SNI-03-6721-2002	Detik	>200		300
3	Berat jenis	SNI 06-2441-1991	-	0,92		1,02

2. Aggregate Gradation Test

Before making the mixture, gradation tests were carried out for all aggregate fractions, both from the Cold Bin and from the Hot Bin.

- Cold Bin Aggregate Gradation Test Results

Table 6. Sieve Analysis Cold Bin I (material 0 - 5mm)

Sieve No.	Cumulative by Weight			Sieve No.	Cumulative by Weight			AVERAGE
	Wt. Ret	% Ret	% Pass		Wt. Ret	% Ret	% Pass	% Pass
3/4"				**3/4"**				
1/2"				**1/2"**				
3/8"	0	0	100,00	**3/8"**	0	0	100	**100**
No.4	111,5	6,10	93,90	**No.4**	52,8	2,62	97,38	**95,64**
No.8	1132,3	61,92	38,08	**No.8**	186,2	9,24	90,76	**64,42**
No. 16	1480,3	80,95	19,05	**No. 16**	690,5	34,27	65,73	**42,39**
No. 30	1638,8	89,62	10,38	**No. 30**	1066,3	52,92	47,08	**28,73**
No. 50	1769,9	96,79	3,21	**No. 50**	1280,5	63,55	36,45	**19,83**
No. 100	1617,8	88,47	11,53	**No. 100**	1565,5	77,69	22,31	**16,92**
No. 200	1514,8	82,84	17,16	**No. 200**	1731,3	85,92	14,08	**15,62**

Table 7. Sieve Analysis Cold Bin II (material 5 – 12 mm)

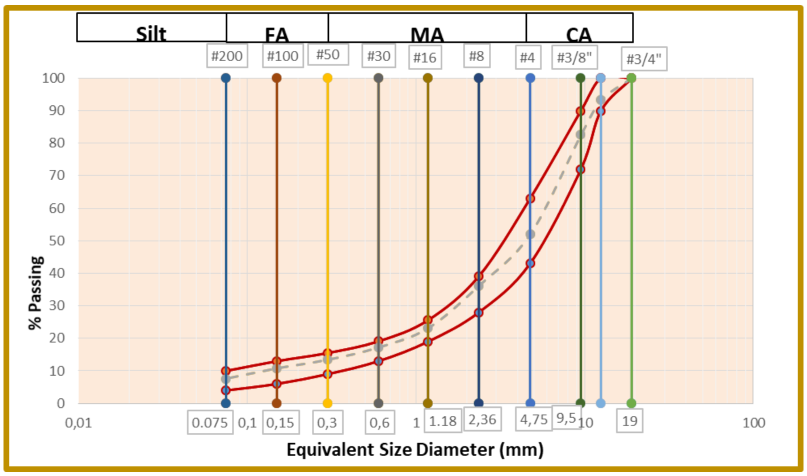
Sieve No.	Cumulative by Weight			Sieve No.	Cumulative by Weight			AVERAGE
	Wt. Ret	% Ret	% Pass		Wt. Ret	% Ret	% Pass	% Pass
3/4"	0,0	0,00	100,00	**3/4"**	0,0	0,00	100,00	**100,00**
1/2"	18,1	0,98	99,02	**1/2"**	24,2	1,12	98,88	**98,95**
3/8"	425,2	22,97	77,03	**3/8"**	498,1	23,05	76,95	**76,99**
No.4	856,6	46,28	53,72	**No.4**	1717,1	79,46	20,54	**37,13**
No.8	1767,5	95,49	4,51	**No.8**	2038,0	94,31	5,69	**5,10**
No. 16	1775,3	95,91	4,09	**No. 16**	2070,0	95,79	4,21	**4,15**
No. 30	1788,1	96,60	3,40	**No. 30**	2087,1	96,58	3,42	**3,41**
No. 50	1798,1	97,14	2,86	**No. 50**	2096,2	97,00	3,00	**2,93**
No. 100	1818,2	98,23	1,77	**No. 100**	2123,2	98,25	1,75	**1,76**
No. 200	1829,2	98,82	1,18	**No. 200**	2134,2	98,76	1,24	**1,21**

Table 8. Sieve Analysis Hot BIN III (material 12 – 19 mm)

Sieve No.	Cumulative by Weight Wt. Ret	% Ret	% Pass	Sieve No.	Cumulative by Weight Wt. Ret	% Ret	% Pass	AVERAGE % Pass
3/4"	0,0	0,00	100,00	**3/4"**	0,0	0,0	100,0	**100,0**
1/2"	2016,0	46,53	53,47	**1/2"**	2002,0	47,35	52,65	**53,06**
3/8"	4140,0	95,55	4,45	**3/8"**	4052,0	95,84	4,16	**4,31**
No.4	4237,0	97,78	2,22	**No.4**	4129,0	97,66	2,34	**2,28**
No.8	4249,0	98,06	1,94	**No.8**	4132,0	97,73	2,27	**2,10**
No. 16	4306,0	99,38	0,62	**No. 16**	4198,0	99,29	0,71	**0,67**
No. 30	4326,0	99,84	0,16	**No. 30**	4218,0	99,76	0,24	**0,20**
No. 50	4333,0	100,00	0,00	**No. 50**	4228,0	100,00	0,00	**0,00**
No. 100	4333,0	100,00	0,00	**No. 100**	4228,0	100,00	0,00	**0,00**
No. 200	4333,0	100,00	0,00	**No. 200**	4228,0	100,00	0,00	**0,00**

Table 9. HOT BIN Material Mix Gradation

SIEVE SIZE		19,00	12,50	9,50	4,75	2,36	1,18	0,600	0,300	0,150	0,075
Material	**Persentase (%)**	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
Cold Bin I (0 - 5)	**46**	46,00	46,00	46,00	43,09	28,92	19,47	13,72	10,15	7,95	5,07
Cold Bin II (5 - 12)	**40**	40,00	38,92	34,05	6,59	4,99	1,56	1,45	1,28	1,14	1,08
Cold Bin III (12 - 19)	**12**	12,00	6,37	0,52	0,27	0,25	0,08	0,02	0,00	0,00	0,00
FILLER	**2**	2,00	2,00	2,00	2,00	2,00	2,00	2,00	1,98	1,68	1,45
Combined	**100**	**100,00**	**93,29**	**82,57**	**51,96**	**36,16**	**23,11**	**17,20**	**13,41**	**10,76**	**7,60**
Specification		**100**	**90 - 100**	**72 - 90**	**43 - 63**	**28 - 39,1**	**19 - 25,6**	**13 - 19,1**	**9 - 15,5**	**6 - 13**	**4 - 10**



Picture 2. Hot Bin Mix Gradation Curve

3. Mixture Testing in Determining KAO

An initial estimate of the optimum asphalt content can be planned after selecting and combining the three aggregate fractions. The calculation is as follows:

Pb = 0.035(%CA) + 0.045(%FA) + 0.18(%FF) + K

- CA (holding #8) = 100% - 35.85% = 64.15%
- FA(passed #8 stuck #200) = 38.85% - 7.45 = 28.4
- FF (passed #200) = 7.45%
- K (0.5 – 1) = 1%

Pb = 0.035 (64.15%) + 0.045 (47%) + 0.18 (7.45%) + 1%
= 2.25% + 1.28% + 1.34% + 1%
= 5.9%

then for testing carried out 5.9% ~ 6% rounded up, for testing carried out with 5 variations of asphalt content, namely: (a – 1), (a – 0.5) , (a) , (a + 0.5), (a+1); then the asphalt content in the test: 5%, 5.5%, 6%, 6.5% and 7%. After testing, the results are shown in Table .

Table 10. Marshall test in determining KAO

No	Sifat Campuran	Persentase Aspal (%) 5	5,5	6	6,5	7	Spesifikasi
1	% Rongga thd Agregat (VMA)	15.1	15.8	16.07	16.53	17.18	Min 15
2	% Rongga Terisi Aspal(VFB)	63.73	70	76.1	80.86	83.89	Min 65
3	% Rongga thd Campuran(VIM)	5.66	4.75	3.84	3.19	2.77	3 - 5
4	Stabilitas (Kg)	915.72	1145.8	1293.3	1319.4	1167.5	Min 800
5	Flow (mm)	3.43	3.63	3.7	3.83	4	Min 3
6	Bulk Density (gr/mm^3)	2.282	2.288	2.294	2.319	2.288	
7	Marshall Quotion (Kg/mm)	266.72	315.35	349.5	344.18	291.87	300

Based on the calculation and testing, the optimum asphalt content is 5.9%. The composition of the aggregate mixture and the optimum asphalt content will then be used as a reference for the composition of the mixture for further testing.

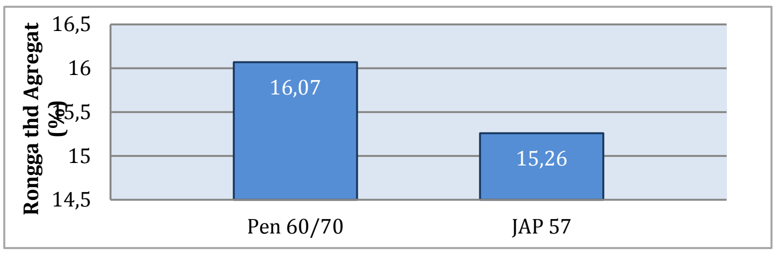
4. Comparison of Test Results

To see how big the difference in the characteristics of the Asphalt Concrete Wearing Course mixture is, using conventional Asphalt (Pertamina Pen 60/70) and Modified Asphalt (JAP 57) further testing is carried out and the test results are as follows: Marshall Test, Durability Test, Wheel Tracking Machine Test.

Table 11. Marshall Test

No	Sifat Campuran	Jenis Aspal		Spesifikasi
		Pen 60/70	JAP 57	
1	% Rongga thd Agregat (VMA)	16,07	15,26	Min 15
2	% Rongga Terisi Aspal(VFB)	75,94	72,41	Min 65
3	% Rongga thd Campuran(VIM)	3,87	4,21	3 - 5
4	Stabilitas (Kg)	1293	1774,5	Min 800
5	Kelelehan/Flow (mm)	3,70	4,47	Min 3
6	Marshall Quotion (Kg/mm)	350	397	Min 300

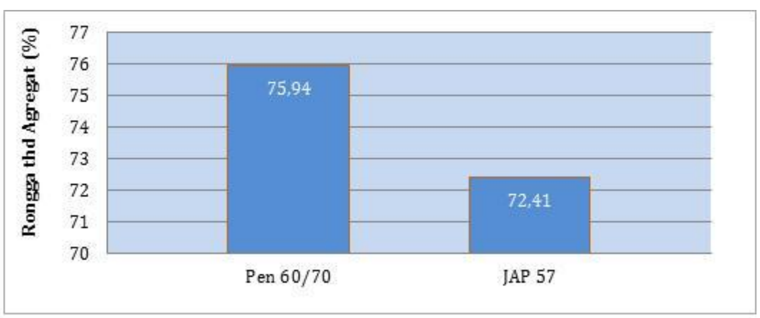
a. Comparison of Conventional Asphalt and Modified Asphalt to VMA (Voids in Material Aggregate) values



Picture 3. Comparison Against VMA

The picture shows that the use of Modified Asphalt JAP 57 in the mixture makes the mixture has a lower VMA value.

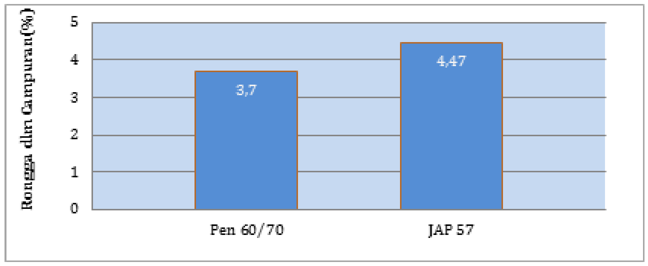
b. Comparison of Conventional Asphalt and Modified Asphalt to the value of VFB (Voids Filled with Bitumen))



Picture 4. Comparison Against VMA

showed that the VFB value of modified asphalt (JAP 57) was smaller than that of conventional asphalt (Pen 60/70).

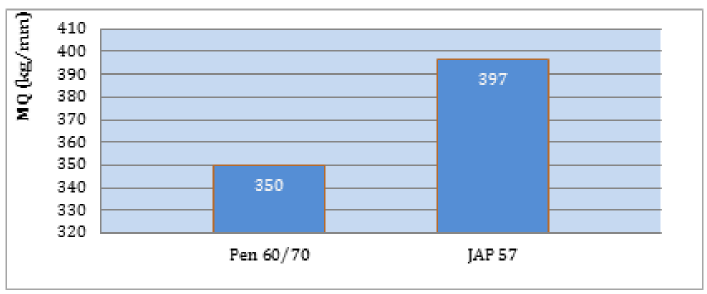
c. Comparison of Conventional Asphalt and Modified Asphalt to melt (flow)



Picture 5. Comparison Against Flow

The picture shows that the mixture using JAP 57 will make the mixture stiffer so that the flow value is lower than the mixture using Pen 60/70.

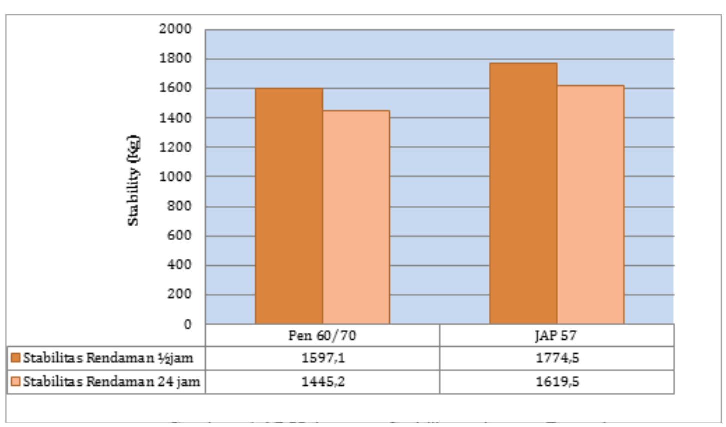
d. Comparison of Conventional Asphalt and Modified Asphalt to the value of MQ (Marshall Quotient)



Picture 6. Comparison Against MQ

The figure shows that the mixture using modified asphalt (JAP 57) tends to be stiffer than conventional asphalt (pen 60/70), where the MQ value of the mixture is higher. This MQ value is influenced by the high stability value of the mixture. This indicates that the mixed material using JAP 57 can make the mixture stiffer where the AC-WC mixture should have higher flexibility.

e. Comparison of Conventional Asphalt and Modified Asphalt on the durability of the mixture
The relationship between the stability value of the standard bath and 24-hour immersion with the variation of the mixture using JAP 57 at optimum asphalt conditions, shows the mixture has a higher residual strength index. The specification of the Ministry of Public Works (2010 Rev 1) requires a minimum residual strength index of 75%.



Picture 7. Stability Relationship With Immersion

f. Dynamic Deformation Test (Wheel Tracking Test)

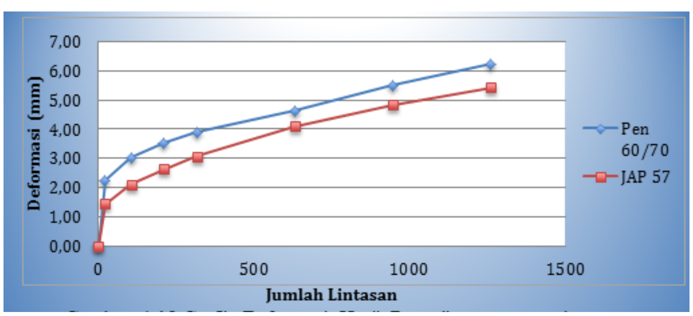
Deformation testing with Wheel Tracking is intended to stimulate the deformation that occurs due to the vehicle's trajectory. The results of the Wheel Tracking test for a mixture of AC WC using conventional asphalt and odified asphalt can be seen in the table.

Table 12. Results of Track Deformation with Wheel Tracking Machine (WTM)

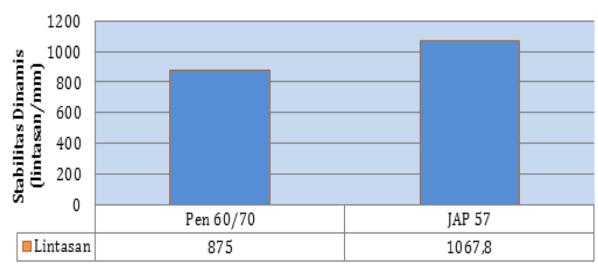
No	Lintasan	Deformasi (mm)	
		Pen 60/70	JAP 57
1	0	0,00	0,00
2	21	2,24	1,44
3	105	3,02	2,10
4	210	3,53	2,64
5	315	3,89	3,08
6	630	4,63	4,09
7	945	5,50	4,84
8	1260	6,22	5,43

Table 13. Wheel Tracking Machine Test Results

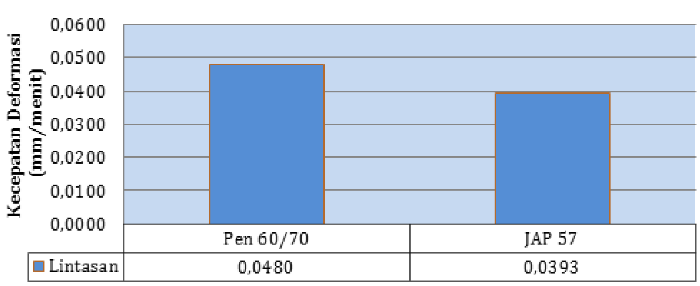
No	Jenis Pengujian	sat	Jenis Aspal	
			Pen 60/70	JAP 57
1	Do : Deflection on Zero (Deformasi saat konsolidasi)	mm	3,34	3,07
2	DS : Dinamic Stability (Stabilitas Dinamis)	lintas/mm	875,0	1067,8
3	RD : Rapid of Determitanition (Kecepatan Deformasi)	mm/min.	0,0480	0,0393



Picture 9. Graph of Deformation of Test Results using WTM



Picture 8. Dynamic Stability Value Comparison Nilai



Picture 10. Deformation Speed Comparison

CONCLUSION

The results showed that the AC – WC mixture using modified asphalt (JAP 57) had high stability and durability values, so that the mixture was stiffer than conventional asphalt (Pen 60/70). Likewise with dynamic stability and speed of deformation, AC – WC mixture using modified asphalt (JAP 57) is better than conventional asphalt (Pen 60/70) as shown in table 4.20.

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