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Resistance to cohesion loss in cantabro test on specimens of porous asphalt containing modified asbuton

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Abstract. Nowadays, road pavement in Indonesia is still dominated by flexible pavement with petroleum bitumen mostly used as a binder. There is a huge deposit of hydrocarbon sedimentary rocks in several areas in Buton Island, Indonesia. One product of Buton natural rock asphalt is refined Asbuton modification which consists of approximately 70% bitumen and 30% minerals. An investigation of the effects of Asbuton modification on the performance of porous asphalt mixture was made using six mixtures based Asbuton modified were 4.5%, 5.0%, 5.5%, 6.0%, 6.5%, and 7.0%. This paper presents a comparative parallel about resistance to disintegration or cohesion loss from the results of the Cantabro test for raveling resistance. The application of Retona Blend as a binder in the porous asphalt mixture improved the raveling resistance in relationship Asbuton modification content with cantabro loss value.

1. Introduction

Aquaplaning and temporary flood on the surface road in the low land area are generated by the heavy precipitation of high-intensity rainfall. The employment of porous asphalt as a wearing course of pavement becomes an interesting solution to overcome the temporary flood problem that occurred from rainfall. Porous asphalt has been used in many countries such as in Netherland [1,2]. Porous asphalt consists mainly of open-graded coarse aggregate with small amounts of fine aggregate and filler, therefore, the skeleton of the open-graded aggregate creates porosity and permeability within the porous. Its porosity can allow water to drain freely through it resulting in aquaplaning reduction [3]. Some areas in southern Buton Island, Indonesia possess natural rock asphalt resources with a deposit of approximately 60,991,554.38 ton (24,352,833.07 barrel oil equivalent). Natural rock asphalt composed of approximately 30% bitumen and 70% mineral. (Refinery Butonic Asphalt, Retona) is a semi extracted type of natural rock asphalt product which is available in the market. The utilization of local materials such as Retona has played an important role in securing stable infrastructure development. This demand will continue in the future [4]. In Indonesia, the heavy precipitation of high-intensity rainfall always creates temporary flood on the surface road in the low land area up to several tens of minutes before flows into the drainage. The utilization of porous asphalt as a wearing course of pavement can overcome the temporary flood problem that occurred from rainfall.

Ravelling refers to a pavement surface distress that takes place due to the dislodgement of aggregate particles from the surface of the mix. The study described raveling as a process that typically begins after 7–9 years in service [5]. It starts with the removal of the first stone, creating a gap, followed by a domino-like effect, with the loss of more stones at a higher rate. When the first



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stone is removed by a vehicle wheel, the remaining stones around the gap lack support in at least one direction.

Cantabro test is commonly used to assess the performance of porous asphalt mixture. The vehicle wheels generate abrasive action on pavement surfacing and lead to material loss which referred to raveling. The raveling resistance or abrasion loss is evaluated [6]. The current research, whose results will be presented below, is based on the characterization of a porous asphalt mixture using Asbuton semi extracted as a binder in its property of resistance to degradation or cohesion loss.

2. Materials and methods

2.1. Retona blend 55

Table 1 show the characteristics of Asbuton modification, Retona Blend 55 used this research.

Table 1. Characteristics of retona blend 55

No.	Kinds of Testing	Testing Result
1	Penetration before weight loss (mm)	78.6
2	Softening point (°C)	52
3	Ductility in 25°C, 5cm/menit (cm)	114
4	Flash point (°C)	280
5	Specific gravity	1.12
6	Weight loss	0.5
7	Penetration after weight loss (mm)	86

2.2. Characteristics of aggregates

Two fractions of coarse aggregates derived from crushed river stone were used : one with aggregate diameter 5-10 mm and the other with crushed stone diameter 10-20 mm. River sand and stone dust obtained from stone crushing process were used as fine aggregate and filler, respectively. The properties of coarse aggregates, fine aggregate and filler are shown in table 2, table 3 and table 4, respectively. The aggregates used for a material component in the cold mixture were collected from Jeneberang river in Gowa.

Table 2. Properties of coarse aggregate

Properties	(Crushed Stone)	
	0,5 - 1 (cm)	1 - 2 (cm)
Water absorption, %	2.071	2.08
Bulk specific gravity	2.622	2.627
Saturated surface dry specific gravity	2.677	2.682
Apparent specific gravity	2.773	2.779
Flakiness index, %	20.1	9.38
Abrasion aggregate, %	25.72	24.36

Table 3. Properties of fine aggregate

Water Absorption, %	2.792	
Sand Equivalent, %	89.66	
Bulk specific gravity 2.449	Saturated surface dry specific gravity	Apparent specific gravity
	2.518	2.629

Table 4. Properties of mineral filler

Water Absorption, %	2.283	
Sand Equivalent, %	69.57	
Bulk specific gravity 2.595	Saturated surface dry specific gravity	2.654
	Apparent specific gravity	2.758

2.3. Combined aggregate gradation and mixtures design

The combined aggregate gradation is shown in figure 1. The combined aggregate gradation was kept by REAM-SP 5/2008 (Road Engineering Association of Malaysia) [7]. The mixtures were all prepared in the laboratory. The content of asphalt Retona Blend 55 was 4.5%, 5.0%, 5.5%, 6.0%, 6.5% and 7.0% of the total weight of the mixture. Table 5 shows the mixture by weight of porous asphalt mixture. Retona Blend 55, aggregates, and filler were mixed and compacted into the cylindrical mold with a capacity of 1,200 gram and diameter of 101.6 mm. In the laboratory, the aggregate and binder (Retona Blend 55) were respectively mixed and compacted at 150 ± 0.5°C. The specimens were compacted with 50 blows each face by using Marshall compactor. After compaction, the specimens were removed from the molds and allowed to cool down. The mixing and compaction process was carried out in the laboratory at temperature, room 27 C.

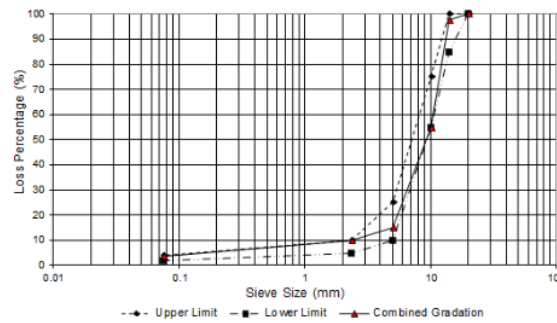


Figure 1. Combined aggregates gradation

Table 5. Asphalt mixture by weight (1,200 gram)

No.	Description	Unit	Asbuton Modification Content (%)					
			4.5	5.0	5.5	6.0	6.5	7.0
A	Asbuton Modification Weight	gr	54	60	66	72	78	84
B	Combined aggregates gradation		Weight of Aggregate by Number of Sieve					
1	3/4"	gr	-	-	-	-	-	-
2	1/2"	gr	-	-	-	-	-	-
3	3/8"	gr	45.38	45.14	44.91	44.67	44.44	44.20
4	No. 4	gr	531.83	529.05	526.26	523.48	520.69	517.91
5	No. 8	gr	263.12	261.74	260.36	258.98	257.61	256.23
6	No. 16	gr	123.16	122.52	121.87	121.23	120.58	119.94
7	No. 30	gr	156.75	155.93	155.11	154.29	153.47	152.65
9	No. 200	gr	25.75	25.62	25.48	25.35	25.21	25.08
	Total	gr	1,145.98	1,139.99	1,133.99	1,127.99	1,122.00	1,116.00
C	Total Weight of Test Piece	gr	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00

2.4. Cantabro test

The cantabro loss testing was carried out to determine the loss of weight of the test object after an abrasion test with a Los Angeles machine. Before the specimen was inserted into the Los Angeles machine drum, it was first weighed to get the weight before being abrasion (Mo). Then the specimen was inserted into the Los Angeles machine drum without a steel ball. The Los Angeles machine is then run at speeds between 30-33 rpm as many as 300 rounds. After finishing the specimen is removed and weighed after abrasion (Mi). The standard testing standard refers to ASTM C-131 [8]. Figure 2 shows the Los Angeles abrasion machine equipment.

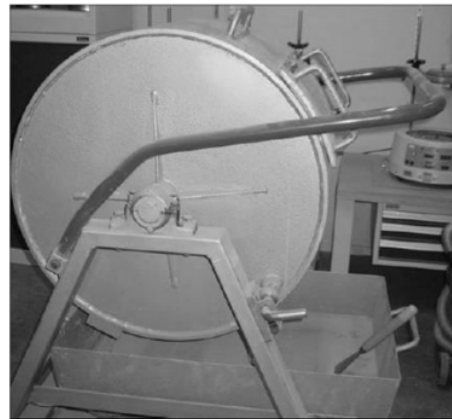


Figure 2. Los Angeles Test Equipment

3. Results and discussion

Based on the results of abrasion testing (cantabro) were to determine the resistance of the test object to the release of grains, the relationship between modified Asbuton contents and cantabro values is shown in figure 3. Tests showed that the reliability of a test object in accepting the existing load. The smaller the weight loss that occurs in the test object means the more resistant and stronger the test specimen. Figure 4 shows the morphology of the test object after wear testing.

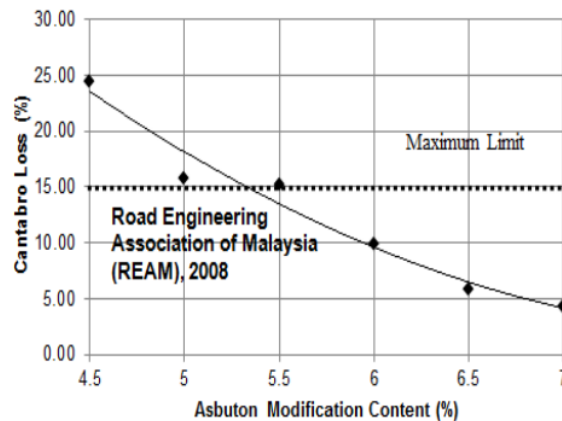


Figure 3. Relationship asbuton modification content with Cantabro loss value



Figure 4. Morphology of specimens after abrasion loss test

The value of weight loss obtained from the results of this test shows that the smallest weight loss value in modified Asbuton content is 6.5% at 5.79%, which is relatively greater than the modified Asbuton level of 7.0% which is 4.30%. While the modified Asbuton content of 4.5% showed the greatest weight loss value of 24.42% and modification of Asbuton 5.0%, 5.5%, and 6.0% respectively, the weight loss obtained was amounting to 15.81%, 15.21%, and 9.82%.

Based on the specifications of REAM, 2008 [7] which requires that the limit of the biggest weight loss from porous asphalt is not more than 15%, so all modified Asbuton levels that meet the required specifications except for modified Asbuton levels are 4.5%, 5.0%, and 5.5%. The results obtained show that with the increase of modified Asbuton levels, the value of the cantilever value on the porous asphalt mixture decreases. Therefore, high abrasion values in porous asphalt mixtures can be caused by inadvertently mixed designs, in appropriate proportions and uses [9].

4. Conclusion

Based on the results, the potential utilization of Asbuton semi extracted (Retona Blend) as a local material is prospective enough to be used as a binder in the manufacture of porous asphalt mixture. According to REAM, 2008, Asbuton modification content that meets the specifications were 6.0%, 6.5%, and 7.0%.

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