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Analysis of The Use of Waste Diesel Oil As an Asbuton Modifier in Hot Mix Cold Laid of Porous Asphalt of Pavement Cantabro Value

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Abstract

The use of petroleum asphalt as a binder still dominates the implementation of road surfacing in Indonesia. Its limited availability and relatively high prices are a problem for the construction industry. Besides petroleum asphalt, Asbuton can also be used as an alternative to the binder in the asphalt mix. Asbuton abundant deposit makes it easier to obtain it at a lower price than petroleum asphalt. However, its use requires a rejuvenating agent to separate the minerals and bitumen and maximize mixing when cold. This study aims to analyze the wear of a hot and cold asphalt mix using rejuvenating agents with variations of 0%, 2%, 3% and 4%, with Asbuton percentages of 5%, 5.5% and 6% with the specifications of the Association of Road Engineers of Malaysia. Laboratory scale. Porous asphalt is intended for light traffic. Wear test of the object to be tested using the Cantabro test. Cantabro test results show that the Porous asphalt mix using waste diesel oil as a rejuvenating agent for Asbuton at the composition of Asbuton 6% + 4% diesel oil waste is the optimal composition. Based on the results of the Cantabro test, it was found that the average wear rate of 0.53% met the REAM specification standards, i.e. wear value ≤ 20%. So the use of diesel with a variation of 4% and Asbuton 6% can be used in porous asphalt mixtures as it contributes to the surface resistance of the road wear layer. Further research needs to be done using the collision variations, assuming that a porous asphalt mix can be used in heavy traffic.

1. INTRODUCTION

Hollow asphalt is an asphalt mixture that uses more coarse aggregate than the fine aggregate. So that the resulting asphalt mixture structure has an open gradation and many pores. The cavity is expected to function as a rainwater management system (Chavanpatil & Chokakkar, 2018) on the road surface or drainage that can drain water both vertically and horizontally (Gusty et al., 2018). The pavement using porous asphalt contributes to a sense of security for its users, especially in the rainy season, so that aquaplaning does not occur, thereby increasing the roughness of the road surface to become rougher and reducing noise (Setyawan, 2009). Porus asphalt is asphalt mixed with certain aggregates, which, after being compacted, has 20% air pores. Porous asphalt generally has a lower Marshall stability value than asphalt concrete that uses dense gradations; Marshall stability will increase if open grading is used with more fine fractions (Cabrera, 2017).

The binder used in the road surfacing always uses less Asbuton than the percentage of bituminous bitumen used (Hermadi, 2015). Asbuton cannot be used optimally because it is still unable to compete with petroleum asphalt. Asbuton must be further refined before being used for pavement mixes in order to obtain optimal results. Apart from these factors, the bitumen content in Asbuton is relatively low, varying between 15% and 45% of the total weight (Alamsyah and Samples, 2003).

While the availability of Asbuton is still plentiful, this is due to the lack of Asbuton, which has low penetration so that the resulting road surface has low resistance (Alamsyah & Meiyanto, 2016). To anticipate this, a modifier or rejuvenating agent is used. The material added is known as a modifier, with the commonly used composition namely bunker oil, petroleum asphalt, As well as light oil (kerosene) and anti-striping or additives with certain compositions. In addition to the several types of heavy oil above, tother heavy oil ingredients may be used in making Asbuton mixture modifiers.

For example, used motorized vehicle or engine oil, which is quite a lot and can be obtained easily and at low prices.

Various attempts have been made to maximize the use of Asbuton in road pavement works. One of them is by using Asbuton usage technology which is being optimized is Cold Paving Hot Mix Asbuton (to moderate) (Special_Specification_CPHMA.Pdf, n.d.) (2013). CPHMA is a mixture of Asbuton consisting of aggregate, grain Asbuton, rejuvenator and other added ingredients mixed in hot conditions and spread out cold. CPHMA has several advantages, namely in the application of CPHMA, it can be compressed in cold conditions, so it is very appropriate to use in areas far from the AMP location. However, in its application in the CPHMA field, it also has shortcomings in workability or ease of work because the cold mixture is stiffer, so it is more difficult to compact. This affects the performance of the mixture (Suroso, 2008).

So this research was carried out to analyze the use of diesel oil waste as a rejuvenator of Asbuton in a hollow hot mix asphalt mixture from the wear value using the cantabro test.

2. METHODS

This research focuses on a porous asphalt mix that refers to the REAM specification of the hot and cold asphalt method using grained Buton asphalt. The asphalt mix uses coarse aggregate and fine aggregate, used diesel oil, and the binder is used 60/70 penetration oil asphalt and 50/30 type Buton granular asphalt (BGA). The equipment used in this research is an oven, a sieve, a Los Angeles machine, a frying pan, a scale, a mole with a capacity of 1200 grams, a Marshall compactor and other supporting equipment.

The Mix Of Design And Experimental Procedures

The process of making a porous asphalt mix, before checking the aggregate characterization, is performed before calculating the design mix based on the specifications of the Association of Road Engineers of Malaysia (REAM). The samples were made with a variation of diesel fuel, respectively 0%, 2%, 3%, 4% variation of Lga 5%, 5.5%, 6% of the total mixture. Each sample consisted of 3 mixed variations using one mole with a capacity of 1200 grams. From the data of the design of the mixture, continue to mix using a pan and stove. Before doing the mixing process, the used oil and Lga are mixed and hardened for 24 hours; the mixture first heating the aggregate, heated to ± 165^{o}C, then mix it with the used oil and Lga. After being evenly mixed, the petroleum asphalt previously preheated is also mixed until the entire surface of the aggregate is covered. After that, the mixture is matured until it reaches a temperature of 50°C and compacted. Before the mixing process, first of all, examining the constituent material of the porous asphalt mixture is carried out. After 24 hours, the test object was made, then the testing process was performed for every three samples for every variation.

3. RESULTS AND DISCUSSION

To determine the physical properties of the aggregates, a test is carried out in the laboratory in order to obtain the characteristic values meeting the specifications. The results of the examination of the physical properties of the aggregates will be presented below.

Physical Properties of Coarse Aggregates

The test results of physical properties of coarse aggregates are carried out according to the test method of Indonesian National Standard (SNI).

Table 1 shows that the inspection value of coarse aggregates with broken stones meets the general specifications of the General Directorate of Roads of the Ministry of Public Works, 2010 (Revision 2).

Tabel 1 Physical Properties of Coarse Aggregates

No.	Testing	Interval Value	Result
1	Absorpsion (%)	Maks. 3	1,58
2	Spesific Gravity (%)		
	a. Bulk Spesific Gravity	Maks. 3	2,58
	b. SSD Spesific Gravity	Maks. 3	2,62
	c. Apparent Density	Maks. 3	2,69
3	Porosity (%)	Maks. 40	31,6
4	Flakiness Index	Maks. 25	24,8

Tabel 2 Sifat-Sifat Agregat Halus

No.	Pengujian	Nilai Interval	Hasil
1	Absorpsion (%)	Maks. 3	2,46
2	Spesific Gravity (%)		
	a. Bulk Spesific Gravity	Maks. 3	2,70
	b. SSD Spesific Gravity	Maks. 3	2,76
	c. Apparent Density	Maks. 3	2,89
3	Sludge Levels (%)	Maks. 5	4,73

Physical Properties Of Fine Aggregates

The results of the physical property testing of fine aggregates carried out according to the Indonesian National Standard (SNI) test method are shown in Table 2.

Table 2 shows that the overall acceptable inspection score meets the general specifications of the General Directorate of Roads, Ministry of Public Works, 2010 (Revision 2).

Determination of mixed gradation

Determination of the combined particle size according to the specifications of the Association of Road Engineers of Malaysia (REAM).

Table 3 and Figure 1 show that the results of the combined aggregate grading test meet the specifications of the Association of Road Engineers of Malaysia (REAM).

Asphalt mix test

The cantabro test is a test for determining the weight of the sample lost after an abrasion test carried out using a Los Angeles machine tool. The test object is made with a diameter of 101.6 mm and compacted on both sides 2x50 from collisions. Test object The porous asphalt mixture is mixed at + 50 ° C. The sample is placed in a Loa Angeles drum using a steel ball and rotated for 300 revolutions or approximately 15 minutes.

Table 4 shows the cantabro test results for a hollow mix of asphalt with BGA 6% and an oil waste content of 0%, 2%, 3% and 4% with an average cantabro value of 87.09 %, 12.10%, respectively. , 1.20% and 0.53%.

Table 4 shows the cantabro test results for a porous mix of asphalt with 6% BGA and an oil waste content of 0%, 2%, 3% and 4% with an average cantabro value of 87.09%, 12.10%, respectively. , 1.20% and 0.53%.

Table 5 shows the cantabro test results for a porous asphalt mix with a BGA of 5.5% and an oil waste content of 0%, 2%, 3% and 4% with an average cantabro value of 71.70%, 24,50%, 2.29% and 42.90%. This explains why adding waste oil up to 3% will further reduce the asphalt mix's weight loss. However, only 3% of a used oil change meets specification with a value below 20%. Meanwhile, 0%, 2% and 4% used oils do not meet specifications.

Table 3. Combined analysis

SIEVE NOMOR		No. 1.5	No. 1	3/4	1/2	3/8	No. 4	No. 8	No. 16	No. 30	No.50	No.100	No. 200
BATU PECAH	**% PASS**	**100**	**100**	88.07	69.53	50.13	32.33	12.33	0.00	0.00	0.00	0.00	0.00
85	**% BATCH**	**85**	**85**	74.86	59.10	37.53	24.20	4.6285	0	0	0	0	0.00
PASIR	**% PASS**	**100**	**100**	100	100	100	100	100	80.50	73.20	66.80	44.90	24.90
15	**% BATCH**	**15**	**15**	15	15	15	15	15	12.08	10.98	10.02	6.735	3.735
AGREGAT GABUNGAN		**100**	**100**	89.86	74.10	52.53	39.20	19.63	12.08	10.98	10.02	6.74	3.74
SPESIFIKASI		**100**	**90-100**	73-90	55-76	45-66	28-39.5	19-26.8	12-18.1	7-13.6	5-11.4	4.5-9	3 - 7'

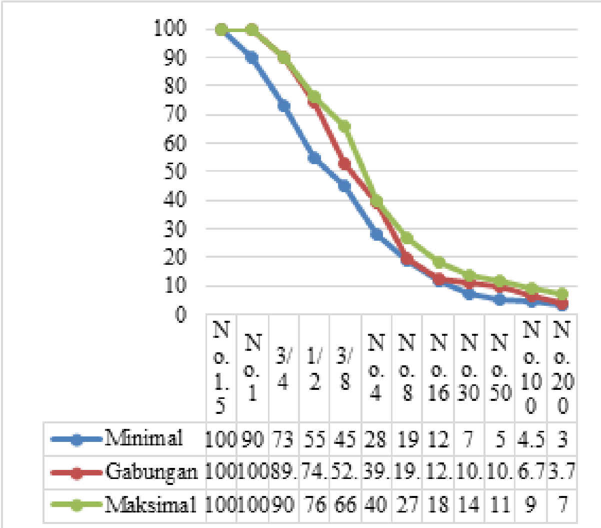

Fig. 1 Aggregate Combined Gradation

Table 4 Cantabro BGA 6% Test Results

Waste Oil Content	BGA Content	Sample	Asphalt Content	Weight Before Testing (Mo)	Weight After Testing (Mi)	Weight Loss	Weight Loss Average	Spesification
						Mo-Mi	(Mo-Mi) / Mo x 100	
Type	%	No.	%	Kg	Kg	Kg	%	%
0%	6	I	6	1240	190	1050	84,68	20
		II		1220	135	1085	88,93	
		III		1215	150	1065	87,65	
Average							87,09	
2%	6	I	6	1225	1075	150	12,24	20
		II		1255	1105	150	11,95	
		III		1240	1090	150	12,10	
Average							12,10	
3%	6	I	6	1255	1245	10	0,80	20
		II		1265	1245	20	1,58	
		III		1215	1200	15	1,23	
Average							1,20	
4%	6	I	6	1265	1255	10	0,79	20
		II		1245	1240	5	0,40	
		III		1285	1280	5	0,39	
Average							0,53	

Table 5 Cantabro BGA 5,5% Test Results

Waste Oil Content	BGA Content	Sample	Asphalt Content	Weight Before Testing (Mo)	Weight After Testing (Mi)	Weight Loss	Weight Loss Average	Spesification
						Mo-Mi	(Mo-Mi) / Mo x 100	
Type	%	No.	%	Kg	Kg	Kg	%	%
0%	5,5	I	5,5	1225	360	865	70,61	20
		II		1220	345	875	71,72	
		III		1230	335	895	72,76	
Average							71,70	
2%	5,5	I	5,5	1250	950	300	24,00	20
		II		1235	935	300	24,29	
		III		1230	920	310	25,20	
Average							24,50	
3%	5,5	I	5,5	1220	1210	10	0,82	20
		II		1290	1250	40	3,10	
		III		1290	1225	65	5,04	
Average							2,99	
4%	5,5	I	5,5	1240	725	515	41,53	20
		II		1235	710	525	42,51	
		III		1265	700	565	44,66	
Average							42,90	

Table 6 Cantabro BGA 5% Test Results

Waste Oil Content	BGA Content	Sample	Asphalt Content	Weight Before Testing (Mo)	Weight After Testing (Mi)	Weight Loss	Weight Loss Average	Spesification
						Mo-Mi	(Mo-Mi) / Mo x 100	
Type	%	No.	%	Kg	Kg	Kg	%	%
0%	5,0	I	5	1225	210	1015	82,86	20
		II		1220	195	1025	84,02	
		III		1250	180	1070	85,60	
Average							84,16	
2%	5	I	5	1230	850	380	30,89	20
		II		1325	840	485	36,60	
		III		1290	830	460	35,66	
Average							34,39	
3%	5	I	5	1220	1210	10	0,82	20
		II		1290	1250	40	3,10	
		III		1290	1215	75	5,81	
Average							3,24	
4%	5	I	5	1265	935	330	26,09	20
		II		1315	975	340	25,86	
		III		1250	915	335	26,80	
Average							26,25	

Table 6 shows the cantabro test results for a porous asphalt mix with 5% BGA and an oil waste content of 0%, 2%, 3% and 4% with an average cantabro value of 84.16 %, 34.39%, respectively. 3.24% and 26.25%. This explains why adding waste oil up to 3% will further reduce the asphalt mix's weight loss. However, only the addition of 3% used oil met specifications with a value below 20%. During this time, 0%, 2% and 4% used oil did not meet specifications.

4. CONCLUSIONS

Cantabro test results show that the porous asphalt mix using waste diesel oil as a rejuvenating agent for Asbuton at the composition of Asbuton 6% + 4% diesel oil waste is the optimal composition. Based on the Cantabro test results, it was found that the average wear rate of 0.53% met the REAM specification standards, i.e. a wear value of ≤ 20%. So the use of diesel fuel with a variation of 4% and Asbuton 6% can be used in a porous asphalt mix as it contributes to the surface resistance of the road wear layer.

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