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Classify Aggregates In Asphalt Pavement Layers (A.C-B. C) Using Sieve Shaker

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Abstract: Aggregates are a significant feature of asphalt mixtures, which significantly affect the volumetric properties and mechanical performance. Layers of concrete asphalt consist of a mixture of fine aggregates, coarse aggregates, and fillers mixed with penetration grade asphalt. The concrete pavement layer (asphalt concrete) has several types: wear surface layer, intermediate surface layer, and foundation layer. The experimental research method with the gradation testing method using the Sieve Shaker machine with aggregate objects. The aggregate used in the form of fine aggregates from Lumajang sand and coarse aggregates from Kediri Kediri is taken randomly with a maximum size of 2.36 mm, aggregate used in the form of corals originating from Kedak area, Semen Subdistrict, Kediri Regency with a maximum size of 19mm. This study aimed to determine the feasibility of aggregate classification in the classification of road pavement layers. The study was conducted using the Sieve Shaker machine with reference to the AASHTO T27. This study obtained the results that the aggregates tested from the Kedak, Kediri, and Pasir Lumajang regions deserved to be included in the Asphalt concrete A.C-B.C category in accordance with Bina Marga Division 6.

Keywords: aggregate, aggregate eligibility, asphalt concerete-binder course, sieve gradation

INTRODUCTION

Aggregates are a major feature of asphalt mixtures, which significantly affect the volumetric properties and mechanical performance of asphalt mixtures(Zhang, Luo, et al., 2019). Consisting of coarse aggregates that have a function in the asphalt heat mixture is in addition to providing stability in the mix and a mortar filler so that the mixture becomes economical(Ar & Hazmi, 2010). Aggregates are an essential material for the manufacture of concrete asphalt layers. A concrete asphalt layer (Asphalt concrete) is a layer on a road construction consisting of coarse aggregates, fine aggregates, fillers, and asphalt mixed, scattered, and compacted in hot conditions at a specific temperature (Datu et al., 2020). Concrete asphalt layers consist of fine aggregates, coarse aggregates, and fillers mixed with asphalt penetration grade (Yusuf et al., 2019). Concrete pavement layers (asphalt concrete) have several types, namely worn surface layer (Wearing Course), surface layer between (Binder Course), and foundation layer (Base). Layers of worn surface (Wearing Course) is to reduce earthquake cracks. The intermediate surface layer (Binder Course) is a layer of concrete that sits between the layer of wear and the foundation layer of the concrete mixture (Ali et al., 2017). While the Lapis Foundation (Base) is the foundation to bear the upper layer load to obtain strong road pavement results (Gaus et al., 2015). Of all the types of asphalt concretes, the difference is the maximum aggregate size contained therein (Zhang, Ma, et al., 2019).

Aggregates consist of Sand, Gravel, coral, slag, or other materials of natural and artificial minerals (Gunarto, 2019). Therefore testing is necessary to determine which aggregates are used to fall into the category of asphalt concrete types. Several parameters are used as a benchmark for aggregate feasibility, including type weight, water absorption, wear rate, sludge levels, and sieve gradation. The test used is the aggregate sieve gradation test. Aggregate gradation is the aggregate particle size distribution and is expressed in percentage to its total weight (Budianto & Lubis, 2020). According to the Bina Marga General Specification 2010, it is explained that aggregate classification can be categorized into asphalt concrete types according to the classification table general specification of Bina marga. If the aggregate used does not match the initial prediction, then the aggregate is not worthy of the maximum size category of the aggregate.

Some studies on aggregate gradation testing have shown that the size of retained aggregates may affect the classification of concrete pavement (Sangiorgi et al., 2017). However, there are still no studies of the classification of concrete pavement layers using aggregate samples from Kedak Kediri village and Lumajang sand. This study aimed to determine the aggregator of the road pavement layer classification. The study was conducted using the Sieve Shaker machine with reference to the AASHTO T27. The aggregate sample was randomly taken as much as 1130 grams. From this study, it will be known that aggregate classification is included in the category of pavement layers that match the initial predictions. So by knowing the results of the asphalt concrete type, it can be used as a reference to prepare a job mix of asphalt mixture.

METHODOLOGY

This research was conducted at the Laboratory of the Department of Civil Engineering, Kadiri University. The experimental research method used with the sieve gradation testing method using the Sieve Shaker machine with aggregate objects(Prayogo et al., 2020). The aggregates used in the form of fine aggregates from Lumajang sand and coarse aggregates from Kedak Kediri are taken randomly. In carrying out this research and efforts to obtain a solution and hypothesis of problems, the research stages include preparation and testing of material physical properties, gradation testing in the form of research data in the form of classification of layers of pavement according to marga(Sumiati & Sukarman, 2014). The test object to be tested gradation of the sieve is aggregate in the form of coral and Sand (KS & Suhendra, 2018). The aggregates tested were aggregates taken in a random field of 1130 grams using cement spoons and stainless containers.

1. Tools and Materials

Gradation test uses materials and tools to get the results of data analysis.

a. Research Materials

The research materials used in this test are aggregates (figure 1). Fine aggregates constitute natural Sand due to the natural disintegration (Hunggurami et al., 2015). The fine aggregates tested gradation is Sand derived from Lumajang sand with a maximum size of 2.36 mm with a percentage of water absorption as much as 3%. The rough aggregates used in the experiments were rough aggregates for mixed designs that were restrained by No.8 (2.36 mm) that were done wet and had to be clean, hard, durable, and free from clay or other unwanted materials and meet the(Yu et al., 2020). Coarse aggregates used in the form of corals originating from Kedak area, Semen Subdistrict, Kediri Regency with a maximum size of 19 mm. The aggregate tested using gradation function to determine the maximum size and classification of aggregates falls into the asphalt concrete category A.C-W.C, A.C-B.C, or A.C-Base.

Figure 1. Aggregate
Source: Research Documentation

b. Research Tools

The tools used in research with the sieve gradation test method are as follows:

1. Sieve Shaker
   Sieve shakers are used to separate particles using layered filtration equipment as well as the presence of different filter values(EL-Sayed & Mostafa, 2014). This equipment utilizes vibrations that make it easier for particles to be separated to pass through a sieve(Dell'Aquila, 2007)(Rahman et al., 2020). The type Sieve Shaker used is the TA-517 type with 220 VA.

a. b.

Figure 2. Sieve Shaker

Source: Research Documentation

Figure 2 illustrates a tool used in sying gradation testing. As in (a) is the brand detail of the tool used; and (b) is a picture of the sieve shaker.

2. Sieve
   Sieve is used to group granules (figure 3), which will be separated into one or more groups (Cahyono et al., 2019).

Figure 3. Sieve
Source: Research Documentation

3. Digital Scales
   Digital scales are used to determine the weight of an object or the mass of an object or substance, with easier use(Manege et al., 2017). The scales use the SF-400 brand (figure 4) with a capacity of 10000 grams.

Figure 4. Digital Scales
Source: Research Documentation

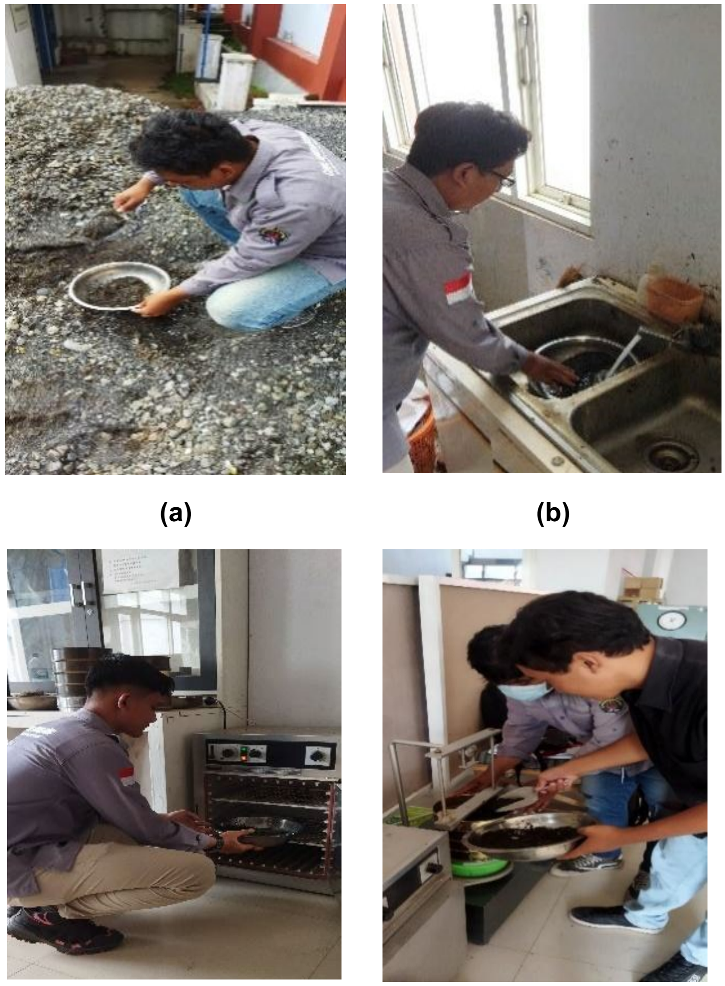
4. Oven
   Ovens are used to heat and dry samples, performing a sterilization process to achieve the desired dryness(Gomathi & Sivakumar, 2014)(Nekkanti et al., 2019). Oven used using memmert brand with a temperature capacity of 200 ° C.

Figure 5. Oven
Source: Research Documentation

2. Data Analysis

Aggregate gradation is the distribution of variations in grain sizes of coarse and fine (Yan et al., 2020). The standard and size of the hole of each sieve used in the test analysis it should be noted that the number of the sieve increases in size, so the size of the hole from the sying increases so that we get the aggregate combined composition with the gradation corresponding to AASHTO T27 (Agency et al., 2015).

The initial process of grading testing will get an aggregate that will be tested in a random field of 1130 grams. Hiled the mud content by washing the aggregate using clean water (Petit et al., 2018). Once the washing process is complete, dry the aggregate until the mass remains at a temperature of 110 ± 5 °C (Teymen, 2019). While waiting for the aggregate to dry and normal temperature, prepare the sieve to be used. The next process inserts the aggregate into the sieve shaker machine and starts the engine for 7 minutes. After the Sieve shaker machine stops, take each sieve and weigh the aggregates held on the sieve.



(a) **(b)** **(c)** **(d)**

Figure 6. Sieve Gradation Testing Process
Source: Research Documentation

The testing process has been described as in figure 6 with aggregate results held back at varying weights as in: (a) search for aggregates from the field at random; (b) the process of washing aggregates to remove sludge levels on aggregates; (c) the process of drying the aggregate until the mass remains for 24 hours; (d) The gradation test process is performed using a sieve shaker machine. From such weight, it will be known whether the aggregate mixture between coarse aggregates from Kedak, Kediri, and fine aggregates derived from Lumajang sand is categorized as worthy of entry A.C-B. C (Asphalt Concrete Binder Course). After getting the results, we will adjust the aggregate held per sieve to the gradation envelope. The grading envelope is the grading limit for aggregate classification in accordance with the General Specification of Bina Marga 2010 Division 6.

Table 1. Aggregate Gradation Limits According to General Specifications of Bina Marga

Size of Sieve (inch)	% Weight Qualified against Aggregate Totals in a Mixture								
	Latasir (SS)		Lataston (HRS)				Asphalt concrete (AC)[1]		
			Semi Senjang Gradation[3]		Semi Senjang Gradation[2]				
	Class A	Class B	WC	Base	WC	Base	WC	BC	Base
1 1/2"									100
1"								100	90 - 100
¾"	100	100	100	100	100	100	100	90 – 100	76 - 90
½"			90 - 100	90 - 100	87 - 100	90 - 100	90 - 100	75 – 90	60 - 78
3/8"	90 – 100		75 - 85	65 - 90	55 - 88	55 - 70	77 - 90	66 – 82	52 - 71
No.4							53 - 69	46 – 64	35 - 54
No.8		75 - 100	50 - 72	35 - 55	50 - 62	32 - 44	33 - 53	30 – 49	23 - 41
No.16							21 - 40	18 – 38	13 - 30
No.30			35 - 60	15 - 35	20 - 45	15 - 35	14 - 30	12 – 28	10 - 22
No.50					15 35	5 - 35	9 - 22	7 – 20	6 - 15
No.100							6 - 15	5 – 13	4 - 10
No.200	10 – 15	8 - 13	6 - 10	2 - 9	6 - 10	4 - 8	4 - 9	4 – 8	3 - 7

[1]*Source: General Specifications of Bina Marga 2018 Division 6*

Table 1 illustrates the aggregate gradation limit to classify aggregates held each year in the latasir, lataston, or asphalt concrete category according to the percentage obtained.

RESULTS AND DISCUSSION

1. Test Results

Gradation testing using a sieve shaker machine is obtained as in Table 2 below.

Table 2. Results Of Sieve Gradation Test

No	Sieve (inches)	Numbers Held Gram (gr)	Number of Escapes	Specifications
1	Sieve No. ¾	-	100%	Course Aggregate
2	Sieve No. ½	120	89%	Course Aggregate
3	Sieve No. ⅜	160	75%	Course Aggregate
4	Sieve No. 4	235	54%	Course Aggregate
5	Sieve No. 8	195	37%	Course Aggregate
6	Sieve No.16	60	32%	Fine Aggregate
7	Sieve No.30	60	27%	Fine Aggregate
8	Sieve No.50	60	21%	Fine Aggregate
9	Sieve No.100	60	16%	Fine Aggregate
10	Sieve No. 200	95	8%	Fine Aggregate
11	Pan	85	0%	Filter
	Sum	1130	-	

Source: Processed data

In Table 2, the results obtained that the coarse and fine aggregates derived from Kedak Kediri Village and Lumajang sand are held back 1/2 to 200, with the percentage of sieve held for various. In accordance with the results obtained in the sieve gradation test, fine and coarse aggregates can be categorized in accordance with the provisions of the 6th division of the clan.

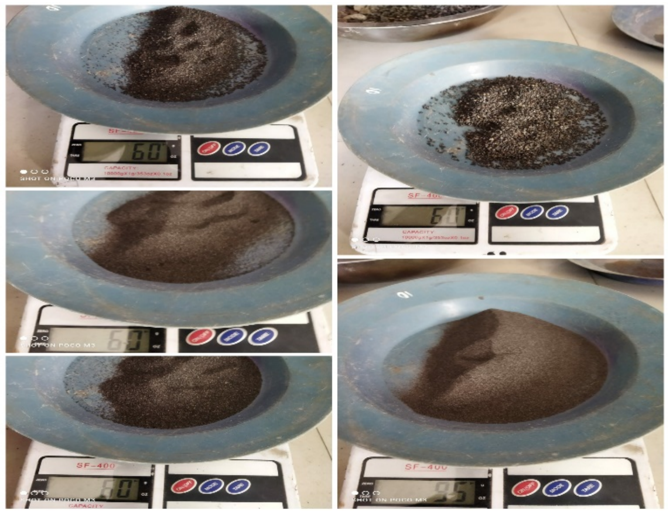


Figure 7. Sieve Gradation Test Results
Source: Research Documentation

Figure 7 shows that the results of the sieve gradation test are weighed and placed in a container to obtain a percentage of the retained aggregate. The percentage results are spelled out and corrected based on general specifications as described in Table 3.

Table 3. Aggregate Grouping Results By General Specifications 2018

No.	Sieve	Asphalt concrete(AC)			Comulative Percentage	Information
		WC	BC	Base	Escape (%)	AC-BC/WC/Base
(1)	(2)	(3)			(4)	(5)
1	Sieve No. ¾		100	90-100	100%	AC-BC
2	Sieve No. ½	100	90-100	76-90	89%	AC-BC
3	Sieve No. ⅜	90-100	75-90	60-78	75%	AC-BC
4	Sieve No. 4	77-90	66-82	52-71	54%	AC-BC
5	Sieve No. 8	53-69	46-64	35-54	37%	AC-BC
6	Sieve No. 16	33-53	30-49	23-41	32%	AC-BC
7	Sieve No. 30	21-40	18-38	13-30	27%	AC-BC
8	Sieve No. 50	14-30	12-28	10-22	21%	AC-BC
9	Sieve No. 100	9-22	7-20	6-15	16%	AC-BC
10	Sieve No. 200	6-15	5-13	4-10	8%	AC-BC
11	Pan	4-9	4-8	3-7	0%	AC-BC

Source: Processed data

Table 3 obtained the result that the aggregate tested randomly in the field belongs to the category asphalt concrete ac-BC road pavement. The results are obtained from the qualified cumulative percentage and adjusted to the Aggregate Gradation Limit table according to the General Specifications of Bina Marga.

CONCLUSION

Based on the gradation test results, the aggregate tested from Kedak, Kediri, and Lumajang Sand with numbers 1/2, 3/8, 4, 8, 16, 30, 50, 100, 200 were tested in the asphalt concrete ac-BC category in accordance with Bina Marga Division 6.

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