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Utilization of Coconut Coir Waste in Fibrous Porous Asphalt Planning Using REAM Spesification

Irianto[1], M. Tumpu[2] and Sri Gusty[3]

[1]Lecturer, Civil Engineering Department, Yapis University, Jayapura Indonesia
[2]Lecturer, Civil Engineering Department, Fajar University, Makassar Indonesia
[3]Lecturer, Magister of Infrastructure and Environmental Engineering Department, Fajar University, Makassar Indonesia
[1]irian.anto@gmail.com*, [2]tumpumiswar@gmail.com,[3]srigusty@ymail.com

Abstract:

type of asphalt mixture is porous asphalt which is a type of pavement that has been developed in several developed countries and is intended only for the wearing course. Porous asphalt is a mixture of asphalt being developed for construction. Most of the coconut husk is only thrown away when it has been processed from the coconut. One of the specifications for porous asphalt is the Road Engineering Association of Malaysia (REAM). Based on this, further research was conducted to find the benefits and contents of the mixture of asphalt and coconut husk. as one of the uses of coconut coir waste in order to reduce coconut coir waste which is rarely processed. The research method that I do is experimental in the laboratory, namely testing to determine the value of Marshall and Cantabro. Marshall testing was carried out with 6 test objects in the form of briquettes and 6 cantabro objects with a total of 12 test objects. The variation of coconut coir used is a variation of 0% and 0.75% with a mixture of asphalt oil content of 4%. From the test results, it can be concluded that the characteristic values of Marshall, namely, Marshall characteristic values that meet Ream specifications are VMA 0.75%, Stability 0%, Flow 0%, MQ 0% and 0.75%. Whereas in the cantabro test the average weight loss at the 0% variation was 22.00%, and in the coconut husk variation was 29.38%.

Keywords: *Coconut coir waste, Porous asphalt, REAM spesification*

I. INTRODUCTION

In Indonesia there are a lot of coconuts, almost everywhere you can find coconuts, 45% of coconut fruit is coir and coconut coir waste is still very rarely processed, most coconut husks are only thrown away when it has been processed from the coconut. Coconut coir is one of the easily available biomass and is a byproduct of agriculture. Coconut coir consists of fibers (fiber) and cork (pitch) that connect one fiber to another. Coconut coir consists of 75% fiber and 25% cork [1-3].

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Coconut coir is the outer part of the coconut fruit. The thickness of coconut husk ranges from 5-6 cm which consists of an outer layer (exocarpium) and an inner layer (endocarpium). Endocarpium contains fine fibers as material for ropes, carpets, brushes, mats, heat and sound insulation, filters, seat/car seat fillers and hardboard boards. One coconut produces 0.4 kg of coir which contains 30% fiber [4].

Porous asphalt is an asphalt mixture that is being developed for construction. This layer uses an open graded which is dominated by coarse aggregate, resulting in a large enough cavity. There is a need for new innovations in finding other alternative developments to reduce the impact of road damage so that rainwater does not seep into the ground using a layer of porous asphalt [5-7].

One of the specifications for porous asphalt is the Road Engineering Association Of Malaysia (REAM). Research conducted by RidwanFalih N., M. ZainulArifin, HendiBowoputro, stated that the results of testing the optimum value of asphalt content, coconut fiber content and coconut fiber length were 4% and 5mm. The results of statistical tests show that there is an effect of the addition of coconut fibers on the Marshall value, namely MQ and the stability of the porous asphalt mixture [8].

Asphalt mixture is still the dominant road pavement cover layer in Indonesia. One type of asphalt mixture is porous asphalt which is a type of pavement that has been developed in several developed countries and is intended only for the wearing course. Porous asphalt is a new generation in flexible pavement. The porous nature is obtained because this mixture uses less fine aggregate than other mixtures so that it has a larger cavity/pore content which is expected to have a high degree of rigidity and the pore can function as a drainage channel in the mixture. These cavities/pores allow water to seep directly vertically and horizontally towards the edge of the road body and then enter the side channel [9-11].

On the basis of this, further research was conducted to find the benefits and contents of the mixture of asphalt and coconut husk. Therefore, I raised this title as one of the uses of coconut coir waste in order to reduce coconut coir waste which is rarely processed. In this research, used dry coconut husk which was cut into 5 mm size, and mixed with asphalt before mixing it with aggregate. The addition of coco fiber to the asphalt aims to find an alternative to the asphalt mixture.

II. MATERIALS AND METHOD

A. Physical Properties of Aggregate

Testing of fine and coarse aggregates is carried out at the Civil Engineering Laboratory of Fajar University, by observing the Indonesian National Standard (SNI). The test results show that the fine and coarse aggregates meet the criteria as the constituent material of concrete. The results of the fine and coarse aggregate test can be seen in Table 1 and Table 2, respectively.

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TABLE I Physical properties of fine aggregate

No.	Characteristics	Results of inspection
1	Water absorption (%)	2.46
2	Bulk specific gravity	2.70
3	Saturated surface dry specific gravity	2.76
4	Apparent specific gravity	2.89
5	Sludge content (%)	4.73

TABLE II Physical properties of coarse aggregate

No.	Characteristics	Result of inspection
1	Water absorption (%)	1.58
2	Bulk specific gravity	2.58
3	Saturated surface dry specific gravity	2.62
4	Apparent specific gravity	2.69
5	Abrasion (%)	31.6
6	Flakiness index	24.8

B. Method of Research

The method used in this study is an experimental method, namely the method used by conducting experimental activities to obtain research data. The purpose of this research was to determine the comparison related to the study of the utilization of coconut husk waste on hollow asphalt. The addition of coconut husk waste to the asphalt mixture was carried out with several variations, namely 0% and 0.75%.

Equipment

Tools used in this study were a scale with a sensitivity of 0.1 gram, oven, shaking machine, filter no. ¾; ½; 3/8; 4; 8; 200 and pan, Marshall, cantabro, los angeles machines, stoves, pans, spatula, thermometer and waterbath.

Procedure 1

In this research activity begins with the preparation stage, namely the collection of data in the form of primary data obtained from the results of tests carried out by researchers while secondary data can be obtained from literature, both from books - books and journals.

Procedure 2

Before carrying out research activities, the tools and materials to be examined are prepared in the laboratory. This activity includes: location survey activities of the materials used, activities to bring/transport test materials from the location of material collection to the laboratory.

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Procedure 3

At the stage of making this specimen the asphalt mixing process will be carried out and carried out based on the calculation results of the Mix Design planning, the things that must be done at this stage are:

1. Mixing process between fine and coarse aggregate.
2. Asphalt mixing
3. Process Coconut coir insertion
4. Process Asphalt mashing process in the moll and the briquettes are left for 2 days (48 hours).

Procedure 4

The testing to be carried out by hollow asphalt includes the composition of the mix asphalt porousand testing of hollow asphalt briquettes. After testing the material and fulfilling the specifications for a hollow asphalt mixture.

Procedure 5

In testing the hollow asphalt specimen, it can be tested by testing, namely: characteristic Marshalltesting and Cantabro testing according to specifications (*REAM* 2008).

C. Marshall Stability Test

The Marshall stability test was conducted on AC-WC mixture with and without Coconut Coir Waste specimens according to SNI 06-2489-1991. Fig. 1 shows the Marshall stability test equipment.

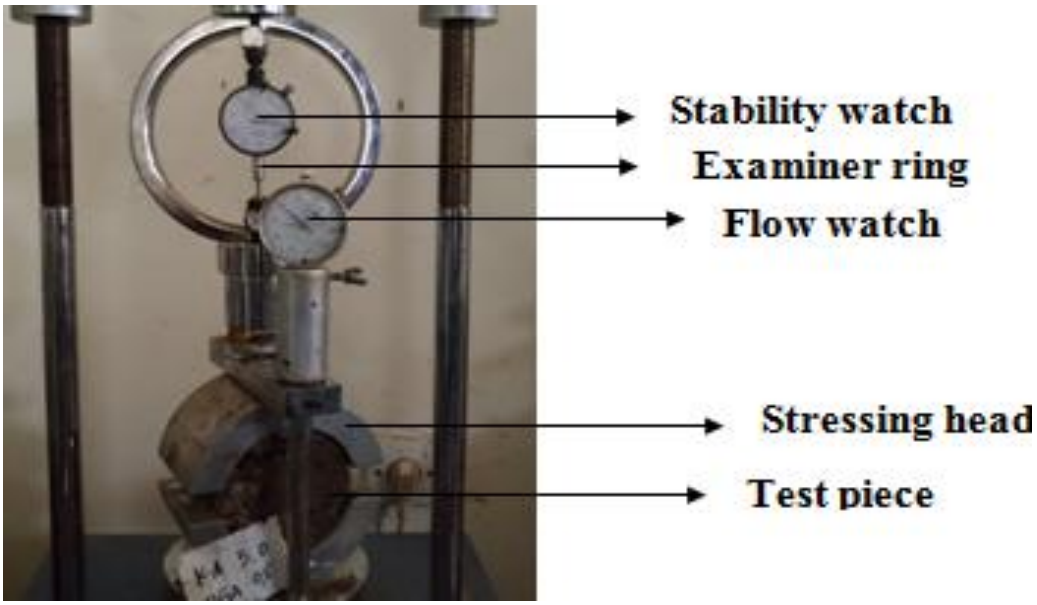

Fig 1: Marshall stability test equipment

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III. RESULTS AND DISCUSSION

A. Combined Aggregates Gradation

The combined aggregate gradation was designed according to REAM-SP 5/2008 (Road Engineering Association ofMalaysia). The mixtures were all prepared in the laboratory. The content of waste PET was 4.5%, 5.0%, 5.5%, 6.0%, 6.5% and 7.0% of the total weight of the mixture. Petroleum bitumen, aggregates and filler were mixed and compacted into the cylindrical mold with capacity of 1,200 gram and diameter of 101.6 mm. In the laboratory, the aggregate and binder (Petroleum Bitumen) 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. Mixing and compaction process were carried out in the laboratory at temperature room 27°C. Fig. 2 shows the combined aggregate gradation.

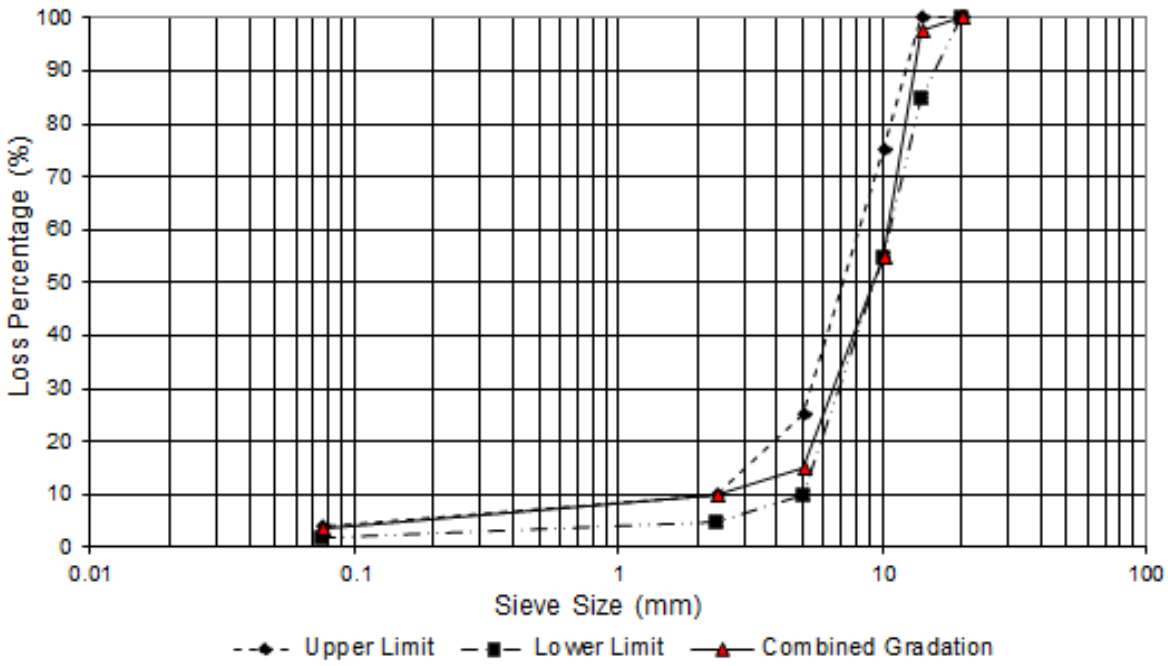

Fig 2: Combined aggregates gradation

B. Marshall Characteristics

Test was carried out to determine the Marshall parameter value using thespecification gradations Road Engineering Association of Malaysia (REAM). The results can be seen in Table 3.

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TABLE III Marshall characteristics

No.	Characteristics	Coconut coir waste		Specification (REAM, 2008)
		0%	0.75%	
1	Void in mineral aggregate (%)	40.46	10.70	Min. 16
2	Void filled bitumen (%)	47.92	131.58	70 – 80
3	Void in mix (%)	31.20	-3.20	18 – 25
4	Stability (kg)	515.00	221.13	Min. 350
5	Flow (mm)	2.55	1.64	2 – 4
6	Marshall quetiont (kg/mm)	290.90	491.69	Min. 200

Voids in Mixture (cavity in the mixture) is the volume of the cavity that contains air in the asphalt mixture, and is expressed as a% of the mixture. Based on the REAM specifications, the required specification value is 18-25%. Based on the Marshall Test results shown in Table 3, the relationship between coconut coir variations and VIM values in REAM specifications, none of which meet the specifications. Based on the results of testing the average VIM value at variation 0% = 31.2%, variation 0.75% = - 3.2%.

Voids in Material Aggregate (Cavities in the aggregate), is the volume of cavities that exist between the aggregate grains of a compacted asphalt mixture. Based on the REAM Specifications, the required VMA specification value is a minimum of 16%. It can be seen in Table 3. Based on the results of the Marshall Test in Table 3, it can be seen that the value of 0% coconut coir variation meets the required specifications while the 0.75% coconut coir variation does not meet the specifications.

VFB is the portion of the cavity between the mineral aggregate that is filled with effective asphalt, expressed in percent. Based on the *Road Engineering Association of Malaysia (REAM)* specifications, the required VFB specification value is at least 70-80%. It can be seen in Table 3 that none of them meet the specifications. Based on the picture above, the average VFB value at the variation of 0% = 47.39%, the variation of coconut coir is 0.75% = 131.58%. In the coconut coir variation, none of the VFB values meet the specifications.

Based on the Road Engineering Association of Malaysia (REAM) specifications which required a minimum of 350 kg. Based on the test results, it can be seen that in Table 3. Effect of coconut coir on the stability value, the stability value at variation 0% = 515 kg, coconut coir variation 0.75% = 221.13 kg, no some meet the required specifications.

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Based on the Road Engineering Association of Malaysia (REAM)specifications, the required flow specification values are a minimum of 2-4 mm. It can be seen in Table 3 that the flow value at the variation of 0% = 2.55 mm, while the variation of coconut husk is 0.75% = 1.64% so that it does not meet the specifications.

Testing Marshall Quetiont (MQ) Based on the required value of the Marshall Quetiont specification, a minimum of 200 kg/mm. It can be seen in Table 3 that the variation of 0% = 290.9 kg/mm, while the coconut husk variation of 0.75% = 491.69kg/mm has met the required specifications.

C. Cantabro Test

The cantabro test is carried out to evaluate the resistance of the asphalt mixture to the release of grains and can be carried out by an abrasion test (Cantabrian Test). The compacted specimen (briquette) was inserted into themachine drum *Los Angeles* to determine the wear of the specimen. After completion, the test object is removed and weighed to determine the weight after abrasion (Mi). Based on the specifications of REAM, 2008, which requires that the maximum weight loss value of porous asphalt is not more than 20%. In the REAM specification, the weight loss requirements for cantabro test on porous asphalt should not be more than 20%, it can be seen from the figure IV.20, the percentage of variation is 0% = 22.00 and 0.75% = 29.38, at REAM specifications do not meet the required specifications, namely a maximum of 20%.

IV. CONCLUDING REMARKS

From the test results, it can be concluded that Marshall characteristic values are: Marshall characteristic values that meet Ream specifications, namely VMA 0.75%, Stability 0%, Flow 0%, MQ 0% and 0.75%. Whereas in the cantabro test the average weight loss at the 0% variation is 22.00%, and in the coconut coir variation is 29.38%. From the results of the Marshall characteristic test, it was shown that by increasing the level of coconut husk waste, the stability value increased. This is because the mixture is denser and the mixture is stiffer, which is indicated by the MQ value of the large Marshall characteristics. A high MQ (Marshall Quetiont) value indicates that the asphalt mixture has higher stiffness and is brittle and correlates to a large compressive strength value. In addition, the combination of coconut coir waste which is polymeric with porous oil shells with a low bitumen penetration value causes good binding.

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