CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol 11 No.2 June 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Utilization of Palm Shell Ash as a Filler in Making AC-WC Type Porous Asphalt

Vella Anggreana[1]*, Sy. Sarah Alwiyah[2], Junita Sari[3]
[1,2,3] Faculty of Engineering, Universitas Islam Riau, Indonesia
*Corresponding Author, e-mail: vella.anggreana@eng.uir.ac.id

Received 9th April 2024; Revision 21th May 2024; Accepted 29th June 2024

ABSTRACT

The background to the research that will be carried out is that the large amount of standing water on the road pavement in each rainy season results in disturbances to motorists' comfort. This is due to impermeable road pavement and poor drainage along the road. Porous asphalt can increase rainwater absorption, thereby reducing puddles on the road surface. Porous asphalt is a new breakthrough in the world of road pavement to reduce the appearance of puddles of water when it rains. Porous asphalt is also designed to have high porosity so that water can flow through side channels and a waterproof base layer to prevent water from seeping into the subbase layer and road body so as to minimize puddles of water on the road surface which often occur after rain and disrupt the smooth flow of traffic. cross. Advances in road pavement technology have encouraged researchers to conduct research using palm shell ash (fly ash) as a filler in porous asphalt mixtures. The use of palm shell ash is expected to increase the stability value and have large cavities so that water can pass through the road surface, as well as to reduce palm oil waste in Indonesia. The objectives of this research are 1. To find out the optimum asphalt content value in porous asphalt mixtures, 2. To know the results of using palm shell ash at 0%, 1% and 2% as a filler for porous asphalt mixtures in flexible road pavement. The research method is Marshall and Permeability Testing. The tests that will be carried out on a laboratory scale use an AC-WC hot mix asphalt system with guidance, namely the basics of asphalt concrete road construction. The research results showed that by adding palm shell ash as a filler in making AC-WC type porous asphalt, it showed that the stability value was higher, while the permeability value was lower, meaning that the addition of palm shell ash to the porous asphalt mixture did not have a significant effect because it was smaller. air voids in the mixture. The addition of palm shell ash to the porous asphalt mixture increases the stability value which can increase the ability of road construction to accept loads, but the pavement layer is not permeable and water flows over the surface more slowly.

Keywords: *Palm Shell Ash; Porous Asphalt.*

INTRODUCTION

Improving and developing road transportation accessibility is something that is very important to support the social and economic activities of a country's regions. Therefore, the development of the road network is something that is deemed necessary to be able to serve the development of traffic flows safely and comfortably. One of the supporting factors is that the accessibility of a road network is safe and comfortable for road users and can last throughout its service life. The background to this research was carried out because researchers saw that there was a large amount of standing water on the road pavement every rainy season, causing disturbances to motorists' comfort. This is due to impermeable road pavement and poor drainage along the road. Porous asphalt can increase rainwater absorption, thereby reducing puddles on the road surface. Porous asphalt is a new breakthrough in the world of road pavement to reduce the appearance of puddles of water when it rains.

Porous asphalt is also designed to have high porosity so that water can flow through side channels and a waterproof base layer to prevent water from seeping into the subbase layer and road body so as to minimize puddles of water on the road surface which often occur after rain and disrupt the smooth flow of traffic. cross. Porous asphalt is expected to function as anti-slip, anti-aquaplaning, drainage and noise reduction which can only be achieved through the use of uniform gradations. Apart from that, uniform gradations have high permeability and porosity and are able to pass water well.

Industry in Indonesia, especially in Riau, tends to produce quite a lot of waste which has a negative impact on people's daily lives. For example, the palm oil industry. To provide good results in the case of palm oil waste and increase and develop road pavement accessibility, researchers will conduct research using palm oil shell waste in the form of ash from its combustion which will be used as a filler in porous asphalt mixtures. Advances in road pavement technology have encouraged researchers to conduct research using palm shell ash (fly ash) as a filler in porous asphalt mixtures. The use of palm shell ash is expected to increase the stability value and have large cavities so that water can pass through the road surface, as well as to reduce palm oil waste in Indonesia.

The problems that will be studied are 1. What is the optimum asphalt content value in a porous asphalt mixture and 2. What are the results of using palm shell ash at 0%, 1% and 2% as a filler for a porous asphalt mixture in flexible road pavement. The specific objectives of this research are 1. To find out what the optimum asphalt content value is in porous asphalt mixtures and 2. To know the results of using palm shell ash at 0%, 1% and 2% as filler for porous asphalt mixtures in flexible road pavement.

RESEARCH DESCRIPTION

Material Testing

1. Sieve Analysis
   Sieve analysis functions to obtain aggregate gradations, namely coarse aggregate, medium (meduim), fine aggregate and sand. Sieve analysis is the determination of the weight of aggregate grains that pass through a set of sieves after which the percentage results are depicted on a grain distribution graph. This sieve analysis test refers to SNI 03-1968-1990. The equipment used is a set of filters starting from filter sizes 1", 3/4", 1/2", 3/8", No. 4, No. 8, No. 16, No. 30, No. 50, No. .100, No. 200.
2. Specific Gravity
   The ratio of the weight of a volume of material to the weight of the same volume of water is the specific gravity of the aggregate. This test is carried out on coarse aggregate and fine aggregate. Specific gravity testing aims to obtain the effective specific gravity of the asphalt mixture.
3. Testing the Adhesion of Asphalt to Aggregate
   The purpose of this test is to determine the adhesion value of the aggregate to asphalt. Apart from testing its adhesion to asphalt, it is also influenced by the aggregate's

properties against water. Rocks and granite which contain silica are aggregates that have hydropolic properties, namely aggregates that tend to absorb water. Aggregates like this are not good for mixing with asphalt because striping easily occurs, that is, the asphalt layer comes off from the aggregate due to being affected by water, so the bond between the asphalt and the aggregate is quite good

4. Palm Oil Shell Ash Processing
   Palm shell ash taken from PT. Talang Jerinjing Sawit (TJS) Indragiri Hulu Regency, Rengat District goes through several processing stages, namely:
   a. Burning Palm Oil Shell Waste
      Burning palm oil shell waste is carried out by collecting the remains of palm oil production in the form of palm shells and then burning them using a boiler (burning furnace) at a temperature of around 700 C to 800 C.
   b. Palm Oil Shell Ash Filtering
      The ash resulting from combustion is filtered using filters No.50, No.100, and No.200. The aim is for the palm shell waste ash to have a uniform level of fineness (ash passes through No. 200 sieve).

Designing the Proportions of Each Aggregate Fraction

Before proceeding to make test objects (asphalt briquettes), researchers must first calculate the amount of aggregate to be used from each aggregate fraction. The design will be based on the gradation of each aggregate fraction to be mixed. In order to obtain optimal mixture proportions, the mixture results must be evaluated and corrected first. The gradation used is an open gradation based on the 2004 Australian Asphalt Pavement Association (AAPA) specifications.

Making Test Objects (Asphalt Briquettes)

Before making test objects, a mix design is carried out. Mix design planning includes aggregate gradation planning, determining asphalt content, and determining the composition of each fraction of aggregate, asphalt, and filler. The test objects (asphalt briquettes) will be made according to the specified variations in asphalt content and filler combination.

Mixed Planning for KAO

Before making test object samples, a calculation will first be carried out for each Optimum Asphalt Content (KAO) with the planned asphalt content, and the aggregate will be separated according to the size of the filter used, namely the AC-WC filter to ensure that all samples are uniform. Then the percentage of KAO use for palm shell ash was made by making asphalt briquette samples with the planned percentage.

After making samples of test objects, stability and flow values will be obtained, then by analyzing existing data, VIM, VMA, VFA values can be obtained, to determine KAO (Optimum Asphalt Content) for each sample level.

Marshall Test

The purpose of carrying out the Marshall Test is to determine the flow and stability of an asphalt mixture. Before carrying out the Marshall test, the necessary weighing is first carried out related to calculating the volumetric properties of the mixture. The asphalt parameter calculations in this research are VIM, VMA, VFA, stability, flow, in accordance with the existing parameters in the mixture specifications.

Permeability Testing

In this test, the method that will be used to measure the amount of permeability is the Falling Head Permeability (FHP) method. This method is useful for measuring the amount of permeability where the water in the tube (stand pipe) falls freely to a certain height until it passes through the cavity in the porous asphalt mixture. The purpose of carrying out this permeability test is to determine the ability of porous asphalt pavement to drain water. The specifications used in this test refer to the Australian Asphalt Pavement Association (AAPA) 2004.

RESULTS AND DISCUSSION

Material Testing Results

In this study, coarse aggregate was obtained from Pangkalan and fine aggregate came from Kampar. Before all aggregates are used, testing is carried out first. The way to carry out the test is by using an abrasion test as a guide to determine the resistance of the coarse aggregate to wear using a Los Angeles abrasion machine (SNI, 2008). The purpose of carrying out this abrasion test is to determine the wear rate which is expressed by the ratio of the weight of the worn material to the original weight in percent. The results can be used in planning and implementing road pavement materials in accordance with the provisions of the 2018 technical specifications. Because the abrasion test value obtained was 19%. Where the maximum aggregate wear limit after abrasion testing with a Los Angeles machine is 40%.

1. Aggregate Grain Size Distribution (Sieve Analysis)
   Aggregate grain size distribution is the determination of the percentage of grain weight on a set of sieves with a certain hole diameter. Check this sieve analysis intended to determine the pass percentage of each aggregate used and then used as a guideline for determining asphalt mixture aggregates.
2. Specific Gravity and Absorption Testing of Coarse and Fine Aggregates
   From the specific gravity and absorption tests it can be seen that the specific gravity and absorption meet the requirements. The specific gravity and absorption test results were good for coarse aggregate, medium aggregate, stone ash and sand.
3. Testing Specific Gravity of Palm Shell Ash (Filler)
   In this research, the filler used is fine aggregate that passes through the No. 200 sieve. The ash that passes No. 200 is fly ash. The physical characteristics of fly ash generally depend on the efficiency of the combustion process at the processing site and the type of material.

Aggregate Combination

The composition of the AC-WC mixture consists of 4 fractions, namely coarse, medium aggregate, stone ash and sand. The percentage of each aggregate usage is obtained using the matrix method. The percentage of aggregate use is multiplied by the percent passing of each aggregate, resulting in a combined aggregate gradation. This test aims to determine the nature or characteristics of the aggregate, this examination is intended to determine the division of grains (gradations) of fine aggregate and coarse aggregate using a sieve. Aggregate gradation testing is also useful for determining the proportion of fine aggregate to total aggregate. The gradation of this combined aggregate must meet the requirements or specifications of the Australian Pavement Association (AAPA) 2004.

Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.2 June 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Table 1. Aggregate gradation results for the AC-WC mixture

NOMOR SARINGAN		% PEMAKAIAN AGREGAT				GRADASI GAB.	SPEK.
		Kasar	Sedang	Abu Batu	Pasir		% LOLOS
Inchi	mm	70,40	15,40	9,95	4,25		
1	25,4	70,40	15,40	9,95	4,25	100,000	100
3/4"	19,1	67,66	15,40	9,95	4,25	97,261	85-100
1/2"	12,7	27,63	15,18	9,95	4,25	57,000	45-70
3/8"	9,5	15,10	13,45	9,95	4,25	42,746	25-45
#4	4,75	5,48	1,20	9,63	3,75	20,060	10-25
#8	2,38	4,96	0,83	5,05	2,15	13,000	7-15
#16	1,18	4,91	0,69	3,95	1,94	11,491	6-12
#30	0,60	4,27	0,57	2,32	1,69	8,856	5-10
#50	0,30	4,03	0,53	1,04	1,58	7,179	4-8
#100	0,15	2,92	0,50	0,46	1,32	5,198	3-7
#200	0,075	2,82	0,49	0,42	1,27	5,000	2-5

Based on table 1, the percent use of coarse aggregate (CA) is 70.40%, medium aggregate (MA) is 15.40%, stone ash (FA) is 9.95%, and sand (FS) is 4.25%. The specifications for the upper middle limit and lower limit in table 1 meet the specifications listed in table 3.4 Specifications for Gradation of Porous Asphalt Combined Aggregates (AAPA 2004). The combined aggregate gradation graph can be seen in Figure 1.

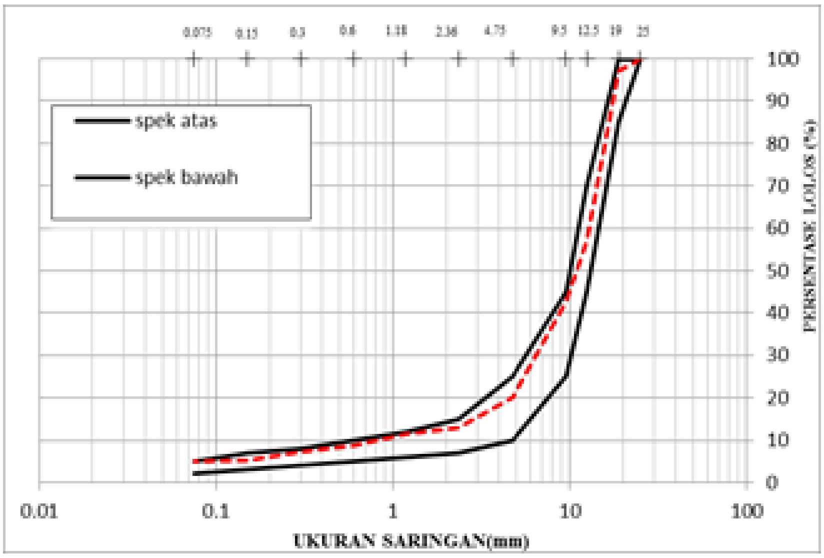

Figure 1. Aggregate gradation graph for the AC-WC mixture

Based on Figure 1, it can be seen that the gradation of the combined aggregate is right between the upper limit and the lower limit, they do not touch each other and this means that this combined gradation meets the specifications.

Asphalt Testing

The composition of the AC-WC mixture consists of 4 fractions, namely coarse, medium aggregate, stone ash and sand. Asphalt quality testing results are taken from secondary data.

Determination of Asphalt Content Variations

Variations in asphalt content are determined based on the estimated initial asphalt content

CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol 11 No.2 June 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

which is the middle/ideal asphalt content (Pb). The variations used were 5 variations of asphalt content, each of which differed by 0.5%. Where, the estimated initial plan asphalt content (Pb) is:

Percent of aggregate retained by sieve No. 8/coarse aggregate (CA) = 87%, Percent of aggregate which passes No. 8 retained by No. 200/fine aggregate (FA) = 8%, Percent of aggregate which passes Sieve No. 200/filler (FF) = 5%, The constant (0.5 – 1) for Laston is used = 0.7, obtained Pb value = 5.0%. From the calculation results, an estimated value for the initial planned asphalt content (Pb) was 5.0% so that variations in mixed asphalt content can be determined, namely 4.0%; 4.5% ; 5.0% ; 5.5% ; and 6.0% of the total weight of the mixture.

Making Test Objects

Aggregates, aggregate gradations, 60/70 penetration asphalt, and palm shell ash that meet the requirements will then be made into three groups of test objects, namely:

1. Test objects with variations in asphalt content. 60/70 deep porous asphalt mixture with asphalt content variations of 40%; 4.5% ; 5.0% ; 5.5% and 6.0%. 15 test specimens were made, of which 3 variations of asphalt content were made test objects, then 3 5 variations = 15 test objects. This test object was made to determine the optimum asphalt content (KAO).
2. 3 test objects in KAO without palm shell ash fruit (0% palm shell ash + KAO).
3. Test object in KAO with 1% palm shell ash content as many as 3 pieces and 2% palm shell ash content as many as 3 pieces as filler.
4. After making the test object, proceed with Marshall testing and permeability testing.

Marshall Test Results

The asphalt content used to determine KAO in the Marshall test is 4%; 4.5% ; 5% ; 5.5% and 6% with a total of 15 briquettes. After obtaining an KAO value of 5.4%, the next step was to make test objects with palm shell ash as a substitute for stone ash at 0%, 1% and 2% palm shell ash for the total weight of the filler mixture to see whether it met the requirements of the Australian Asphalt Pavement Association (AAPA) specifications.) 2004. Marshall test results including VMA, VFA, VIM, Stability, Flow, and MQ can be seen in table 2.

Table 2. Marshall Test Results

No	Karateristik Campuran	Satuan	Kadar Aspal (%)					Spek. AAPA 2004
			4	4,5	5	5,5	6	
1	VMA	%	25,843	25,586	29,929	32,480	28,287	-
2	VFA	%	30,065	34,461	30,986	30,424	40,691	-
3	VIM	%	18,073	16,769	20,655	22,598	16,777	18 - 25
4	STABILITAS	Kg	987,405	694,840	804,552	1170,258	1206,828	Min. 500
5	FLOW	mm	4,7	4,9	4,95	4,58	5,35	2 – 6
6	MQ	Kg/mm	210,086	141,804	162,536	255,515	225,575	Maks. 400

Based on table 2, it can be seen that the highest VIM value and meets the 2004 Australian Pavement Association (AAPA) specifications is only at an asphalt content of 5.5% with a value of 22.598%, at an asphalt content of 4.5% and 6% the VIM value does not meet the specifications because is below 18 – 25 percent. The stability value for the five asphalt content variations has met the specifications because the value is more than 500 kg, where the highest value is at 6% asphalt content and the greater the asphalt percentage, the higher the stability value. The flow value meets the specifications because it is in the range 2 – 6 mm, the greater the asphalt percentage, the higher the flow value. The MQ value for the five asphalt content variations has met the specifications because the MQ value is smaller than the maximum limit. After analyzing the 15 asphalt briquettes, then calculate the Optimum Asphalt Content (KAO) value which can be seen in Figure 2.

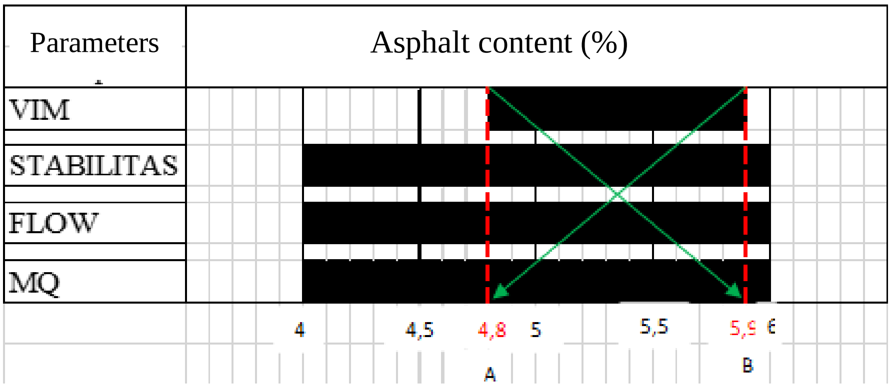

Figure 2. KAO Selection Diagram

After carrying out marshall testing of 15 pieces of asphalt briquettes, based on Figure 5.2, the KAO value was obtained at 5.4%. Next, make test objects using palm shell ash filler for KAO. The test specimens that will be made are 9 briquettes, of which 3 briquettes for 0% palm shell ash and 3 briquettes for 1% palm shell ash, then 3 briquettes for 2% Figure 2 Palm shell ash against the total weight of the rock ash filler mixture. Following are the results of the Marshall KAO test + percentage of palm shell ash which can be seen in table 3.

Table 3. Marshall test results of palm shell ash on KAO

No	Karateristik Campuran	Satuan	Kadar Abu Cangkang Sawit (%)			Spesifikasi AAPA 2004
			0	1	2	
1	VMA	%	34,103	33,180	32,594	-
2	VFA	%	27,735	28,907	29,685	-
3	VIM	%	24,645	23,588	22,917	18 - 25
4	STABILITAS	Kg	904,130	1.238,99	1.339,45	Min. 500
5	FLOW	mm	4	5,5	6,9	2 – 6
6	MQ	Kg/mm	226,032	225,271	220,063	Maks. 400

Based on table 3, it can be seen that the testing of palm shell ash as a filler meets the 2004 Australian Asphalt Pavement Association (AAPA) specifications. The greater the percentage of palm shell ash added, the lower the VIM and MQ values. But the stability and melting (flow) values will be higher.

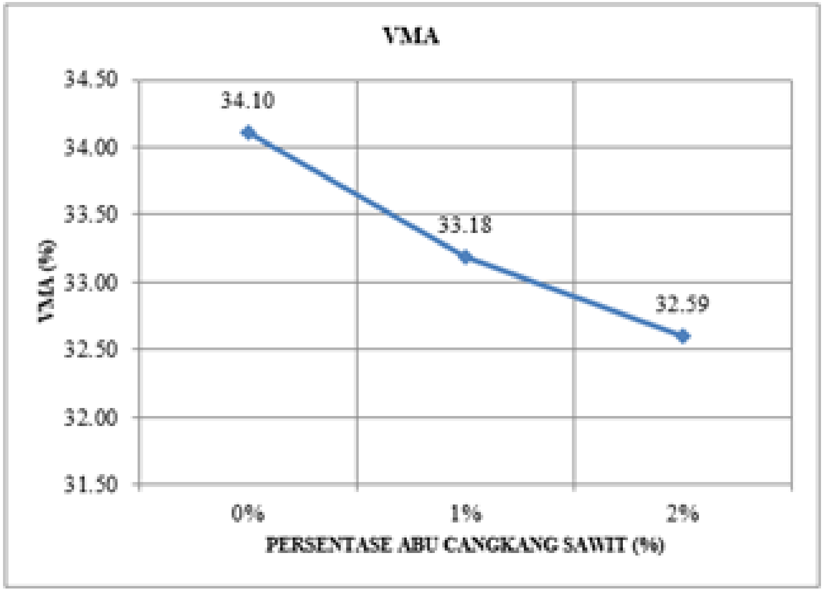

Figure 3. VMA Test Results Graph

Figure 5 shows that the greater the percentage of palm shell ash, the lower the VMA value. For palm shell ash content of 0%, the VMA value is 34.10%. For palm shell ash content of 1%, it produces a VMA value of 33.18%. And for palm shell ash content of 2% it produces a VMA value of 32.59%. The lowest VMA value was at 2% palm shell ash content and the highest value was at 0% palm shell ash content.

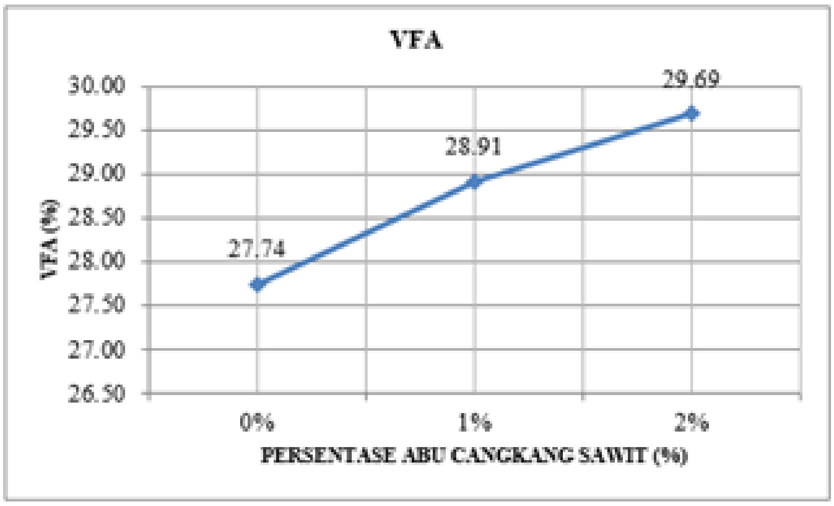

Figure 4. VFA Test Results Graph

Figure 4 shows that the greater the percentage of palm shell ash, the higher the VFA value. For palm shell ash content of 0%, the VFA value is 27.74%. For palm shell ash content of 1%, it produces a VFA value of 28.91%. And for palm shell ash content of 2%, it produces a VFA value of 29.69%. The lowest VFA value was at 0% palm shell ash content and the highest value was at 2% palm shell ash content.

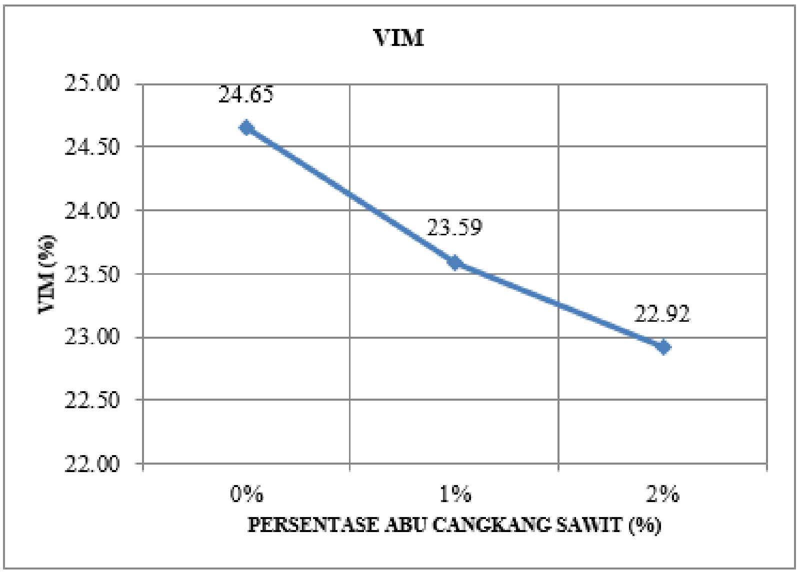

Figure 5. VIM Test Results Graph

Figure 5 shows that the VIM value in this study meets the 2004 Australian Asphalt Pavement Association (AAPA) specifications with a limit of 18 – 25%. The greater the percentage of palm shell ash, the lower the VIM value. For palm shell ash content of 0%, the VIM value is 24.65%. For palm shell ash content of 1%, it produces a VIM value of 23.59%. And for palm shell ash content of 2%, it produces a VIM value of 22.92%. This means that the greater the percentage of palm shell ash, the smaller the voids between the aggregates. The lowest VIM value was at 2% palm shell ash and the highest value was at 0% palm shell ash content.

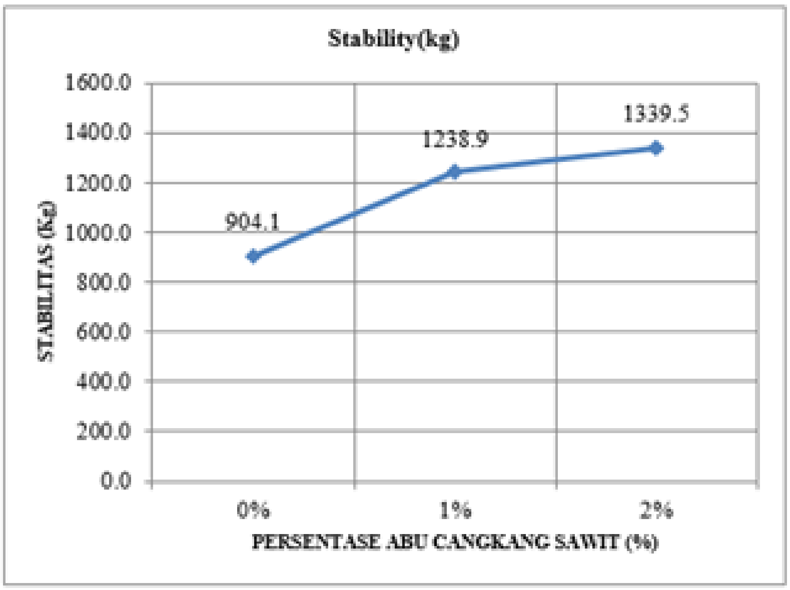

Figure 6. Stability graph

Figure 6 shows that the stability value in this study meets the 2004 Australian Asphalt Pavement Association (AAPA) specifications with a minimum limit of 500 kg. The greater the percentage of palm shell ash, the higher the stability value. The higher the stability value, the less friction between aggregates, increases the locking between particles, and is more resistant to changes such as bleeding or grooves and waves. For palm shell ash content of 0%, it produces a stability value of 904.1 kg. For palm shell ash content of 1%, it produces a stability value of 1238.9 kg. And for palm shell ash content of 2%, it produces a stability value of 1339.5 kg. The lowest stability value was at 0% palm shell ash content and the highest value was at 2% palm shell ash content.

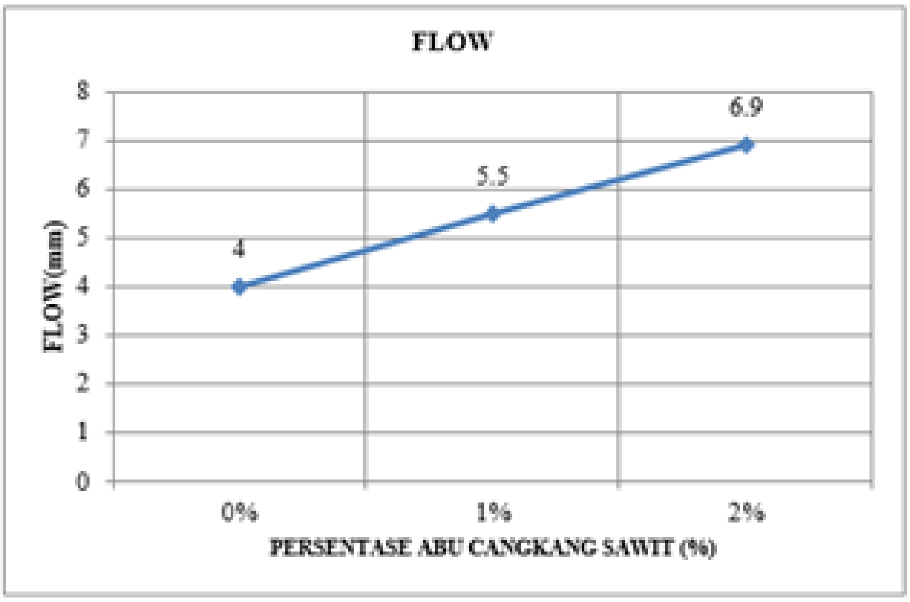

Figure 7. Graph of Flow Test Results

Figure 7 shows that the flow values in this study meet the 2004 Australian Asphalt Pavement Association (AAPA) specifications with the condition that the flow is in the value range of 2 – 6 mm. The greater the percentage of palm shell ash, the higher the flow value. For palm shell ash content of 0%, it produces a flow of 4.0 mm. For palm shell ash content of 1%, it produces a flow value of 5.5 mm. And for palm shell ash content of 2%, it produces a flow value of 6.9 mm. The lowest flow value was at 0% palm shell ash content and the highest value was at 2% palm shell ash content. The flow value indicates the level of flexibility or elasticity of the mixture. A high flow value indicates high flexibility, so that cracks that arise due to loading can be avoided. However, on the other hand, low flow indicates a low level of layer flexibility and is brittle, so it easily breaks due to separation between grain particles.

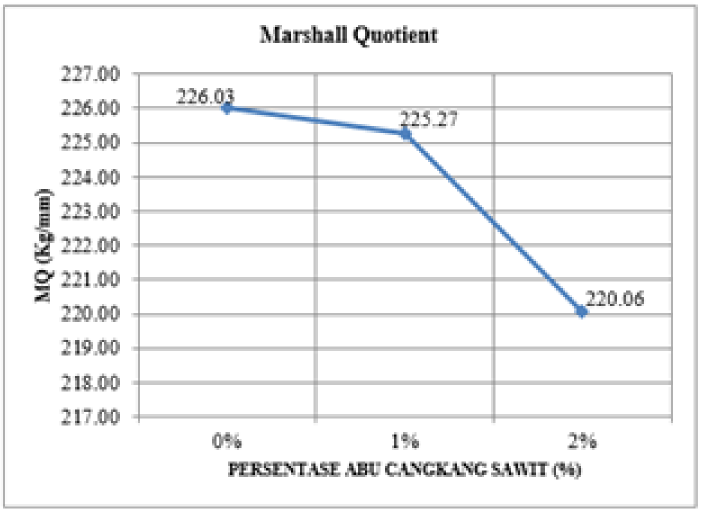

Figure 8. Marshall Quotient Test Results Graph

Figure 8 shows that the MQ value in this study meets the 2004 Australian Asphalt Pavement Association (AAPA) specifications with a maximum limit of 400 kg/mm. The greater the percentage of palm shell ash, the lower the MQ value. For palm shell ash content of 0%, the MQ value is 226.03 kg/mm. For palm shell ash content of 1%, the MQ value is 225.07 kg/mm. And for palm shell ash content of 2% it produces an MQ value of 220.06 kg/mm. The lowest MQ value was at 2% palm shell ash content and the highest value was at 0% palm shell ash content. The lowest MQ value can be said to mean that this asphalt is becoming more flexible and will tend to become plastic and pliable, so that it easily changes shape (deformation) when withstanding high and heavy traffic loads.

Permeability Test Results

Based on table 4 below, it can be seen that this permeability test meets the 2004 Australian Asphalt Pavement Association (AAPA) specifications. The greater the percentage of palm shell ash content, the lower the permeability value so the longer it takes for the water to flow. It is known that the lower the permeability value, the smaller the voids in the mixture, so that the mixture is not porous, and vice versa. The size of the permeability value is greatly influenced by the distribution and gradation of the aggregate which will make the mixture denser.
Permeability testing is intended to determine the ability of porous asphalt pavement to drain water. The permeability of the porous asphalt mixture for all stages is in accordance with the 2004 Australian Asphalt Pavement Association (AAPA) specifications with a value of 0.1-0.5 cm/s. The results of permeability testing can be seen in Figure 9.

Table 4. Permeability Test Results

Hasil Perhitungan *Permeabilitas* Aspal Porus		
Kadar Abu Cangkang sawit (%)	**No**	**Waktu dalam *second* (cm/s)**
0%	1	0,411
	2	0,410
	3	0,400
	Rata²	0,407
1%	1	0,350
	2	0,349
	3	0,324
	Rata²	0,341
2%	1	0,310
	2	0,291
	3	0,268
	Rata²	0,290
Spesifikasi *Permeabilitas*		0,1 – 0,5 cm/s

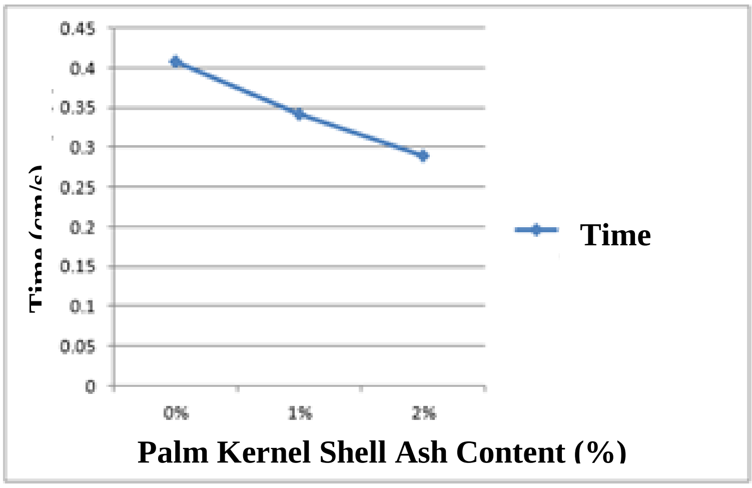

Figure 9 Graph of Permeability Test Results

Figure 9 shows that the permeability values in this study meet the 2004 Australian Asphalt Pavement Association (AAPA) specifications with a limit value of 0.1-0.5 cm/s. The greater the percentage of palm shell ash, the lower the permeability value. The lower the permeability value, the smaller the air voids in the mixture so that the time for water to flow over the surface will be longer. This palm shell ash does not have a big effect on the porous asphalt mixture. Because it causes the air cavity to become smaller. For palm shell ash content of 0%, the permeability value is 0.407 cm/s. A palm shell ash content of 1% produces a permeability value of 0.341 cm/s. And a palm shell ash content of 2% produces a permeability value of 0.290 cm/s. The lowest permeability value was at 2% palm shell ash content and the highest value was at 0% palm shell ash content.

CONCLUSION

From the results of the research and discussions that have been carried out, the following conclusions can be drawn:

1. Based on the percentage of coarse aggregate usage of 70.40%, medium aggregate 15.40%, fine aggregate 9.95%, sand 4.25% and variations in asphalt content with a percentage of 4%; 4.5% ; 5% ; 5.5% ; and 6%, the optimum asphalt content value obtained in the porous asphalt mixture is 5.4%.
2. The use of palm shell ash in porous asphalt meets the 2004 Australian Asphalt Pavement Association (AAPA) specifications for marshall characteristics and permeability. The use of palm shell ash at asphalt content of 0%, 1%, 2% has an effect on the porous asphalt mixture. The greater the percentage of palm shell ash, the lower the VFA, VIM, MQ and permeability values. The use of palm shell ash in this research shows that the higher the stability value will increase the locking between the particles on the road pavement, so that the surface layer will be more resistant to changes (deformations) such as bleeding and waves. Meanwhile, in terms of permeability, the lower the permeability value means that the use of palm shell ash in the porous asphalt mixture does not have a significant effect because the air spaces in the mixture are smaller. The use of palm shell ash in a porous asphalt mixture increases the stability value which can increase the ability of road construction to accept loads, however the pavement layer is not permeable and drains water over the surface more slowly.

REFERENCE

[1] AAPA. Australian Asphalt Pavement Association. 2004. Open Graded Asphalt Design Guide, Australian.

[2] SNI 03-1968-1990. (1990). Test Method for Sieve Analysis of Fine and Coarse Aggregates. Indonesian National Business Standards Agency, 1-5.