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Influence of hyacinth plant as filler on mixed ac-wc (asphalt concrete - wearing course) with marshall test

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Abstrak. Hyacinth plant is a destructive plant because the plant has the potential to make the swamps or rivers become shallow and damaging scenery. Though hyacinth plants can be exploited as a substitute for portland cement filler on road pavement Aspalt Concrete – Wearing Course mixture. This research is to know the optimum asphalt content and how much effect to the addition of ash hyacinth to Marshall result. The test specimens in this research were made with variation of 5%, 6% and 6.5% asphalt content and using five filler variations namely portland cement, as ash hyacinth, 50% hyacinth with 50% portland cement filler, 75% water hyacinth with 25% portland cement filler, and 25% hyacinth water mixture with 75% portland cement filler. From the results on Aspalt Concrete –Wearing Course mixture with the variation of bitumen content and filler variation done in the laboratory of Mercu Buana University, it is found that the optimum asphalt content of portland cement is 6.1%, the optimum asphalt content of ash hyacinth is 5.75%, 50% hyacinth with 50% portland cement filler is 6.1%, 75% water hyacinth with 25% portland cement filler is 6.0%, and a 25% ash hyacinth mixture with 75% portland cement filler is 6.0%.

Keywords: Asphalt Concrete Wearing Course Warm Mix Marshall Test Ash Hyacinth

1. Introduction

Pavement is a pavement layer that lies between the ground layer and the wheel of the vehicle that provide services of transportation, then it is expected that the time specified does not occur significant damage. The materials used are very influential for the formation of the pavement layer is aggregate as the main material that influences the carrying capacity of the surface layer and asphalt as aggregate binder for the waterproof pavement layer.

Bending flexible often occurs damage caused by asphalt which has weakness that is viscosity level and has no resistance to heat oxidation and radiation. The damage to the road is caused by the entry of water into aggregate pores during rainy weather. The pavement is continued before the asphalt is really strong because of the less asphalt covering the rocks can result in damage to the texture that can occur gradually from the surface layers down. The harden appears to break and become small pieces, such as exfoliating. Discharged granules can occur throughout the surface due to poor location.

In another context, the rapid growth of traffic volume will give impact to the need of building pavement structures and the use of materials used. Especially for the condition of pavement structure in Indonesia traffic loads that exceed the boundary conditions often occur so that there is a need for special consideration in planning the mixture of asphalt including improving the quality of asphalt. The idea of modifying asphalt materials with additives is expected to enlarge the energy of bitumen attachment to rocks. Additives are usually able to reduce damage exfoliation caused by sun burning one of them is using ash hyacinth.

The purpose of this study to determine the effect of ash hyacinth on the test durability of AC-WC mixture (Asphalt Concrete - Wearing Course) with the variation of immersion duration (30 minutes) is summarized as follows:

1. Determining the physical characteristics of asphalt, aggregate, and ash-water hyacinth.

2. Looking for optimum bitumen content for AC WC mixture with additional hyacinth ash.
3. Compare the Marshall characteristics of the mixture using ash-water hyacinth as a condition of the new hot mix asphalt concrete specification for the AC-WC mixture.

2. Literature Review

Pavement is a pavement layer that lies between the basement underground layer and the wheel of the vehicle, which serves to provide services to the means of transportation, and during service period expected no significant damage occurred. In order for the pavement to have adequate carrying capacity and durability, but also economical, the pavement is made in layers. The flexible pavement layer consists of:

1. Basic Soil Layer (Subgrade)
   The base soil layer is for the bottom of the road pavement. If the condition of the land on the road construction site has a planned specification then the land will be directly compacted and can be used. Terms of thickness between 50 -100 cm which serves as a place for the placement of the highway.
2. Bottom Base Layer (Sub base Course)
   This layer is under the foundation layer above the base soil layer. This layer serves to spread the load from the bottom layer to the base layer. In addition, the bottom layer of the foundation also serves to prevent fine particles from entering into road pavement material and fungus as a protector for water does not enter into the layer below.
3. Top Base Layer (Base Course)
   In this layer is located below the surface layer. This layer serves to withstand latitudes due to wheel loads and continuous loads to the lower layer, as a cushion for the surface layer and the impregnation layer for the bottom layer. The material used for this layer is the material with high quality so that it strongly withstand the load already planned.
4. Surface Course
   At this surface layer is located at the top of a highway. Layers that we usually tread or layers in direct contact with the vehicle tire wheels. This layer serves to hold the wheel of the tire. In this layer has a high stability and has and impermeable, so it can protect the underlying layer and water can flow to the water channel located next to the road. Here is the function of the road surface layer as follows:
   a. In the upper layer must be watertight, so rain water that fell above it can not seep into the layer under it because it can weaken the layers.
   b. The vehicle wheel hardened pavement layer must have high stability to withstand the wheel loads working on it.
   c. Wearing Course, a layer that immediately receives the friction of the wheel of the vehicle due to the braking of the vehicle making it easy to wear out.
   d. The layer that spreads the lower layer load, so it can be borne by other layers that have a weaker carrying capacity.

   In addition, the surface layer also has the requirements of mixing materials include:
   - Asphalt as one of the mixing materials should not contain paraffin.
   - Aggregate rocks used must be strong.
   - Rocks and aggregates are not easy to worn out.
   - Rocks and aggregates must be sturdy.
   - The asphalt used should be able to bond with asphalt and aggregate.
   - The materials used should be able to hold good bonds with asphalt.

2.1. Aggregate

Aggregates are generally defined as formations as hard and solid earth shells. ASTM defines agar as a material consisting of a material material composed of solid material, either large or fragmented.

2.2. Portland cement

The most important material has the highest cost in making concrete is portland cement. Portland cement and limestone and other minerals are mixed and burned in a combustion device and thereafter can be powdered materials. The powder will harden and bond strongly due to a chemical reaction when mixed with water (Harold N. Atkins, PE 1997)

2.3. Filler

The filler is one part of the fine aggregate having a minimum standard requirement of 75% passing from filter no. 30 (0.06 mm) in other words filler is a material that passes filter no. 200 (grain size smaller than 0.0075). The materials used as fillers may consist of portland cement, fly ash, limestone dust, ash stone, cement kiln ash, or other non-plastic materials. The filler function in an asphalt mixture:

a. Can fill the fine and coarse aggregate space as it increases the density.
b. Filler and asphalt will simultaneously form a paste compound that will bind and bind fine aggregates to form mortar.
c. Modify the fine aggregate so that the aggregate type weight increases and the amount of asphalt needed to fill the cavity is reduced.

2.4. Hyacinth Plant

The utilization for this plant is still very rare because the majority of people know that the use of hyacinth plant is only to making craft solely, this plant is able to grow up to 1.9% per day. Though hyacinth plant has a high fiber content (20% fiber) so we try to mixing as a filler.

2.5 Characteristics of Marshall Mixes

Asphalt hot mixed concrete is one type of pavement layer of flexible pavement construction. This pavement type is a mixture of equally between aggregate and bitumen as a binder at a certain temperature. Because it is mixed in hot conditions then this proses called Hot Mix. The following hot mix concrete asphalt function can be classified as follows:

a. Like a weather-resistant surface, frictional, and vehicle-wheeled force and provide an impermeable layer that protects the underlying layer from rain and water seepage.
b. By of the upper base layer.
c. As a foundation-forming layer, if used in repair or maintenance workers.

The mixture characteristics that must be possessed by hot mixed asphalt concrete mixture are:

a. Stability that the stability of the pavement layer is the ability of pavement layer to receive traffic load without permanent shape change such as wave, groove or blending.
b. Durability is required on the surface layer that the layer can be able to withstand wear due to weather effects, water and temperature changes or wear changes due to vehicle friction.
c. Flexibility that the flexibility of the pavement layer is the ability of the layers to be able to follow the deformation occurring due to traffic loads without the occurrence of cracks and volume changes. High flexibility can be obtained by:
    1. Use of asphalt enough to get a small VIM.
    2. The use of aggregate graded gap so that obtained a large VMA.
    3. Use of soft asphalt (Asphalt with high penetration)
d. Skid resistance (Hold shear / stray)
    Shear resistance is the ruggedness that provides by the pavement so that the vehicle does not slip either during rain or wet or dry time. Endurance, Fatigue (Fatique Resistance)
    Resilience, Fatigue is the resilience of asphalt concrete in receiving recurrent loads without the occurrence of fatigue in the form of rutting and cracking.
    Factors that affect resistance to fatigue are:
        1. High VIM and low bitumen content will result in faster fatigue.
        2. High VMA and high asphalt content can result in flexible plywood layers.

e. Ease to implementation
What is meant by the ease of implementation is the ease of a mixture to be spread out and compacted to obtain results that meet the expected density.
Information :
VMA: The volume of cavities between aggregate minerals.
VIM: The cavity volume in the mix
VFB: The cavity volume is filled with asphalt
Vmb: Bulk volume of solid mixture
Vmm: Aggregate volume without cavity
Vb: Asphalt Volume
Vba: Asphalt volume absorbed by aggregates
Vsb: Aggregate mineral volume (based on bulk density)
Vse: Aggregate mineral volume (based on effective density)

3. Result And Discustion

3.1. Examination of Crude Aggregate Characteristics
The gross aggregate weight is divided into 3 as follows.

1. Specific gravity (bulk specific gravity) is the calculated density of all available volumes (pore volume that can be absorbed by asphalt or can be said all of the pore surface can be passed water and particle volume). The data above are the parameters obtained from the test results of the test materials used in this study. It can be seen that the coarse and fine aggregate used for this research is of good quality and meets the requirements in accordance with Indonesian National Standard (SNI).
2. Specific gravity surface type (SSD specific gravity) is the specific gravity which takes into account the pore volume which can only be impregnated with asphalt plus the particle volume. The test piece is removed from the water and wiped with water until the water membrane on the surface is lost. The result of determining rough aggregate wear can be seen from the rough aggregate resistance to the Los Angeles machine with the standard water impedance to the crude aggregate on the AC-WC mixture type up to 40%. We can see that the wear rate on the crude aggregate is about 15.1% which means it meets the standard requirement of 40% then it meets the standard, which means the aggregate used has good ability to withstand wear and collision in holding the traffic load.
3. The apparent specific gravity is the weight of the kind that takes into account the volume of special particles alone without taking into account the volume of pores that can be passed over the water or is part of a solid material density relave formed from a mixture of particles, pore or pore air can absorbs water differences in the tests of each specific gravity and water absorption between the coarse aggregate and the fine aggregate in the method of the test apparatus, while the calculation process is almost the same. In addition the level of accuracy on fine aggregate is more used than coarse aggregate. Because the gradation of fine aggregate is smaller than the coarse aggregate, so the waste material is more likely. The data is based on the examination of filler ash hyacinth and filler portland cement. It can be seen that the filler hyacinth ash used in this research has been able to fulfill the requirement with the value of 2,91 and 2,90 that is more than > 1% in accordance with the National Standard Indonesia (SNI).

3.2. Marshall Testing Process
Insert the specimen into the test tool clip tool and adjust the scale so that the needle points to a zero. Press the up button, note the melting scale, if the scale slows down and stops spinning, press the stop button to stop and read the scale on the stability pointer. Record the scale indicated by the test apparatus, and note the stability and melt. This test was conducted under AASHTO T-245-74.

3.3. Marshal Test Results

In this study used asphalt level of 5.5%, 6%, and 6.5%. From Marshall test obtained values of VMA, VIM, VFB, Stability, Melting, Stiffness, KAO (Optimum Asphalt Level) and IKS (Index of residual strength). By using filler variation of portland cement filler, powder filler and filler of husk ash to determine its effect on a paved mixture.

KAO filler variation is portland cement, ash hyacinth, 50% hyacinth with 50% portland cement filler, a 75% mixture of water hyacinth with 25% portland cement filler, and 25% ash hyacinth mixture with 75% portland cement filler.

Here are the conclusions as follows**:**

Table 1 Results of AC-WC With Portland Cement Filler

No	**Information**	**Average**				
		Standard		**IKS 30 Menit**		
		Min	**Max**	**5,0**	**6**	**6,5**
1	VMA (%)	13	-	21,12	23,06	23,38
2	VIM (%)	2	6	5,48	5,34	4,49
3	VFB (%)	60	-	35,45	38,41	41,13
4	Stability (Kg)	700	-	1710,52	1779,27	1265,71
5	Melting (mm)	2	-	5,32	3,62	4,33
6	Stiffness (Kg / mm)	200	-	322,02	515,48	294,85

Table 2 Results of AC-WC With Ash Hyacinth Filler

No	**Information**	**Average**				
		Standard		**IKS 30 Menit**		
		Min	**Max**	**5,0**	**6**	**6,5**
1	VMA (%)	13	-	20,17	22,36	24,65
2	VIM (%)	2	6	4,34	4,49	6,08
3	VFB (%)	60	-	37,57	40,10	38,33
4	Stability (kg)	700	-	1480,03	1767,14	1548,77
5	Melting (mm)	2	-	4,09	4,52	3,58
6	Stifness (Kg/mm)	200	-	434,41	450,12	453,67

Table 3 Results of AC-WC Mixed Properties With Ash Hyacinth Filler 50% + Portland cement ferers 50%

No	**Information**	**Average**				
		Standard		**IKS 30 Menit**		
		Min	**Max**	**5,0**	**6**	**6,5**
1	VMA (%)	13	-	20,49	21,70	22,74
2	VIM (%)	2	6	4,71	3,67	3,70
3	VFB (%)	60	-	36,91	41,60	42,59

4	Stability (Kg)	700	-	2252,39	2029,98	6187,00
5	Melting (mm)	2	-	3,97	3,74	3,58
6	Stifness (Kg/mm)	200	-	572,28	553,75	1576,46

Table 4 Results of AC-WC With Filler Ash Hyacinth Filler 25% + Portland cement ferers 75%

No	Information	Average Standard		IKS 30 Menit		
		Min	**Max**	**5,0**	**6**	**6,5**
1	VMA (%)	13	-	21,35	23,13	22,20
2	VIM (%)	2	6	5,75	5,42	3,02
3	VFB (%)	60	-	34,97	28,20	29,86
4	Stability (Kg)	700	-	2163,43	2535,46	1512,38
5	Melting (mm)	2	-	4,74	4,58	4,75
6	Stifness (Kg/mm)	200	-	457,02	549,76	319,55

Table 5 Results of AC-WC Mixed Properties With Ash Hyacinth Filler 75% + Portland cement Filler 25%

No	Information	Average Standard		IKS 30 Menit		
		Min	**Max**	**5,0**	**6**	**6,5**
1	VMA (%)	13	-	19,05	22,26	22,03
2	VIM (%)	2	6	3,00	4,36	2,81
3	VFB (%)	60	-	40,32	39,83	44,19
4	Stability (Kg)	700	-	2038,92	1920,99	1866,25
5	Melting (mm)	2	-	4,78	5,26	4,53
6	Stifness (Kg/mm)	200	-	1064,19	817,27	771,19

After obtaining the value on VMA, VIM, VFB, Stability, Melting, and Sickness values, there for each KAO of filler variation is obtained. The results from research conducted at the university's civil laboratory, on an AC-WC mixture with the addition of asphalt content variations and filler variations. Here are the conclusions as follows:

Figure 1. KAO Cement Portland

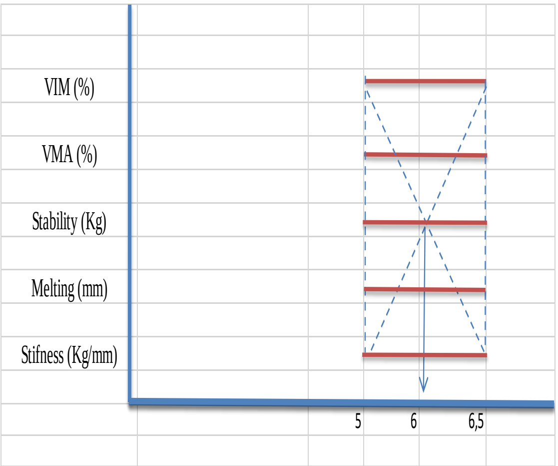


Figure 2. KAO Filler Ash Hyacinth 50% + Filler Cement portland 50%

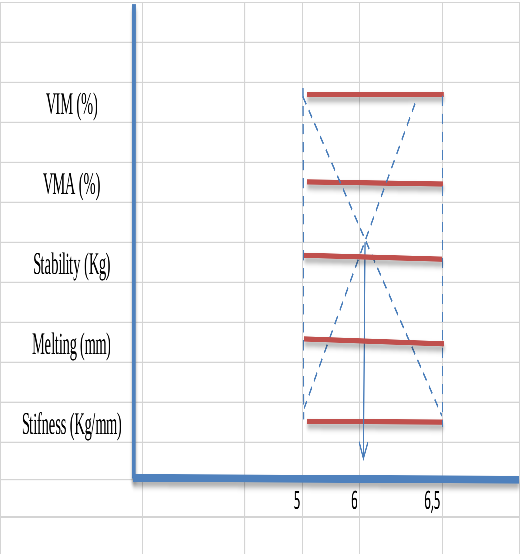


Figure 3. KAO Filler Ash Hyacinth

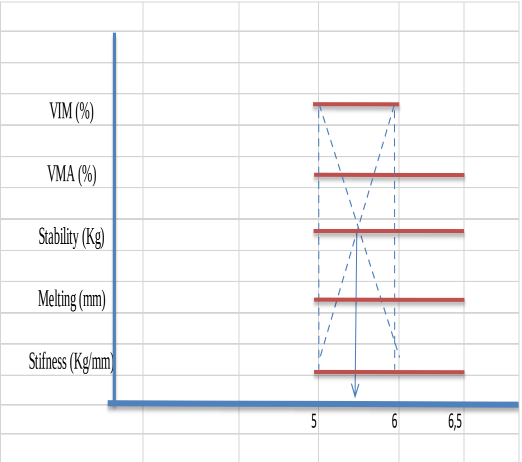


Figure 4. KAO Filler Ash Hyacinth 25% + Filler Cement portland 75%

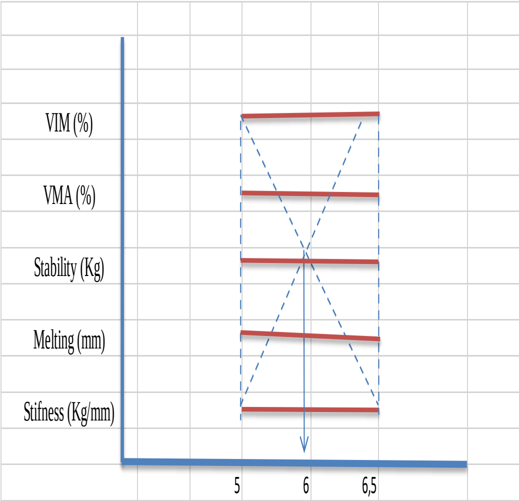
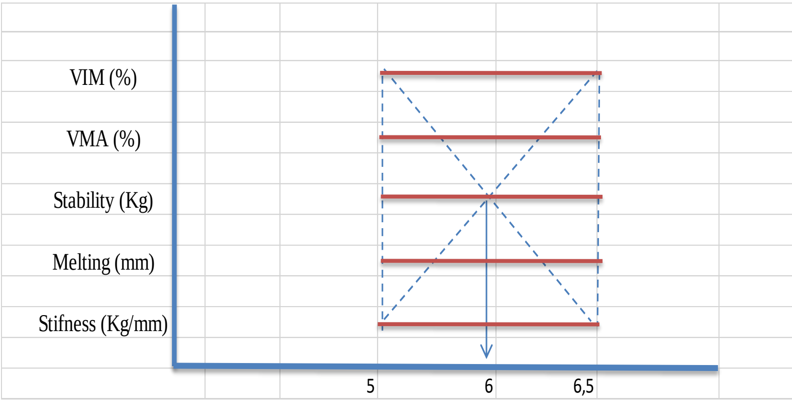


Figure 5. KAO Filler Ash Hyacinth 75% + Filler Cement Portland 25%



4. Conclusion

1. The highest value of Asphalt Optimum Content (KAO) on the filler mixture100% portland cement is 6.1%, a portland cement filler mixer 50% + 50% ash hyacinth is 6.1%, mixture of cement filler portland 75% + 25% ash hyacinth is 6%, and portland cement filler mixture 25% + 75% ash hyacinth is 6%. Optimum Asphalt Optimum (KAO) is on the ash mixture water hyacinth 100% is 5.5%
2. The greatest value of the stability is portland cement filler 75% + 25% ash hyacinth. The second largest value is portland cement 25% + 75% ash hyacinth. Therefore, the use of ash hyacinth and portland cement as an alternative to the pavement, in particular to the Aspal Concrete –Wearing Course mixture able to increase the value of stability. So that restrain is more greater load.

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