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THE EFFECT OF ASPHALT BATHS WEARING COARSE (AC–WC) ON THE TIDE

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ABSTRACT

The phenomenon of high tide that occurs in the coastal areas of Indonesia, especially on the island of Java which often results in floods or often called tidal floods. Tidal flooding is a flood event caused by the overflow of sea tides into coastal land. Often the overflow reaches on some roads located in coastal areas so that roads located in those coastal areas are damaged. Therefore, it is necessary to conduct research to investigate the effects caused by stagnant water on road pavement. The study used two standard methods of immersion in high tide and water in the laboratory. This study aims to determine the durability performance of the soaking mixture continuously (continuously) and periodically (intermittently). Soaking specimens (test objects) in a tide with a time variation of 12 hours; 24 hours; 48 hours; and 72 hours. While periodic soaking is carried out by soaking the specimen (test object) for 12 hours, then removed and allowed to stand for the next 12 hours for 3 days. Soaking the asphalt concrete wearing course (AC-WC) mixture either continuously or periodically in the tide has a greater influence compared to the use of laboratory water. This is indicated by the value of the Stability of the asphalt mixture in a bath with a tide smaller than the asphalt mixture soaked with laboratory standard water.

INTRODUCTION

High tide is a flood of seawater or rising sea level caused by high tide that inundates land (Habel et al., 2017). It is a problem that occurs in areas lower than sea level. In Semarang and Demak, this problem has been happening for a long time and is getting worse because there is a subsidence in the land while the sea water rises as a result of warming the earth's temperature. High tide is also an unexpected natural disaster because the tide is not expected to come (Correa et al., 2020). One of the characteristics of the high tide disaster is the rainy season at the end and beginning of the year (Thomas et al., 2015). High tide is water that comes from the sea then the water rises into the waterways then continues to the shoulder of the road, the body of the road, to finally hit the houses on the lower surface (Gaul, 2019).

Roads located on the coast such as Kaligawe and Sayung are often soaked by flood tides and will suffer damage. Therefore, there is a need for research to investigate the effects caused by high tides on road pavement. This study aims to determine the durability performance of asphalt concrete mixture with Marshall modification. Soaking specimen (test objects) in a tide with time variations of 7 days, 14 days and 21 days.

With the occurrence of high tide on Semarang and Sayung Demak National Roads will result in long traffic jams during the rainy season (Suwardo & Sugiharto, 2004). National Roads become damaged and potholes due to being submerged by continuous tidal floods so that many trucks experience a slowdown and many accidents due to potholes have an impact on the inconvenience of road users (Chen et al., 2002; Sidiq et al., 2013; Utomo, 2008), and the economic stagnation that occurs on the Pantura route to Jakarta and Surabaya (Riyadi & Amalia, 2005; Suardi, 2009; Sukirman, 2012).

This high tide flood from 1998 to 2018 continued to be handled. After being submerged by floods the road was damaged again. Now, the Semarang National road and Demak Regency KM 8 + 350 - km 9 + 550 is a national disaster in the rainy season so that research is carried out to deal with national roads affected by tidal floods. Hence, in these locations tidal floods can be smooth and comfortable to drive (The Asphalt Institute, 1997).

The use of Asphalt Concrete Wearing Course Modifications to Bina Marga road works have so far been carried out in various regions on the island of Java (Djalante, 2011). This modification of Asphalt Concrete Wearing Course was conducted by using JAP Polymer Asphalt Properties – 57 (Jaya Trade Polymer Asphalt) with a test implementation method that meets the requirements of type II B asphalt in the General Specification of Bina Marga Revision 3 (Bina Marga, 2018).

The objectives of this research conducted are to:

1) Examines changes in the characteristics of asphalt concrete wearing course (AC-WC) Modifications submerged in water coming from high tide and compares them with those submerged in laboratory standard water.
2) Examines the extent of the effect of long soaking with water coming from high tide and compares it with that submerged in laboratory standard water on the durability of the Asphalt Concrete Wearing Course (AC-WC) Modification.
3) Assessing the extent of the influence of the chemical element chloride (Cl-) content in the water used for soaking on the durability of the Asphalt Concrete Wearing Course (AC-WC) Modification.
4) Assessing the extent of the influence of continuous and periodic or intermittent immersion patterns on the durability of the Asphalt Concrete Wearing Course (AC-WC) Modification.

METHOD

Sampling of tidal flood water was carried out in the High Tide Flood Inundation Area in the Sayung Demak Area of Central Java. Analysis of sampling results, making samples of asphalt mixture and Marshall testing were carried out at the PT Laboratory. Perwita Construction of Stem Convex. The place where tidal water sampling is carried out is in Sriwulan Sayung Village, Demak Regency, Central Java.

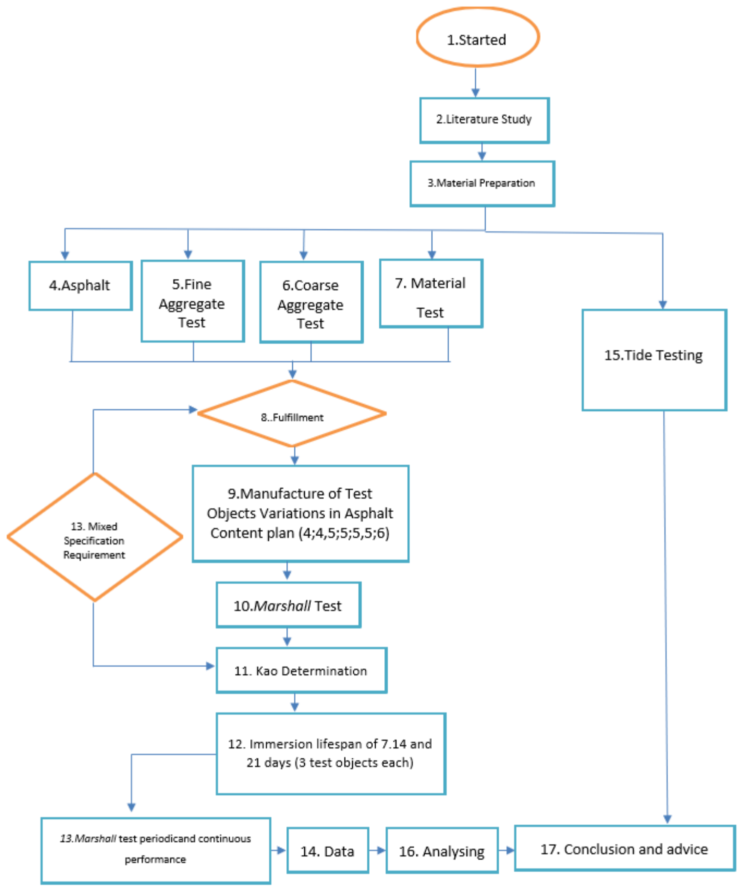

Figure 1. Research Flow

Continuous and periodic Immersion Test Methods

The comparison of soaked Stability with standard water stability is expressed in percent and is called the Residual Stability Index (IRS).

IRS = $\frac{MSi}{MSs}$ x 100 % ………………………… (1)

Information:
IRS = Residual Stability Index
MSi = Marshall Standart Stability (Kg)
MSs = Immersion Marshall Stability (Kg)

Hot Asphalt Mix Specification Requires the IRS to be greater than 80%.

Durability Method

Durablitas is related to the durability of the mixture to water baths over a period of time. Durability can be improved by making asphalt mixtures that are dense and impermeable and resistant to the water obtained from the use of aggregates.

The characteristics of the mixture after soaking for 24 hours do not necessarily describe the durability of the asphalt mixture after a longer soaking period (Craus et al., 1981).

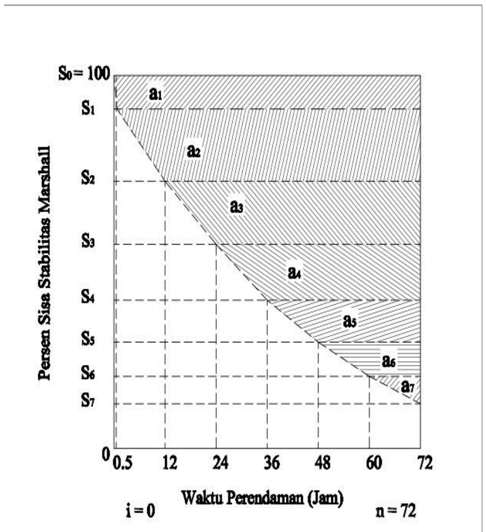

Figure 2. Durability Curve (Craus et al., 1981)

Asphalt

Asphalt is a hydrocarbon compound and the main compounds are Aromat, Napathen and Alkan. The characteristics of the asphalt are the background to the provisions stipulated in the specifications. Some of the following provisions and asphalt testing aim to ensure the achievement of the required asphalt characteristics:

1) Asphalt sampling for test materials;
2) Penetration testing;
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The methods or procedures mentioned above are regulated in the Indonesian National Standard (SNI) for each type of test (Departemen Pekerjaan Umum et al., 1990, 1991).

Characteristics of Asphalt Concrete Mix

Asphalt concrete is formed from aggregates, asphalt and or without materials that are mixed evenly or homogeneously in mixing installations at a certain temperature. The mixture is then spread, compacted so that solid asphalt concrete is formed. The calculation commonly used in asphalt concrete mixtures is

1) Bulk Specific Gravity of Solid Asphalt Concrete (GMB): The bulk specific gravity of solid asphalt concrete (GMB) can be measured using Archimedes' law, namely:

$$\text{GMB} = \frac{Dry\ Test\ Weight}{Surface\ Dry\ Test\ Weight - Test\ Weight\ in\ Water}$$

2) Maximum Specific Gravity of Uncompacted Asphalt Concrete (GMM): The maximum specific gravity of the un-compacted asphalt concrete mixture (GMM) is the specific gravity of the asphalt concrete mixture with no air, obtained from laboratory examination.

$$GMM = \frac{100}{\frac{Ps}{Gse}+\frac{Pb}{Gb}}$$

GMM = Maximum Specific Gravity of the Mixture
Pb = Amount of Asphalt, % against Total Weight of Mixture
Ps = Aggregate Amount, % against Total Weight of Mixture
Gb = Specific Gravity of Asphalt
GSe = Effective Specific Gravity of Aggregates

3) Cavity between aggregate minerals (VMA): The cavity between aggregate minerals (VMA = voids in the mineral aggregate), is the number of pores between the grains of the aggregate in solid asphalt concrete, expressed in percentage terms.

$$VMA = 100 - \frac{Gmb\ x\ PS}{Gsb}$$

GMB = Mixed Bulk Type Weight
GSB = Effective Specific Gravity of Aggregates
Ps = Aggregate Amount, % against Total Weight of Mixture

4) Cavities in the mixture (VIM): The number of pores residing in solid asphalt concrete (VIM) is the number of pores between the grains of the aggregate enveloped in asphalt. VIM is expressed in percentage against the volume of solid asphalt concrete.

$$VIM = 100 - \frac{Gmm-Gmb}{Gmm}$$

GMM = Maximum Specific Gravity of the Mixture
GMB = Mixed Bulk Type Weight
VIM = Air cavity in the mixture, percent against the volume of the mixture

5) Asphalt-filled cavity (VFA): The number of pores between aggregate grains (VMA) inside solid asphalt concrete, which is filled with asphalt, is expressed as VMA. The percentage of pores between asphalt-filled aggregate grains is called VFA. So, VFA is the part of the VMA that is filled with asphalt, excluding the asphalt that is absorbed by each aggregate grain. Thus, it is this VFA filling asphalt that is the percentage volume of solid asphalt concrete that becomes an asphalt film or blanket. The basis of the calculation is carried out on the basis of the volume of solid asphalt concrete.

$$VFA = \frac{100.(VMA-VIM)}{VMA}$$

VIM = Air cavity in the mixture, percent against the volume of the mixture
VMA= Grain Pores aggregate inside asphalt concrete, % of bulk volume of asphalt concrete
VFA = Pores between grains Asphalt-filled aggregate % of VMA

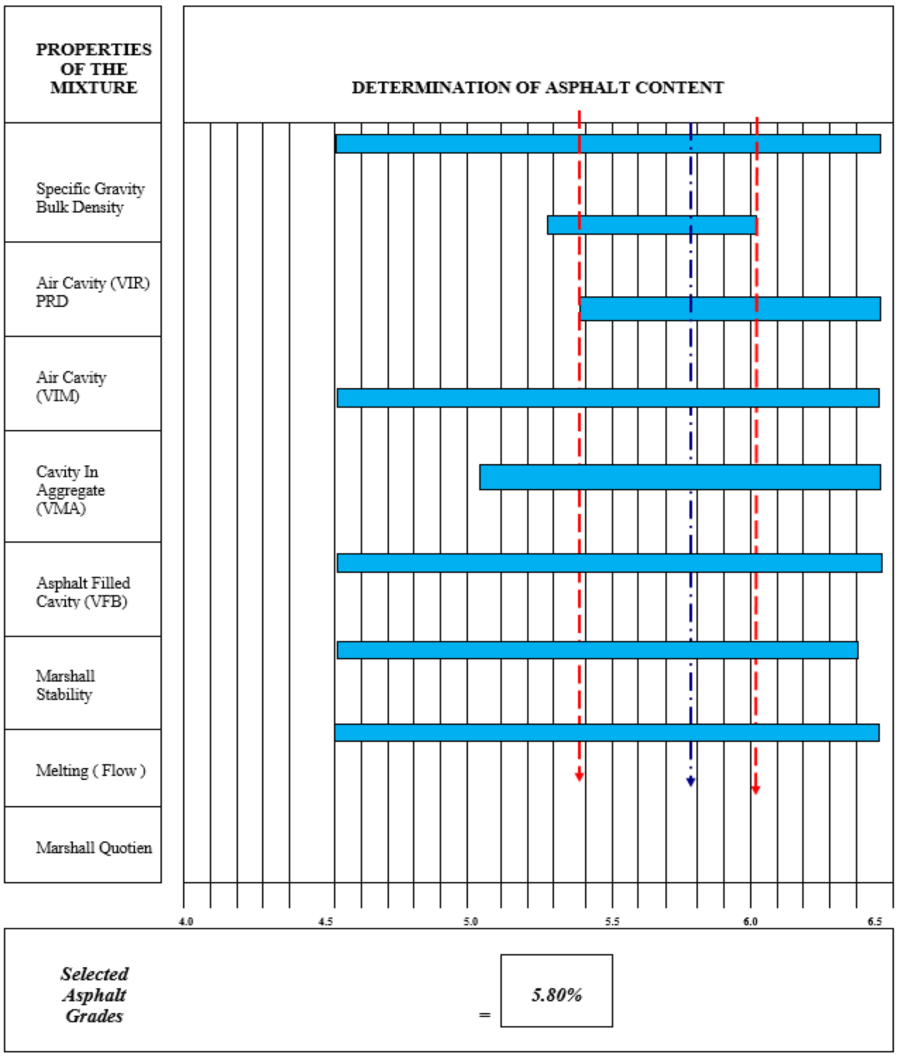
6) Determination of Optimum Asphalt Content: Determination of optimum asphalt content according to SNI-06-2490-1991 with the formula (Departemen Pekerjaan Umum et al., 1991):

$$B = \ x\ 100\% \frac{(W1-W2)-(W3+W4)}{VMAW1-W2}$$

B = Asphalt Content, expressed in %
W1= The weight of the test object is expressed in grams
W2 = The weight of the water in the test piece is expressed in grams
W3= The weight of the extracted mineral is expressed in grams

RESULT AND DISCUSSION

Table 1. Results of Determining Optimum Asphalt Content



From the results of the recapitulation chart of the properties of the asphalt mixture, it can also be concluded that the Optimum Asphalt Content is 5.8%.

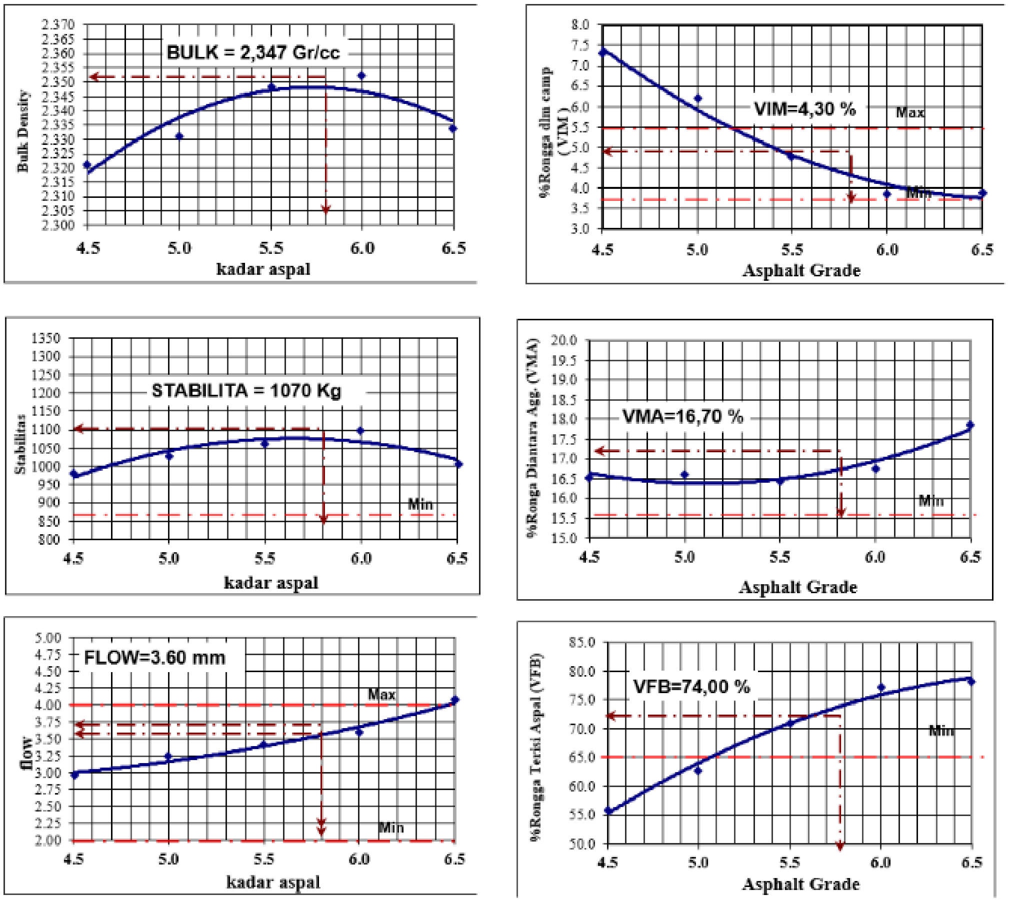


Table 2. The Levels of Asphalt

Table 3. Results of Recapitulation Continuous and Periodic Immersion of Tide Periodic and Continuous Immersion

Decline Due to Soaking	**Initial Test Value**	**Tide**					
		Periodic Soaking			**Continuous Soaking**		
		24 Hours	**48 Hours**	**72 Hours**	**7 Days**	**14 Days**	**21 Days**
		5%	**9%**	**12%**	**21%**	**43%**	**62%**
Air Cavity (PRD)	2.5	2.375	2.275	2.2	1.975	1.425	0.95
Air Cavity (VIM)	4.3	4.085	3.913	3.784	3.397	2.451	1.634
Cavities in Mineral Aggregates (VMA)	16.7	15.865	15.197	14.696	13.193	9.519	6.346
Asphalt Filled Cavity (VFB)	74	70.3	67.34	65.12	58.46	42.18	28.12
Marshall Stability	1170	1111.5	1064.7	1029.6	924.3	666.9	444.6
Plastic Melt (Flow)	3.6	3.42	3.276	3.168	2.844	2.052	1.368
Marshall Quotient	300	285	273	264	237	171	114

Table 4. Results of Recapitulation of Continuous and Periodic Immersion of Tides Periodic and Continuous Immersion

Decline Due to Soaking	Initial Test Value	Laboratory Water					
		Continuous Soaking					
		11%	18%	26%	22%	40%	60%
Air Cavity (PRD)	2.5	2.225	2.05	1.85			
Air Cavity (VIM)	4.3	3.827	3.526	3.182			
Cavities In Mineral Aggregates (VMA)	16.7	14.863	13.694	12.358			
Asphalt Filled Cavity (VFB)	74	65.86	60.68	54.76			
Marshall Stability	1170	1041.3	959.4	865.8			
Plastic Melt (Flow)	3.6				2.808	2.124	1.332
Marshall Quotient	300	267	246	222			

CONCLUSION

Changes in the characteristics of asphalt concrete wearing course Modifications submerged in the tide (Rob) at the continuous immersion of 7, 14, and 21 days of age have decreased by 21%, 43%, 62%. Meanwhile, the Modified Asphalt Concrete Wearing Course soaked with laboratory water experienced a decrease in characteristics of 11%, 18% and 26%, but in plastic meltdown (Flow) in laboratory water testing decreased by 22%, 41%, and 63%. Durability (Durability) of Asphalt Concrete Wearing Course Modification of immersion with water from the tide (Rob) decreased by 62% compared to those submerged in laboratory standard water decreased by 26%.

The effect of the chemical element chloride (Cl-) content in the water used for soaking on the durability (durability) of the Asphalt Concrete Wearing Course Modification is to reduce stability up to 62% with a soaking life of 21 days.

The effect of durability asphalt concrete wearing course Modification of continuous immersion pattern is resulting in a decrease in durability by 62% and the effect of durability asphalt concrete wearing course modification of intermittent immersion pattern is resulting in a decrease in durability by 12%.

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by Aris Krisdiyanto

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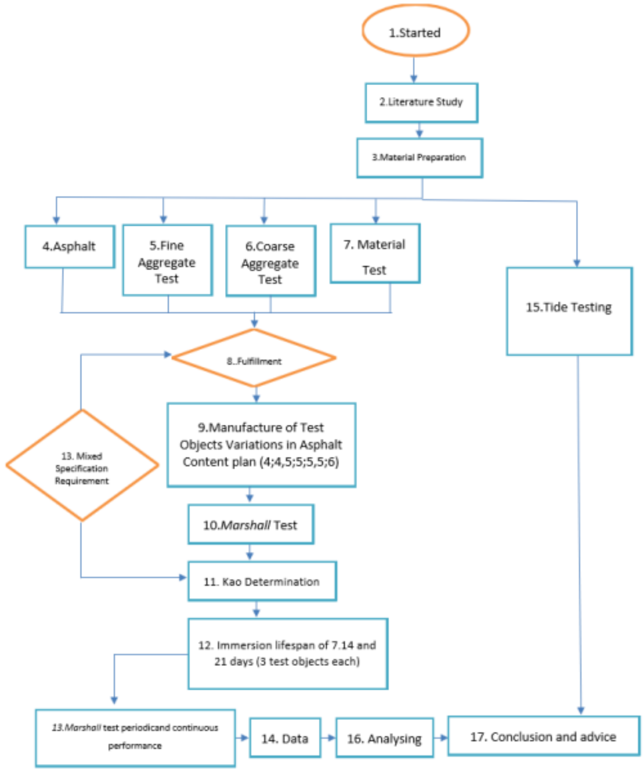

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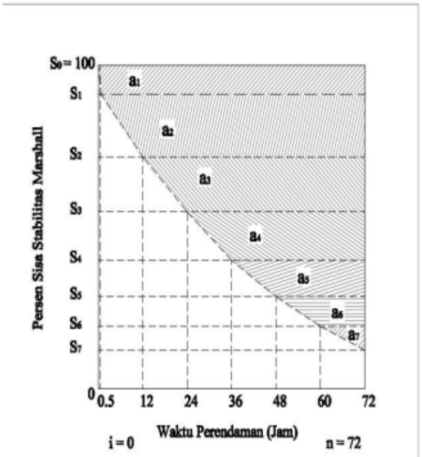

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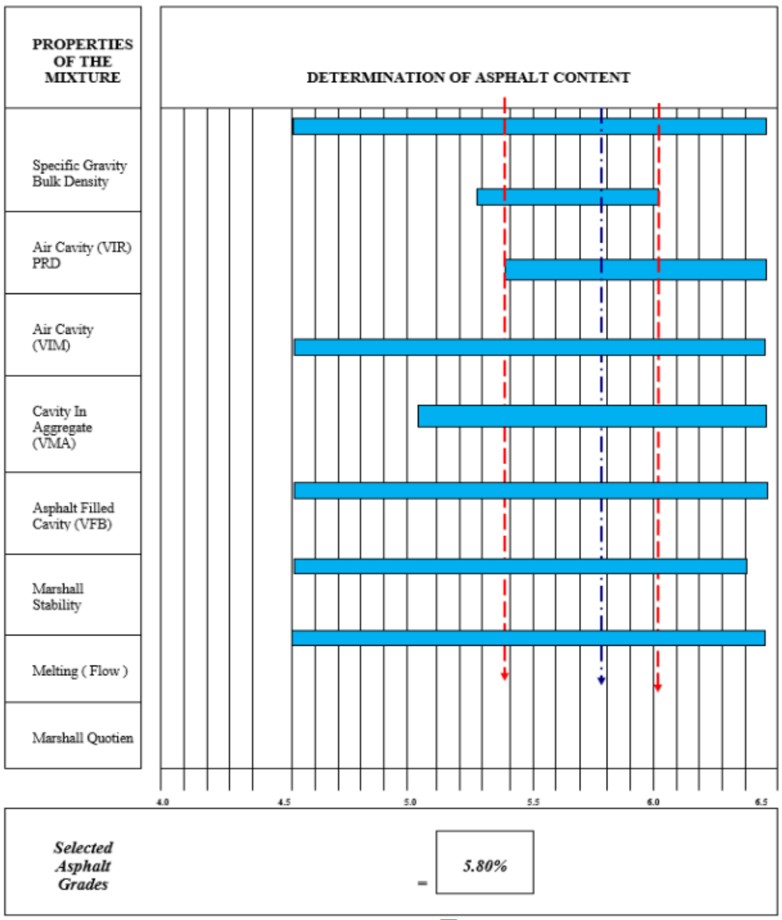
RESULT AND DISCUSSION

Table 1. Results of Determining Optimum Asphalt Content



From the results of the recapitulation chart of the properties of the asphalt mixture, it can also be concluded that the Optimum Asphalt Content is 5.8%.

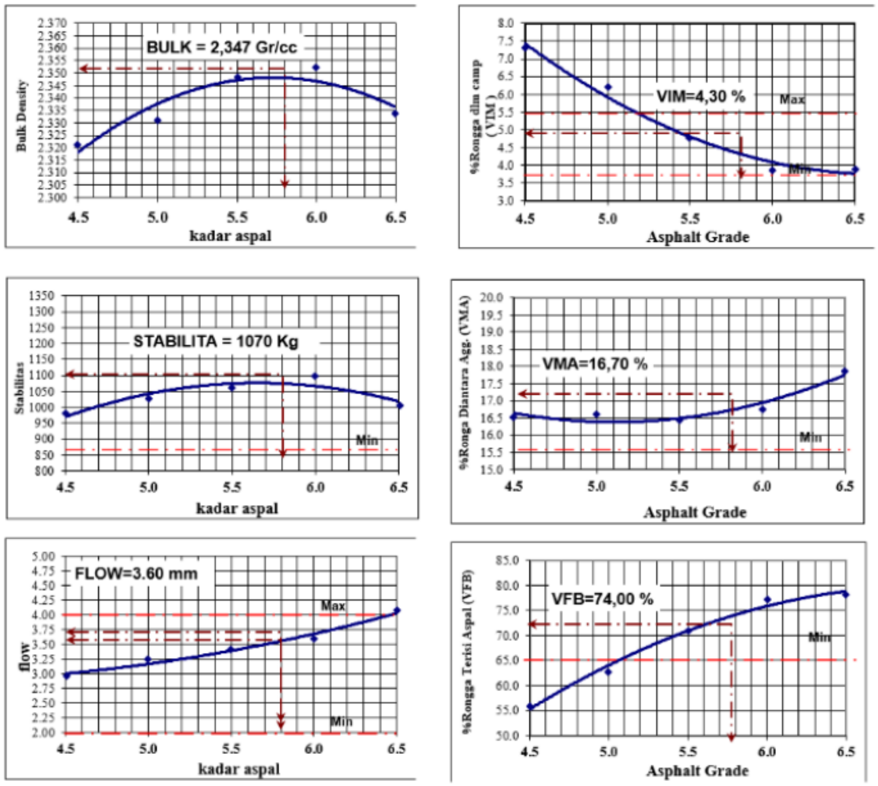


Table 2. The Levels of Asphalt

Table 3. Results of Recapitulation Continuous and Periodic Immersion of Tide Periodic and Continuous Immersion

Decline Due to Soaking	**Initial Test Value**	**Tide**					
		Periodic Soaking			**Continuous Soaking**		
		24 Hours	**48 Hours**	**72 Hours**	**7 Days**	**14 Days**	**21 Days**
		5%	**9%**	**12%**	**21%**	**43%**	**62%**
Air Cavity (PRD)	2.5	2.375	2.275	2.2	1.975	1.425	0.95
Air Cavity (VIM)	4.3	4.085	3.913	3.784	3.397	2.451	1.634
Cavities in Mineral Aggregates (VMA)	16.7	15.865	15.197	14.696	13.193	9.519	6.346
Asphalt Filled Cavity (VFB)	74	70.3	67.34	65.12	58.46	42.18	28.12
Marshall Stability	1170	1111.5	1064.7	1029.6	924.3	666.9	444.6
Plastic Melt (Flow)	3.6	3.42	3.276	3.168	2.844	2.052	1.368
Marshall Quotient	300	285	273	264	237	171	114

Table 4. Results of Recapitulation of Continuous and Periodic Immersion of Tides Periodic and Continuous Immersion

Decline Due to Soaking	Initial Test Value	Laboratory Water					
		Continuous Soaking					
		11%	18%	26%	22%	40%	60%
Air Cavity (PRD)	2.5	2.225	2.05	1.85			
Air Cavity (VIM)	4.3	3.827	3.526	3.182			
Cavities In Mineral Aggregates (VMA)	16.7	14.863	13.694	12.358			
Asphalt Filled Cavity (VFB)	74	65.86	60.68	54.76			
Marshall Stability	1170	1041.3	959.4	865.8			
Plastic Melt (Flow)	3.6				2.808	2.124	1.332
Marshall Quotient	300	267	246	222			

CONCLUSION

Changes in the characteristics of asphalt concrete wearing course Modifications submerged in the tide (Rob) at the continuous immersion of 7, 14, and 21 days of age have decreased by 21%, 43%, 62%. Meanwhile, the Modified Asphalt Concrete Wearing Course soaked with laboratory water experienced a decrease in characteristics of 11%, 18% and 26%, but in plastic meltdown (Flow) in laboratory water testing decreased by 22%, 41%, and 63%. Durability (Durability) of Asphalt Concrete Wearing Course Modification of immersion with water from the tide (Rob) decreased by 62% compared to those submerged in laboratory standard water decreased by 26%.

The effect of the chemical element chloride (Cl-) content in the water used for soaking on the durability (durability) of the Asphalt Concrete Wearing Course Modification is to reduce stability up to 62% with a soaking life of 21 days.

The effect of durability asphalt concrete wearing course Modification of continuous immersion pattern is resulting in a decrease in durability by 62% and the effect of durability asphalt concrete wearing course modification of intermittent immersion pattern is resulting in a decrease in durability by 12%.

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THE EFFECT OF ASPHALT BATHS WEARING COARSE (AC–WC) ON THE TIDE

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