

CHARACTERISTICS OF AC-BC MIXED BY USING ADDITIONAL MATERIALS OF EGG SHELL**Charles Kamba and Alpius**

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ABSTRACT

The study was intended to test the characteristics of the AC-BC mixture by utilizing the egg shell as a added material. The methodology in this study is to design variations in the rate of egg shell addition then the manufacture of AC-BC mixed test objects and conduct Conventional Marshall testing. The results of the research in the Road and Asphalt Laboratory of the Department of Civil Engineering, Faculty of Engineering, Universitas Kristen Indonesia Paulus Makassar provided research results that the characteristics of the AC-BC mixture through Conventional Marshall testing met the General Specification of Bina Marga 2018. The effect of adding eggshells to the AC-BC mixture will make the cavity in the mixture small so that the mixture can be more resistant to water.

Keywords: AC-BC, EggShell, Characteristics, Marshall Test

1 INTRODUCTION**Background of the Problem**

Roads are one of the most important transportation infrastructures for the economic and social sectors. In line with the increasing social status of the community, there is a tendency to increase the number of vehicles that pass a road.

When using the road, the demands of road users are comfort, safety and speed. To meet the demands of the road user community, the pavement must meet the requirements of functional and structural conditions. The functional requirements concern the flatness and roughness of the pavement surface, while the structural condition requirements concern the ability to maintain its functional condition at a reasonable level. Structural conditions are indicated by the strength or bearing capacity of the pavement which is usually expressed in structural values.

Along with the development of technology, many studies have been carried out in maximizing the stability of asphalt mixtures. One of them is the addition of additives in the asphalt mixture. The addition of additives can affect the characteristics of the asphalt mixture.

One of the added ingredients that can be used is by utilizing egg shells. The selection of egg shells as an added ingredient in the AC-BC mixture is due to; are not easily decomposed and are economical because they are easy to find and obtain. And can determine the effect of adding additives to the AC-BC mixture.

Research purposes

The aims of this research are:

1. This study aims to determine the characteristics of the AC-BC mixture using Nabarua river stone, Nabire district, Papua Province with egg shell added.
2. This study aims to determine the effect of adding egg shells to the AC-BC mixture using Nabarua river stones, Nabire Regency, Papua Province.

Scope and Limits of Research

The scope and limitations of this research are:

1. The type of mixture used is Asphalt Concrete – Binder Course (AC - BC) with egg shell added.
2. The asphalt used is 60/70 penetration asphalt, because it is used in tropical areas, especially Indonesia.
3. The egg shells used are egg shells that are crushed into small pieces.
4. The aggregate used in this study is from the Nabarua River, Nabire Regency, Papua Province.
5. The egg shell variations used were 0%, 1%, 2%, 3%, and 4%.

2 METHODOLOGY

The type of research is experimental, where the research is located at the Road and Asphalt Laboratory, Indonesian Christian University Paulus Makassar. reading the scale (11) the designation of the needle / dial displacement indicator, x (mm) when compression occurred in the spring (10).

INGREDIENTS

a. Aggregate

The aggregate to be used is aggregate from river rock. The aggregate was taken from the Nabarua River, Nabire Regency. Aggregate retrieval can use two-wheeled vehicles or four-wheeled vehicles.

b. Asphalt

The asphalt that will be used is 60/70 penetration asphalt for the AC-BC mixture test which was obtained from the Asphalt Testing and Research Center, Department of Public Works (DPU) Baddoka, Makassar.

c. Ingredients for Adding Egg Shells

The added material used is chicken egg shell taken from one of the restaurants in Makassar City which is then mashed as much as 30gr to become powder.

Mixed Asphalt Concrete – Binder Course (AC - BC)

The composition used in this study where the composition consists of coarse aggregate, fine aggregate, filler, and asphalt. The asphalt content used was 5% as a binder, and egg shells as an additive with variations in addition of 0%, 1%, 2%, 3%, and 4% in the AC-BC mixture.

Making the AC-BC Mixture Test Objects used, namely, egg shells were pounded until smooth and through the Marshall test with a total of 18 pieces. The materials used in the AC-BC mixture must be tested and meet the specifications. The composition of the mixture in this study is a gradation based on the 2018 General Specifications of the Asphalt Pavement Division.

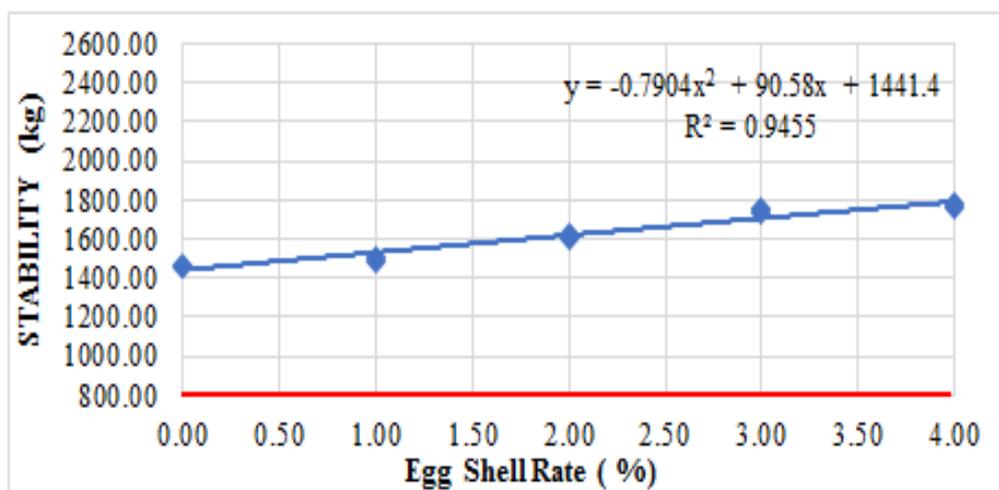
Marshall Testing Conventional Mixed Asphalt Concrete – Binder Course (AC - BC)

Conventional Marshall Test refers to SNI 06-2489-1991. There are 3 (three) stages of testing the Conventional Marshall method, namely by measuring specific gravity, measuring stability and flow as well as measuring density and analyzing cavity using eggshell added material.

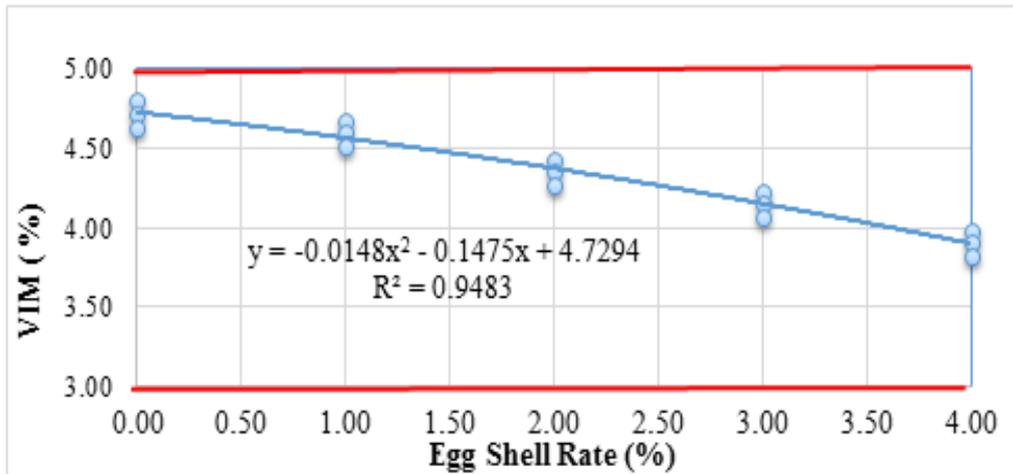
The data analyzed is the characteristic data of the AC-BC mixture of Marshall immersion test results which are presented in the form of tables and graphs and analyzed according to the formulation of the problem and objectives.

1. The characteristics of the AC-BC mixture can be known through the conventional Marshall test, where the values obtained are the values of stability, flow, VIM, VMA, and VFB.
2. In this study, it will be known the effect of eggshell levels on a mixture characteristic by looking at each eggshell content, by looking at the values of stability, flow, VIM, VMA, and VFB experiencing an increase or decrease in each level through the Marshall test, so you can compare mixtures that use eggshells and those that don't use eggshells as an added ingredient.

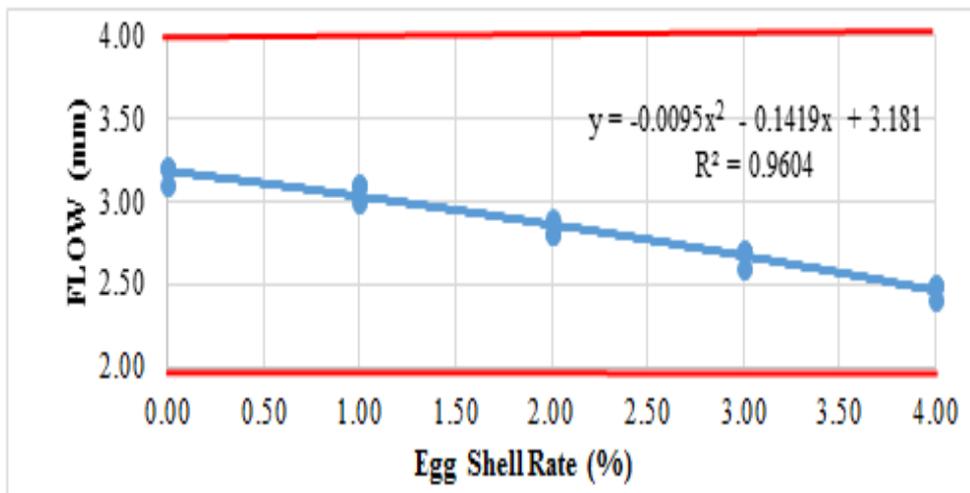
3 RESULT AND DISCUSSION



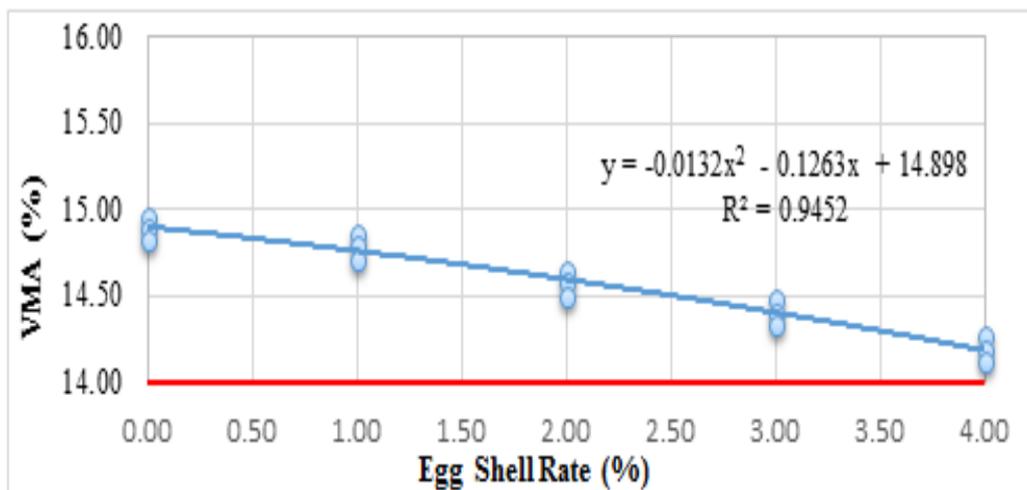
The use of a small amount of eggshell powder in the AC-BC mixture will produce a thin asphalt mixture on the surface of the aggregate which results in weak bonds between aggregates, so that the stability of the mixture becomes small, but if the eggshell content increases then the bond between aggregates becomes strong/mixture stability becomes big.



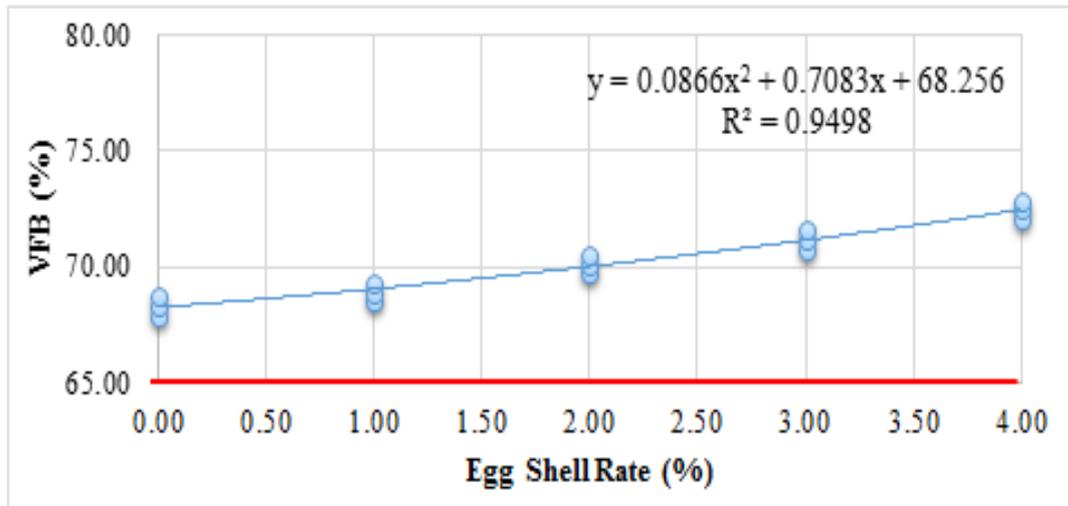
The higher the eggshell content used, the smaller the VIM value, and vice versa if the lower the eggshell content used, the VIM value will be even greater. This is because the eggshell powder functions as a cavity filler in the mixture.



If the addition of eggshell powder to the asphalt mixture is small, the voids in the mixture will be filled with asphalt which causes greater melting.



The more various levels of egg shells used, the smaller the voids in the aggregate filled with asphalt so that the VMA value will decrease.



Using a small amount of eggshell powder in the mixture can reduce the VFB value, because a decrease in the eggshell content in the mixture causes the voids in the mixture to be filled with less eggshell powder.

Test Result Mixed Asphalt Concrete – Binder Course (AC - BC)

Requirements		Vim	Stability	Vfb	Flow	Vma
Rate Asphalt (%)	Egg Shell Level (%)	3 - 5 (%)	Min 800 (kg)	Min 65 (%)	2 - 4 (mm)	Min 14 (%)
5	0	4,72	1460,66	68,31	3,17	14,89
5	1	4,60	1493,85	68,91	3,07	14,79
5	2	4,35	1615,57	70,13	2,83	14,57
5	3	4,15	1748,36	71,16	2,67	14,40
5	4	3,91	1770,49	72,46	2,47	14,19

Based on the results of testing using the Conventional Marshall method on an AC-BC mixture using Nabarua River stone, Nabire Regency with eggshell added ingredients, the Stability, VIM, Flow, VMA, and VFB values meet the General Specifications of Highways 2018 obtained:

Effect on Stability

The effect of adding eggshell content on the stability value can be seen in Figure 7 and Table 12 and can also be seen in the equation of the line, namely $y = -0.8769x^2 + 100.49x + 1599.1$. It was found that for every 1% increase in eggshell content, the stability increased to 4% eggshell content. Based on the equation of the curve line, the greatest stability was found in the egg shell content of 2.10% with a stability value of 1993.26 kg.

Effect on VIM (Vim in Mix)

The effect of adding eggshell levels to the VIM (Vim in Mixture) value can be seen in Figure 8 and Table 13 and can also be seen in the line equation $y = -0.7904x^2 + 90.58x + 1441.4$ indicates that each increase in eggshell content 1%, then VIM has decreased to 4%. Based on the equation of the curve line, the VIM value reaches the minimum limit of 3% at 6.92% eggshell content, while the VIM does not reach the maximum limit that has been set, which is a maximum of 5% even though the egg shell content is 0% with a VIM value of 4.73%.

Effect on Flow

The effect of adding eggshell levels to the Flow value can be seen in Figure 9 and Table 14 and can also be seen in the equation of the line, namely $y = -0.0095x^2 - 0.1419x + 3.181$, indicating that every 1% increase in eggshell content, the Flow will experience decreased to 4% egg shell content. Based on the equation of the curve line, the minimum flow limit is obtained, namely the egg shell content, which is 5.95% with a Flow value of 2.00 mm

Effect on VMA (Void in Mineral Aggregate)

The effect of adding eggshell levels to the VMA (Void in Mineral) value can be seen in the equation of the line, namely $y = -0.0132x^2 - 0.1263x + 14,898$. It shows that for every 1% increase in eggshell content, the VMA will decrease to the level of the shell. eggs 4%. Based on the equation of the curve line, the VMA value reaches its minimum limit of 14% at 4.75% egg shell content.

Effect on VFB (Void Filled With Bitumen)

The effect of adding eggshell levels to the value of VFB (void filled with bitumen) can be seen in Figures and can also be seen in the equation of the line, namely $y = 0.0866x^2 + 0.70836x + 68.256$ shows that every 1% increase in eggshell content, then VFB value is increasing. Based on the equation of the curve line, the VFB value is 68.26% and does not reach the minimum limit that has been set, which is at least 65% even though the egg shell content is 0%.

Effect of Eggshell Fiber Levels on AC-BC Mixture

Based on the results of the study, it can be seen the effect of eggshell levels on the AC-BC mixture by comparing the quality of the mixture at each egg shell content of 0% (non-egg shell), 1%, 2%, 3%, and 4% which can be seen in Table of the following:

Comparative Value of Egg Shell Content

Test	No Egg Shell	The presence of egg shells
Stability	1608,20	1460,66
	2083,52	1493,85
	2430,78	1615,57
	2038,23	1748,36
	1923,44	1770,49
VIM	4,79	4,72
	4,55	4,60
	4,00	4,35
	3,79	4,15
	3,46	3,91
Flow	2,92	3,17
	2,50	3,07
	3,20	2,83
	2,83	2,67
	2,73	2,47
VMA	15,83	14,89
	16,82	14,79
	17,55	14,57
	18,56	14,40
	19,47	14,19
	69,74	68,31
	72,99	68,91
VFB	77,20	70,13
	79,61	71,16
	82,24	72,46

With the addition of egg shells, the effect of egg shells can be seen by comparing the existing test results at 0%, 1%, 2%, 3%, and 4% egg shells. That the value of Stability is increasing, which is increasing at levels of 0% to 4%, and VFB is increasing at levels of 0% to 4%, this is due to the addition of egg shells into the asphalt mixture which causes the mixture to become denser and the cavities within the mixture can be filled so that the asphalt becomes better. As for the value of Flow, VIM and VMA decreased at levels of 0% to 4%. This was caused by the addition of egg shells into the asphalt mixture which resulted in the cavities in the aggregate and asphalt mixture getting smaller because the cavities were filled by egg shells. All of the characteristics of the mixture have complied with the 2018 Highways General Specification Standards.

4 CONCLUSION

Based on the results of the study, it can be concluded as follows:

The addition of egg shells affects all characteristics of the AC-BC mixture, namely the value of Stability, Flow, VIM, VMA, VFB. Where the value of Stability and VFB is increasing and the value of VIM, Flow, and VMA is decreasing. The addition of egg shells to the AC-BC mixture was able to fill the voids in the mixture and make the bonds between the aggregates stronger.

The results of this study are expected to be a consideration for the community and the government of Nabire Regency, Papua Province in utilizing egg shells as an added ingredient in the Asphalt Concrete – Binder Course (AC-BC) mixture.

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