Experimental study on stability of (ac-bc) made with asbuton modification (retona)

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Abstract. Using of asbuton modification asphalt is another alternative to increase mixing quality. Usually, asphalt the aim of asbuton modification to decrease asphalt penetration. For that, it is needed to see the benefit of using asbuton modification as the natural asphalt. In this research mix using 5 asphalt content variation that was 4.5%, 5%, 5.5%, 6%, 6.5%. 15 specimens made using asphalt penetration 60/80 with each asphalt content three specimen. Using asbuton modification (Retona) asphalt mix which was Marshall characteristic to determine the optimum asphalt content, VMA, VFA, VIM, stability, flow and Marshall Quotient. The experiment for optimum asphalt content result of asbuton modification (Retona) asphalts it was 5.5% the test result value in accordance with specifications of the effective asphalt content determination by the Department of Public Works 2006. According to optimum asphalt content for asbuton modification (Retona) asphalt obtained stability 2251.01kg, for the result above it can be stated that asbuton modification asphalt retona mix it can use to develop the quality of pavement course and increasing the stability of the asphalt that used in road pavement.

1. Introduction
Presently there are still many road sections unpaved relatively heavy traffic still using the standard asphalt its properties not match the demands of the field so that often encountered early damage such as cracks, grooves or other shape change so the lifetime is not achieved. The solution should be done is complicated. As one of the alternative handling of aspects of asphalt pavement is relatively resistant to damage Early in the asphalt layer is using hot asphalt mix design appropriate with the demands of the field, which takes into account the burden of passing traffic and the relatively high temperature pavement to meet expected quality then do the use of asphalt mixture AC-BC asbuton which has been in modifier with Retona. (Asbuton modification) is a combination of asbuton items have been extracted partly by hardness asphalt pen 60/80, the manufacturing is done in the fabrication mixed the temperature of 110°C. Hot asphalt mixture using.

Retona more Preferred to line the roads with asphalt pavement high temperatures for airport traffic is heavy and solid for traffic load plan> 10,000,000 ESA or LHR> 2 000 vehicles per day by the number of trucks of more than 15%. [1].

Whereas the precise quantity is not exactly known, one can safely say that the potential of the available resources is huge. On Buton this natural asphalt is found as a brownish-black asphaltic
porous rock which is insignificance and contains aggregates, bitumen, and water. The refinement process used to reacquire the bitumen is branded as Refined Asbuton modification (RETONA).

1.1 Problem Formulation
1. How is the effect of asbuton modification content on the hot mix Marshall Test Asphalt Concrete Binder Course?
2. How is the effect of asbuton modification on the Marshall Stability and flow values of binder layer Asphalt Concrete Binder Course hot mix?

1.2 Research Purpose
To determine the Marshall stability and flow values of asbuton modification content (Retona) Asphalt Concrete Binder Course hot mix.

1.3 Problem Scope
Asbuton modifications Issues it’s so extensive so that it is necessary to limit the issues of the study to be more directed, so that this research focused on the following matters;
1. That the research was done in the form of experiments test in the laboratory.
2. That Asphalt is used a mixture of asphalt is a process of extraction Buton asphalt.

2. Literatur review

2.1 Aggregate
The aggregate nature is one of the determinants of the ability of the pavement to bear the burden of traffic and weather resistance. Which determines the quality of the aggregate as road paving material is Power adhesion to the asphalt. Properties of these aggregates are influenced by the type of rock.

2.2 Asbuton Modification (Retona)
Refinery buton asphalt Asbuton modification (retona) is asbuton combine which has reduced the amount of minerals inside the asbuton (by extracting way and using chemical materials) and mixed with asphalt. Next, ready to be released in the asphalt tank AMP with or without additional bitumen more oil to be pumped into Pugmill that contains aggregate.

Buton asphalt the Type of Retona Blend 55 is natural asphalt Buton with oil bitumen that is processed become one, using a tool with a bitumen specification of a minimum of 90% and a maximum mineral of 10% [2].

| Properties                              | Terms                      |
|-----------------------------------------|----------------------------|
| Penetration (25°C, 5 second, 0.1mm)     | 40-55                      |
| Softening point                         | Min. 55                   |
| Flashpoint                              | Min. 225                  |
| Ductility (25°C)                        | Min. 50                   |
| Specific gravity (25°C)                 | Min. 1.0                  |
| Solubility in Tricolor Ethylene; % weight | Min. 90               |
| Weight Loss (with TFOT); % weight       | Max. 2                    |
| Penetration after losing weight; % original | Min. 55           |
| Ductility after TFOT; % original        | Min. 50                   |
| Mineral passing no. 100; %              | Min. 90                   |
2.3 Marshall Stability Test

Marshall Mix design is the oldest design methods used. Improved by Bruce Marshall for the Mississippi Highway Department in the late '30s, this method is still widely used by most states. The Marshall Method criteria permit the engineer to select an optimum asphalt content to be added to the specific aggregate blend to a mix where the desired properties of density, stability, and flow are met. The Marshall method uses standard (HMA) briquettes that are 4 inches in diameter and 2 1/2 inches high. The preparation procedure is carefully selected, and involves heating, mixing, and compacting asphalt/aggregate mixtures.

![Figure 1. The marshall test machine.](image)

2.3.1 Stability. Marshall Stability specimen test is the maximum desired load to create failure when the specimen is preheated to a specific temperature placed in a special test head and the load is applicable at a constant strain (5 cm per minute). While stability test is in progress a dial gauge is used to measure the vertical deformation of the specimen. The diversity in stability with binder content is small and indicates that the stability is not sensitive to variations in binder content [3].

2.3.2 Void in the Mix (VIM). VIM is the intergranular space occupied by asphalt and air in a compacted asphalt mixture. In a component diagram, it is the sum of the volume of air and the volume of effective asphalt. Figure 1 shows the relationship between Asbuton Modification content and VIM.

2.3.3 Voids in the mineral aggregate (VMA). Voids in the mineral aggregate (VMA) are the air-void spaces that subsist between the aggregate particles in a compacted paving mixture, comprehensive spaces filled with asphalt. VMA represents the space that is obtainable to fit the asphalt and the volume of air voids necessary in the mixture. The more VMA in the dry aggregate, the more space is available for the integument of asphalt. Because the thicker of the asphalt integument on the aggregate particles the more durable, specific minimum requirements for VMA are specified in most specifications. Minimum VMA values should be abided to so that a durable asphalt integument thickness can be achieved. Mounting the gradation density of the aggregate to a point where below minimum VMA values are acquired leads to thin integument of asphalt and a dry looking, low durability mix. Therefore, economizing in asphalt content by lowering VMA is counter-productive and injurious to pavement quality.
2.3.4 Flow. The deformation at the failure point specified in units of 0.25 mm is called the Marshall Flow value of the specimen. The flow value on the arloji is in inches then it must be converted into the millimeter unit [3].

2.3.5 Void filled with bitumen (VFB). The VFB is the percentage of voids in the compacted aggregate mass that are filled with asphalt cement. It is synonymous with the asphalt-void ratio. The VFB property is important not only as a measure of relative durability but also because there is an excellent correlation between it and percent density. If the VFB is too low, there is not enough asphalt to provide durability and to over-density under traffic and bleed. Thus, VFB is a very important design property.

2.3.6 Marshall Quotient (MQ). Marshall Quotient (MQ), defined as the ratio of the stability to the flow, is used as an indicator of the stiffness of the specimens. Samples with higher MQ represent stiffer behavior [3].

3. Research methods
This research was conducted at the Department of Civil Laboratory Faculty Engineering of Hasanuddin University. The aggregates type used comes from stone crusher and binders materials such as asbuton modifications. Then performed assessment and testing of Marshall Stability.

Standards/rules as a reference in this study are:
a. American Association for Testing and Material (ASTM),
b. American Association of State Highway and Transportation Officials (AASHTO),
c. Standard National Indonesia (SNI)

3.1 Research location
Experiments were conducted in the Civil Department laboratories, Faculty of Engineering, Hasanuddin University, Makassar, Indonesia during 2016-2017.

3.2 Research data collection method
Used two methods of data collection in this study are:
a. Study books, to obtain secondary data through various literatures such as books, research journals, scientific articles, and testing standards.
b. Examination and samples testing in the laboratory aims to obtain the primary data which will be used in analyzing the research results was conducted.

| Test | Asbuton modification content | Total specimen | Test Standard |
|------|------------------------------|----------------|--------------|
|      | 4,5%                         | 3              |              |
|      | 5%                           | 3              |              |
| Marshall Stability Test | 5,5%                         | 3              | SNI 03-6758-2002 About Marshall Stability Test |
|      | 6%                           | 3              |              |
|      | 6,5%                         | 3              |              |
3.3 Flowchart of Research
To facilitate this research, then it needs to be planned stages that will serve as guidelines and direction for this research, the stages the process is shown in Figure 2.

![Research Flowchart](image)

Figure 2. Research flowchart

4. Results and discussion

4.1 Test result of aggregate characteristic
Table 3 show the Physical Properties of Coarse and fine aggregate. All the test results of coarse aggregate (crushed stone); as well as stone dust indicates that the aggregate used has fulfilled the specifications of the Directorate of Highways for road materials.

| No. | Inspection                        | Test Results | Specifications | Unit |
|-----|-----------------------------------|--------------|----------------|------|
| 1   | Water absorption                  | 2.79         | -              | 3.0  | %   |
|     | Bulk Specific Gravity             | 2.54         | 2.5            | -    | -   |
|     | Specific Gravity SSD              | 2.51         | 2.5            | -    | -   |
| 2   | apparent specific gravity         | 2.62         | 2.5            | -    | -   |
| 3   | Sand Equivalent                   | 89.6         | 50             | -    | %   |

Table 3. Physical properties of fine aggregates.
4.2 Determination of mixes gradation

The proportion of the combined aggregate was obtained through the value of the aggregate composition ratio plan multiplied by the percent pass of the sieve analysis. From the results obtained for all components, that is crushed stone 1-2 cm, and 0.5-1 cm and stone dust is then summed and analysis sieving to earn a percentage of the expected combination. The combined aggregate gradation is shown in Figure 4.1. Aggregate composition ratio between the coarse aggregate crushed stone 1-2 cm, fine aggregate crushed stone 0.5-1 cm and stone dust is 18%: 51%: 26% of the aggregate composition respectively. The combined aggregate proportion of which has been obtained will be adjusted by the value of interval specifications of the Directorate of Highways, 2010. The design of the combined aggregate is located between the upper threshold and lower threshold within the interval specification of the Directorate of Highways for road materials to obtain the optimal mixture.

| No | Testing                                | Results | Specifications Min | Specifications Max |
|----|----------------------------------------|---------|--------------------|--------------------|
| 1  | Penetration Before Losing Weight (mm)   | 78.6    | 60                 | 79                 |
| 2  | Softening point (°C)                   | 52      | 48                 | 58                 |
| 3  | Ductility at 25 °C, 5cm / minute (cm)  | 114     | 100                | -                  |
| 4  | Flashpoints (°C)                       | 280     | 200                | -                  |
| 5  | Specific gravity                       | 1.12    | 1                  | -                  |
| 6  | Weight Loss (%)                        | 0.3     | -                  | 0.8                |
| 7  | Penetration After Losing Weight (mm)    | 86      | 54                 | -                  |

4.3 Marshall testing results

The Marshall Stability and flow test results apply to dense-graded asphalt mixtures with maximum size aggregate up to 1 in. (25 mm) in size. For the purpose of mix design, Marshall Stability and flow test results should consist of an average of a minimum of three specimens at each increment of binder content wherever the binder content varies in 1, 5% increase over a range of binder content. The binder content range is generally selected based on experience and historical testing data of the component materials but may involve trial and error to include the desirable range of mix properties. Dense-graded mixtures will generally show a crest in stability during the range of binder contents tested. Stability, density, air, flow, voids, and voids filled with asphalt binder, maybe conspire against binder content to allow the picking of optimum binder content for the mixture. The above test properties may also be weighted differently to reflect a particular mix of design philosophy. Also, a mixture design may be required to meet minimum voids in the mineral aggregate based on the nominal maximum aggregate size in the mixture.

5. Conclusion

Stability, flow, bulk density, voids in the mix, VFA was done for 110°C temperatures, according to the analysis and discussion of test results it can be concluded as follows:

1. The value of obtained Marshall stability asbuton modification the content of 4.5%, 5%, 5.5%, 6%, and 6.5% at 1186.96 kg, 1369.57 kg, 2475.76 kg, 1432.78 kg and 1390.64 kg. From these results the most optimum the modification asbuton content 5.5% and smallest modifications
asbuton the content of 4.5%. The optimum content of asbuton modification was found to be 5.5% for HMA at 110°C temperature of the mix.

2. Based on the relationship between the content of asbuton modification and the Marshall test hence got content of the optimum bitumen content at 5.5% then the test result value accordance with specifications of the effective asphalt content determination by the Department of Public Works 2006.

References
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