# Methods of Making Laboratory Scale CPHMA Specimens

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***Abstract***
*The long-term objective of this research is to substitute the role of petroleum asphalt in road constructions with asbuton (asphalt concrete). This will not only have a positive impact in terms of empowering local resources, but also to increase the role of technology in asbuton use, as well as to decrease dependence on overseas asphalt supply. Abundant deposits of asbuton in Indonesia have not been utilized to their maximum potential, due to inadequate quality of asbuton, better performance of petroleum asphalt, and constraints related to supply chain. It has caused road contractors' reluctance to use asbuton. One of the hurdles in production process is the need for a modifier to extract asbuton bitumen. To date, no material has been found which would be able to do the maximum extraction. Due to this constraint, users assumed that the lack of bitumen in asbuton would result in more asbuton needed to construct roads than petroleum asphalt with the same volume. This caused asbuton to be more expensive than petroleum asphalt. This research is the first step of a laboratory-scale testing on the application of modifier on CPHMA with many variables that affect the performance of asbuton, one of which is the method of making the test objects. The results of the study, obtained a method with the addition of the standing process after the submerging process gives better performance than conventional methods, while the application of the process in the field can be in the form of the use of roads which are delayed a day after the compaction process.*

**Key words :** *Asbuton, bitument, CPHMA*

## I. INTRODUCTION

The availability of petroleum asphalt produced by Pertamina Ltd. amounts to 0.3 – 0.4 million tons/year, which can only supply 20 – 30% of the national asphalt needs of 1.3 – 1.5 million tons/year, while the shortfall is imported from abroad [1]. Therefore, the government has been trying to utilize mountain asphalt from Buton Island, also known as buton asphalt. Buton asphalt or asbuton is an alternative material that has the potential to replace petroleum asphalt [2] whose deposits recorded in 2013 as amounting to 662, 96 million tons [3], thus it should be able to meet the asphalt needs in Indonesia for more than 400 years.

One of the asbuton products is the Cold Paving Hot Mix Asbuton (CPHMA), whose manufacturing process is carried out like the mixing process when making hot asphalt mixtures, but whose paving process is carried out in cold. CPHMA is very suitable for areas with limited procurement of Asphalt Mixing Plant (AMP).

The challenge in using asbuton for road constructions is its performance, which to date has not been as good as petroleum asphalt. Asbuton productions can only replace about 7 – 10% of petroleum asphalt processing. Extraction is needed to obtain bitumen, wherein the processing of 1 ton of asbuton can only produce 70 – 100 kilograms of bitumen.

Furthermore, asbuton can only be used optimally in class II and III roads [4]. Asbuton consists of ±30% bitumen and ±70% minerals, wherein the bitumen fuses with and enters the mineral pores resulting in the difficulty to separate the bitumen from the asbuton mineral [5]. Another problem encountered in laboratory research is the lack of standards for the method of making test objects in which this process is one factor that affect the performance of asbuton. Studies conducted by Budiamin et al [6], Djakfar et al [7], Djakfar et al [8], Firstyan et al [9], Ricky et al [10], Thanaya [11], and Tjaronge [12] used certain methods.

## II. MATERIALS

### *A. Aggregates*

The aggregate used was based on the specifications of CPHMA [13], weighing 1000 grams for each test object. In this research, the material of asbuton was also counted as fine aggregate that met the gradation < 4.75 mm to prevent over-aggregation. The percentage of asbuton gradation was obtained from the filter analysis on the remains of asbuton materials left by the extraction. In this research, the obtained bitumen content of asbuton extraction was 25.1%.

***B. Asbuton***

Utilization of Asbuton is a challenge for researchers, practitioners and all parties related to road pavement, where the use of Asbuton as a binder is not as easy as the use of oil asphalt [2]. Many failures in road construction caused the use of Asbuton to be stopped around 1987. This failure was caused by, among others, the varying Asbuton quality, relatively large grain size, which caused the modifier to not work optimally, as well as high water content, which was the impact of Asbuton delivery, bulk form. Until the early 90s, Asbuton research was again activated to improve Asbuton technology [5].

The asbuton used is an LGA (Lawele Granular Asphalt) 20/25 where the weight of asbuton was determined based on the asbuton asphalt content sample needed. The asphalt content was determined as 6%, based on the formula of efficient asphalt requirement with the range for CPHMA asphalt content 6% - 8% [14].

***C. Modifier***

The modifiers used were kerosene and gasoline (pertalite), used in 20% of the weight of asbuton. The choice of kerosene and gasoline was based on several prior studies that had used the two materials for asbuton extraction, as conducted by Magesa [15], Annas et al [16], Sidiq et al [17], Annas et al [18], Sarwono et al [19], and Halimi et al [20]. Meanwhile, the use of kerosene and gasoline to improve asbuton's performance through direct mixing had also been carried out by Alamsyah [21], and Mulyono [22]. Other methods applied to chitosan that may have similar application in Asphalt mixture include the works by Al Azab [23] and Shehata [24].

## III. METHODS

To determine the best method for the sample mixing process 6 methods were tested, namely the conventional method and five variations of the method. Each method was tested using kerosene and gasoline, in which each modifier and method used five test objects so that 60 test objects were obtained. The variations conducted were "only" on the mixing method so that the other variables were assumed to be the same. The temperature for the heating of the mixture was based on the modifier's boiling temperature to prevent overheat which would have caused the modifier to evaporate before dissolving could occur. Mixing with kerosene used a temperature of 170°C, while gasoline used 70°C. The duration of heating was set to 1 hour based on Affandi's study [5]. In the testing of this method, no storage process and compaction processes were conducted above room temperature.

***A. Method 1***

This is a conventional method where asbuton, aggregate, and flask were mixed together and then heated in an oven for 1 hour. Afterwards, the briquettes were compacted and let stand for 24 hours. The next day, the briquettes were soaked for 24 hours while the Marshall test would be conducted the day after that.

***B. Method 2***

In this method, asbuton was mixed with a modifier at room temperature and then heated separately from the aggregate in an oven for 1 hour. The mixing of the three materials was carried out immediately after the materials were removed from the oven while they were still hot. Afterwards, the briquettes were compacted and let stand for 24 hours. The next day, the briquettes were soaked for 24 hours while the Marshall test would be conducted the day after that. This method is based on the assumption that modifier performance would be more effective in dissolving the bitumen without any aggregate in the dissolution process. After dissolution occurred, the aggregate was then included in the mixture, expecting the bitumen to have been dissolved from the asbuton and thus would be able to bind the aggregate. Before mixing, the aggregate was heated first to remove water content.

***C. Method 3***

In this method, the three materials were heated separately for 1 hour in an oven. Afterwards, the briquettes were compacted and let stand for 24 hours. The next day, the briquettes were soaked for 24 hours while the Marshall test would be conducted the day after that.

This method aims to remove water content from aggregates and asbuton while heating the modifier so that when mixing, the heat modifier will more easily dissolve the asbuton bitumen and bind the aggregate.

***D. Method 4***

This method is a variation of Method 1 by adding a standing process after the 24-hour soak, so the Marshall test would be conducted on day 4.

Additional process in the form of standing process #2 is based on the reality of the test results where briquettes experience a very high vulnerability to destruction after experiencing immersion. Application in the field can be done by delaying the use of the road at least a day after compaction.

***E. Method 5***

This method is a variation of Method 3 by adding a standing process after the 24-hour soak, so the Marshall test would be conducted on day 4. Consideration of the addition of the standing process is the same as method 4.

### *F. Method 6*

In this method, the aggregate and asbuton were mixed and then heated for 1 hour to remove the water content. The mixture was then mixed with the modifier and then re-heated for 1 hour, so the total duration of heating was 2 hours with oven. Afterwards, the briquettes were compacted and let stand for 24 hours. The next day, the briquettes were soaked for 24 hours while the Marshall test would be conducted the day after.

This method is based on the AMP process in which each material is first heat treated and then mixed. In AMP practice, as-buton is mixed with aggregates first then heated in a container, after leaving the container then mixed with the modifier.

## IV. RESULTS

The results of the stability testing as shown in Figure 1, show that there are significant differences from Method 4 to other methods, where the resulting stability values tend to have higher values and are evidenced in the use of both modifiers.

The results of the flow watch readings in Figure 2 show results that are consistent with the value of stability, where high stability will produce a low flow value.

The flow chart as seen in Figure 3 shows the heating process has been carried out on the specimens before compaction even though in the CPHMA method the process was not applied where the specimens were compacted as soon as possible after exiting the oven so that the temperature was always above room temperature. If this process is carried out in the field, it will increase the value of Marshall stability and is easy to implement.

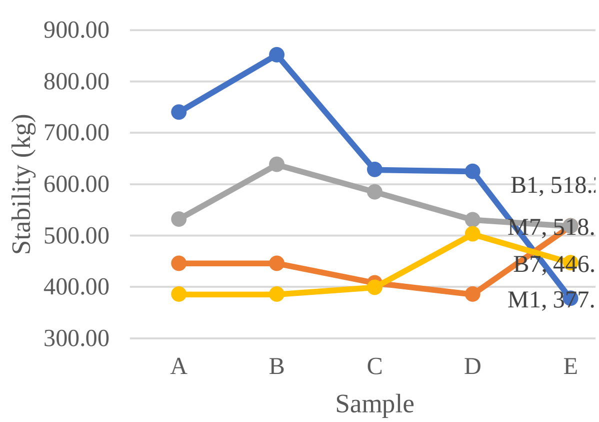


**Figure 1**: Marshall Stability Test Results

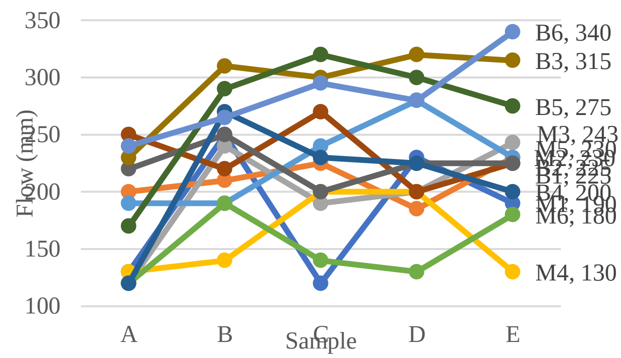


**Figure 2:** Marshall Flow Test Result

The method of making test specimens in this study did not carry out the storage process as generally the CPHMA method. This is done with the consideration that the process is not a variable that varies so that it does not affect the determination of the ability of the method. However, Method 7 has been tested, a method with the addition of a storage process to Method 1 with lower stability results. So it is estimated that if the storage process is held it will reduce the marshall stability values as shown in Figure 4.

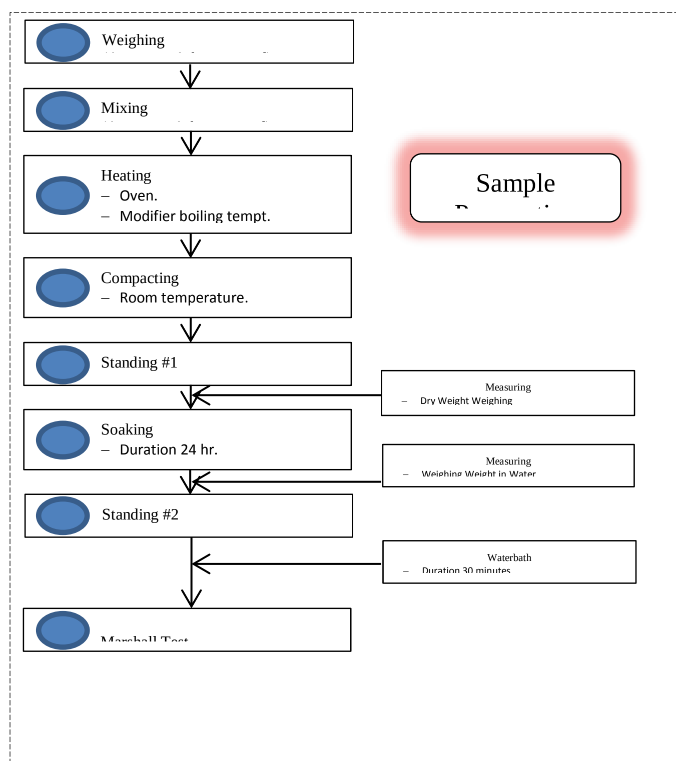


**Figure 3**: Flow Chart Making Test Specimens

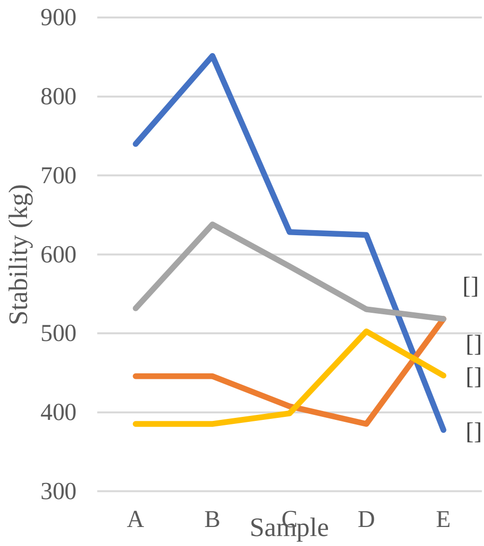


**Figure 4**: 1st Method & 7th Method

## V. CONCLUSION

1. Results of method testing using kerosene and pertalite revealed that Method 4 was the best method.
2. Method 4 showed that the performance of the sample would improve after undergoing recovery process and the 24-hour soaking treatment.
3. The compaction in this testing was conducted at above room temperature so that this method can be applied universally to hot mixed asbuton.
4. Tests are needed with variations in the duration of heating.

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