UNTAR
FACULTY OF ENGINEERING

ICET 2017

3rd International Conference on Engineering of Tarumanagara

"SMART ENGINEERING FOR FUTURE CITIES"

Jakarta, 04-05 October 2017

PROCEEDING

FACULTY OF ENGINEERING
TARUMANAGARA UNIVERSITY
Main Building, Campus I, Jl. Letjen S. Parman No 1, Jakarta Barat
Jakarta 11440 - Indonesia

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Tarumanagara University

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ICET 2017
CONFERENCE PROGRAM

Day 1: Wednesday, October 4th, 2017

	Time	Activity
1	08.00-08.30	Registration + coffee break
2	08.30-09.30	Opening ceremony - Opening remarks from ICET 2017 chairperson - Opening remarks from the Dean of Engineering Faculty - Opening remarks from the Rector of Universitas Tarumanagara
3	09.30-12.00	Keynote Speaker I Prof. Dr. Stephen Cairns, Program Director od the Future Cities Laboratory, ETH Zurich *"Urban Transformations in Asia: Responsive Knowledge Strategies, Design Scenario, and Action Plans"*
		Keynote Speaker II Prof. Dr. Tech. Ir. Danang Parikesit, M.Sc. (Professor of Transportation Planning and Engineering UGM, Chair – Transportation Technical Committee, National Research Council) *"Updates on The Progress of Intelligent Transportation System for Indonesian Urban Areas"*
		Discussion (moderator: Dr. Danang Priatmodjo)
4	12.00-13.00	Lunch break
5	13.00-15.00	Parallel session I
6	15.00-15.15	Coffee break
7	15.15-17.00	Parallel session II

Day 2: Thursday, October5th, 2017

	Time	Activity
1	08.00-08.30	Registration + coffee break
2	08.30-10.30	Parallel session III
3	10.30-10.45	Coffee break
4	10.45-12.15	Parallel session IV
5	12.15-12.30	Closing
6	12.30-end	Lunch break

Note :
- Opening ceremony and plenary session: Main Building, Auditorium 3rd floor
- Parallel session: Main Building, 14th floor

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ASPHALT CONCRETE CHARACTERISTICS USING AGGREGATE COATED WITH PLASTIC WASTE LOW DENSITY POLYETHYLENE (LDPE)

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Abstract

Road is the most important infrastructures to facilitate the mobility of person and services in order to improve the economic growth, but most of the roads are damaged by effects of weather that is the rain water intrusion into the pavement layer that accelerates the erosion process. The asphalt erosion process on the adhesion often causing road damage. It needs a material coating so the erosion can be minimize. The Materials used to coat the aggregate surface is LDPE plastic waste. The volume of LDPE plastic waste used as much as 5% of the aggregate retained in sieve no.8, made in the form of a plastic waste pieces. The specimens are cylinders with a diameter of 4 inch and a thickness of 2.7 inch. Marshall testing with the addition of LDPE wasted plastic can increase the stability by 63.75% compared to conventional asphalt concrete mixture.

Keywords: *asphalt, LDPE plastic waste, marshall, stability*

1. INTRODUCTION

Road is the most important land transportation infrastructure which is one of elements in the effort to facilitate the mobility of goods and services in order to improve the national economy. To achieve this, the provision of transportation infrastructure can't be separated from the provide of material of the road construction. Natural aggregates that are often used for pavement construction material are non-renewable materials and in the long run the availability will be used up.

Sukirman (2003) [1], asphalt is a material that at room temperature come in the form of solid, dense, and thermoplastic. The asphalt will melt if heated to a certain temperature, and freeze again if the temperature drops. With aggregates, asphalt is a pavement-mixing material. The weather effect, is intrusion of rain water into the layers construction pavement will result in the acceleration of road damage and aggregate weathering. Therefore need for a material that can help coating agregrat material other than asphalt in the manufacture of road pavement construction materials. The alternative material is Low Density Polyethylene (LDPE) plastic waste can be taken from waste plastic food bags.

Vasudevan (2013)[2],the use of 10% plastic waste in pavement mixture, can reduce 3% void from conventional mixture.

This study is expected to provide data on pavement material in term of the characteristics of the concrete asphalt mixture, using an LDPE plastic waste as coating. The study is also expected to provide an alternative use of LDPE plastic waste by estimating the amount of waste that can be used, thus being the answer to minimize pollution and degradation of environmental due to LDPE plastic waste.

The purpose and objective of this research is to know the effect of the addition of LDPE plastic waste to the increase of asphalt mixture characteristics and to determine the

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optimum bitumen content of the mixture and the LDPE plastic waste to obtain better mixture characteristics of asphalt concrete.

Better planning is the first step in the successful construction of pavement to obtain service age according to plan. To obtain a longer usage life then roads can be designed with the addition of certain substitute materials

The use of LDPE plastic waste as an additive material to the concrete asphalt mixture is expected to improve the stability of the mixture and give a better effect on the properties of the mixture.

The problems exist in this study are the comparison between Marshall characteristic test of conventional asphalt concrete mixture and asphalt concrete mixture with LDPE plastic waste.

The problem in this study is limited only to the characteristics of asphalt concrete mixtures using LDPE plastic waste as a aggregate coating. This research conducted in the laboratory with marshall test and the collection data, using related regulation and journals as a reference to be poured in the basic theory.

2. RESEARCH METHODS

The plastic waste used in this study serves as an additional material to aggregate coating material as a part of the asphalt concrete mixture. Tests conducted in this study according guidelines from DGH 2010 Division 6 revision 3.[3]

Preparation of materials includes activities procurement of materials to be used in research. The materials used in this research included coarse aggregate, fine aggregate, asphalt and LDPE plastic waste.

Aggregates are such as: broken stone, gravel, sand, and filler. Aggregates are crushed stone used together with a bonding medium an asphalt or mortar form.The asphalt concrete layer is a layer of highway construction, which is composed by of a mixture aggregate asphalt and continous graded , mixed, spread and compacted in a hot state at a certain temperature. The mechanical properties of LDPE plastic types are strong, slightly translucent, flexible and some what fatty surfaces. At temperatures below than 60 ° Celsius is very resistant to chemical compounds, water vapor protection is quite good, but not good for other gases such as oxygen.[4]

The materials used in this research consist of coarse aggregate, fine aggregate, asphalt and waste of LDPE plastic which is tested in accordance with the test method used.

The aggregate is weighed according to the gradation plan of each fraction and sieve.The asphalt level approaches the optimum used is 6% of the total weight of aggregate (1100 grams) or as much as 66 grams. Plastic waste content of LDPE is planned at 5%.en the aggregate is heated to 165 ° C, then the weighed plastic is mixed into the pan containing the aggregate being heated and stirred until well mixed, after which is mixed with hot asphalt and then stirred again until evenly distributed. Then the mixture is put into the mold to be pounded as much as 2 × 75 times. The test specimen is made of two (2) pieces for each bitumen content.

Testing the specimen using a marshall test tool. A marshall tool is a press device equipped with a proving ring used to measure the stability and flow meter values used to measure flow. Stages of research follow the steps as follows Flow chart in Figure 1.

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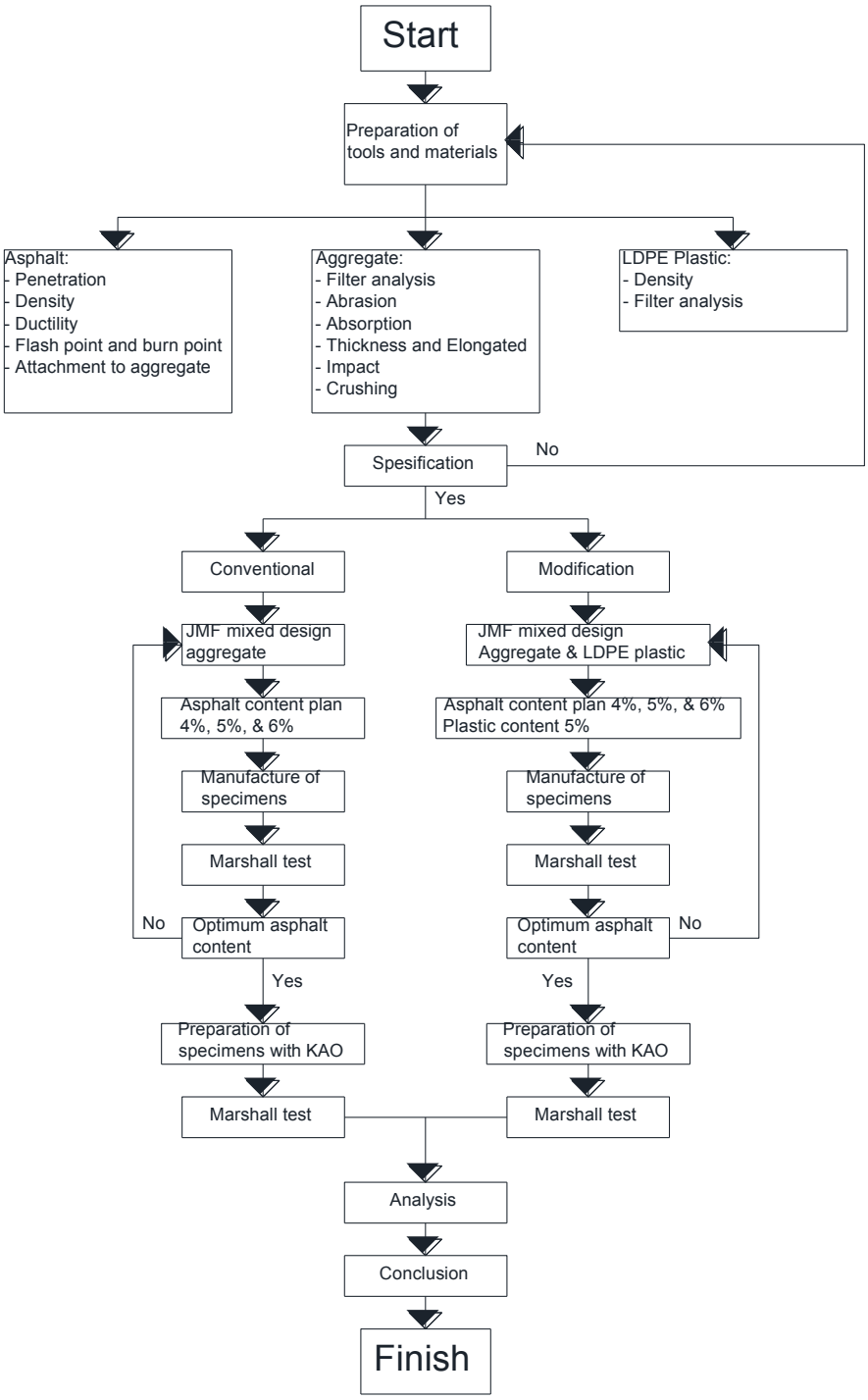

Figure 1. Research's Flowchart

3. ANALYSIS AND DISCUSSION

The first step in this research, we examined the material that will be used to examine the physical characteristics of materials: aggregate, asphalt, and waste of LDPE plastic. It is necessary to know whether the type of aggregate, asphalt, and waste of LDPE plastics used qualified to meet specifications or not. This study was conducted in

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accordance with existing testing guidelines and also supported with was calibrated equipment.

3.1. Aggregate

From the examination of the characteristics of coarse aggregate, fine aggregate, and filler used for asphalt concrete mixture (LASTON), the results are as in Table 1.

Table 1 Results of the Aggregate Characteristic Examination

Aggregate	Specification	Results
BJ. Aggregate Coarse	Min. 2.5	2.56
BJ. Fine Aggregates	Min. 2.5	2.5
BJ. Filler	Min. 2.5	2.5

Table 1 Results of the Aggregate Characteristic Examination (ext)

Aggregate	Specification	Results
Impact	≤ 30%	28.4%
Crushing	≤ 30%	8.21%
Adhesion to Asphalt	≥ 95%	97%
Abrasion	max 40%	24.9%
Kepipihan dan Kelonjongan	max. 10%	1.9% ; 9.3%

3.2. Asphalt

The result of examination of the asphalt characteristic with Esso Pen 60/70 asphalt material done in Road Laboratory of Civil Engineering Department Faculty of Engineering Tarumanagara University is presented in Table 2.

Table 2 Results of Asphalt Characteristic Inspection

Asphalt	Specification	Results
Penetration	60 / 70	69 / 70
Ductility	≥ 100 cm	112 cm
BJ. Asphalt	≥ 1	1.016213
The soft spot	≥ 48°C	53°C
Flash Point and Burn Point	≥ 232°C	325°C; 340°C

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3.3. Waste Plastic

Waste plastic used is a plastic type LDPE (Low Density Polyethylene) obtained from the collectors located in Dadap. From the results of the specific gravity test, we obtain the weight of LDPE plastic waste amounted to 0.919 gr / cm³, the result as in table 3.

Table 3 Results of Examination of LDPE plastic waste

Plastic	Specification	Results
Specific gravity	≥ 0.91 gr/cm³	0.919

3.4. Standard Immersion Marshall Test Results (30 minutes)

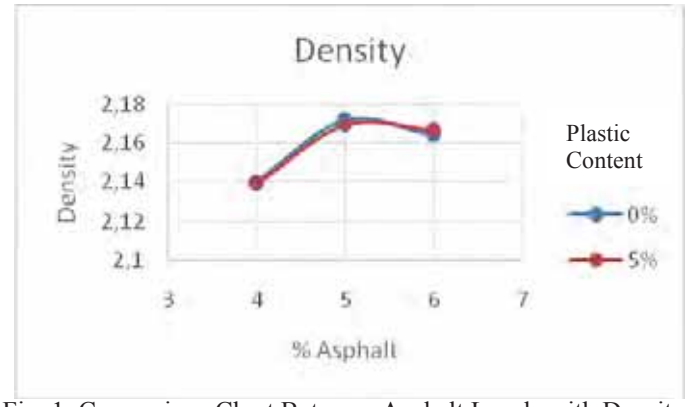

Fig. 1. Comparison Chart Between Asphalt Levels with Density

It can be seen in Figure 1 that the density value of the concrete asphalt mixture without the addition of LDPE plastic waste is higher than the mixture using LDPE plastic waste additive. This is due to the LDPE plastic waste involved covered with asphalt that reduces the level of asphalt that should fill the cavities in the mix.

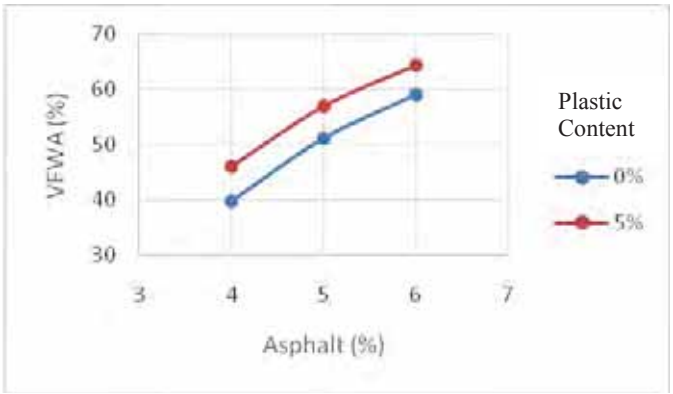

Fig. 2. Comparison Chart Between Asphalt Levels with VFWA

Can be seen in figure 2 as the addition of bitumen content, VFWA value also increased. Judging from the addition of LDPE plastic waste content, VFWA value is increasing, this is caused when the mixing of LDPE plastic waste which is also covered with asphalt reduces the amount of asphalt that should fill the void in the mixture.

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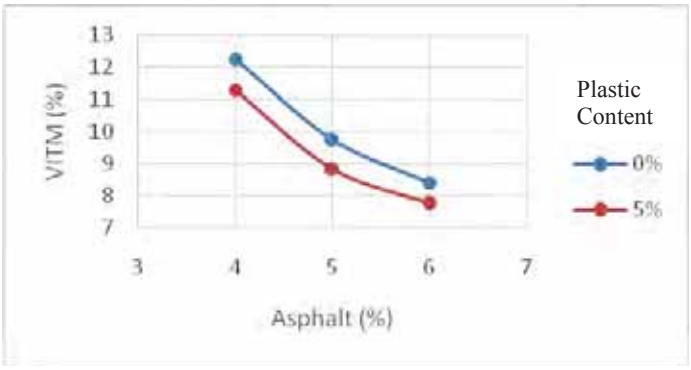

Fig. 3. Comparison Chart Between Asphalt Levels with VIM.

From Figure 3 comparison graph between asphalt content with VITM we can see that the higher bitumen content, the smaller the VITM value. And in mixtures with 5% LDPE plastic content the VITM value decreases, this is due to the added LDPE plastic waste content inhibiting the asphalt void in the mixture.

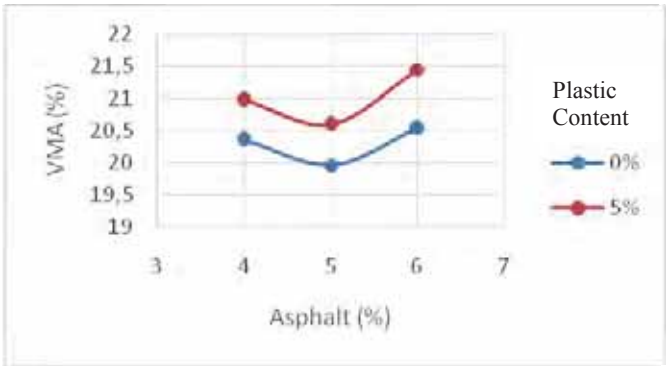

Fig. 4. Comparison Chart Between Asphalt Levels with VMA.

In Figure 4, it appears that the addition of asphalt content in the three variations will first decrease the value of VMA then if the bitumen content is added then the VMA value will increase. This happens when the asphalt is added the aggregate so that the void among aggregates decreases, but if the asphalt content is reduce will also cause the aggregate spacing to become larger.

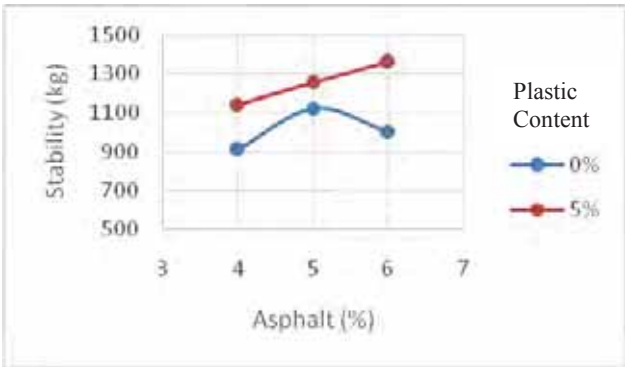

Fig. 5. Graph of Comparison Between Asphalt and Stability.

It can be seen from figure 5, The graph of the test result that with the addition of the LDPE plastic waste content, the stability value tends to increase. This is due to the added LDPE plastic waste in the form of fibers and the asphalt , will covered angled aggregates

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locking each other up . The aggregate position does not easily move from its place when it is loaded, so its stability increases.

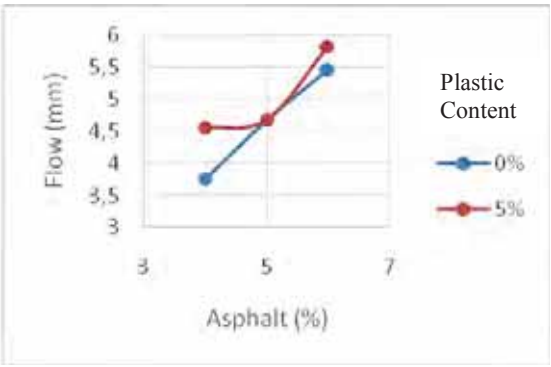

Fig. 6. Comparison Chart Between Asphalt Levels with Flow.

From Figure 6 graph the comparison of asphalt content with flow. It can be seen flow value tends to increase at the time of adding more asphalt content and at the addition of LDPE plastic waste. The addition of LDPE plastic waste content, flow value will be higher than if the mixture is not added by LDPE plastic waste, this is because the nature of the plastic itself is softer than aggregate

3.5. Comparison of Standard Immersion Results With Immersion 24 Hours

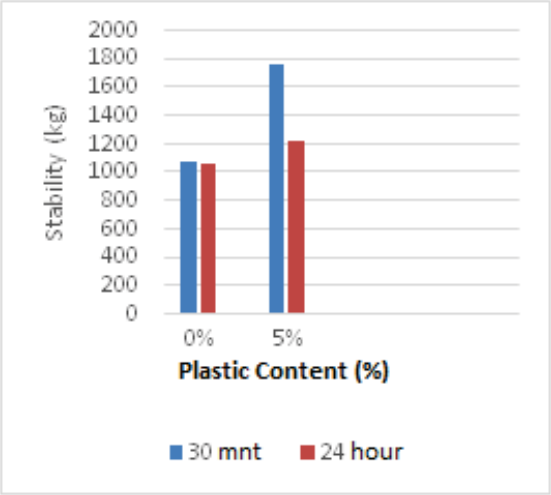

Fig. 7. Graph of Stability Against Soaking 30 Minutes and 24 Hours.

Seen on the picture 7 graph of stability to soaking 30 minutes and 24 hours. The longer the immersion time, stability value will be decrease at the level of plastic 0% as well as the content of 5% LDPE plastic waste. This decrease in stability value occurs because the asphalt is a thermoplastic material hence the nature of the asphalt is greatly influenced by temperature.

In figure 8 the flow graph of 30 minutes and 24 hours immersion shows that. The flow value will tend to increase at the time of addition of 5% LDPE plastic waste content. This indicates that the use of LDPE plastic waste will improve the plastic condition of the mixture so that pavement will be more vulnerable to loading.

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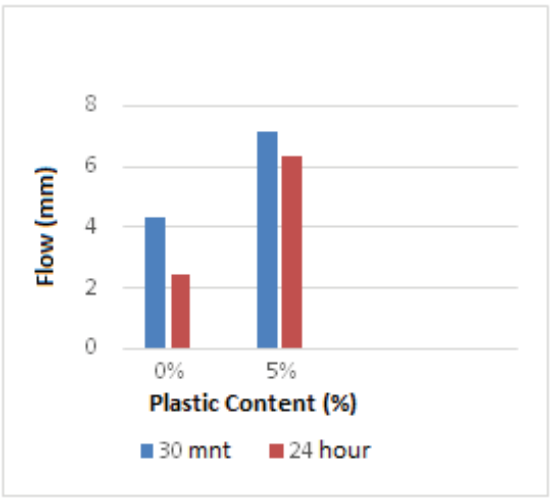

Fig. 8. Flow Chart Against Soaking 30 Minutes and 24 Hours

3.6. Discussion on the Use of LDPE Plastic Waste In Mixture

Environmental Consideration with use of the LDPE plastic waste in large volumes for a pavement construction, a significant LDPE plastic waste treatment solution is obtained. In AC-BC mixture with 5% plastic content variation, the weight of LDPE plastic waste is 5% of total weight of gradation no8. Thus every 1 m3 of AC-BC mixture having a specific gravity of 2.34 gr / cm3 or 2,340 kg will be use LDPE plastic waste as much as 5% x 2340 kg = 117 kg. So for AC-BC mixture with 75cm pavement thickness and road width [2 (2x3.5)] m with 1 km road length can utilize LDPE plastic waste of 122,85 tons..

4. CONCLUSION

Based on the research that has been done by using Low Density Polyethylene (LDPE) plastic waste as a substitute for the coarse aggregate of Asphalt Concrete - Binder Course (AC-BC) mixture, the following conclusions are obtained:

1. LDPE plastic waste can be used as an additional material for gradation aggregate pass sieve no. 4 and retained in sieve no. 8 because the volumetric and Marshall values still meet the required specifications on all variations in the plastic content under test.
2. Stability value tends to increase when the asphalt concrete mixture is covered by the LDPE plastic waste with the result of the stability value increased 63.75% in the manufacture of the specimen with the asphalt content approaching optimum in 30 minutes immersion
3. AC-BC mixture with LDPE plastic waste is feasible to be applied in terms of several aspects,such as engineering, economics, and environment. Technically the use of plastic waste match the specification requirements, economically reducing government costs in plastic waste disposal, and in the environmental aspect can be a handling solution for degradable plastic waste.
4. Flow value increases when plastic content increases. Flow value increased as much 65.35% on the manufacture of specimens with asphalt content approaching optimum in 30 minutes immersion.
5. The air void in the asphalt concrete mixture decreased by 1.08% at the time of adding the plastic content..

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6. By adding LDPE plastic waste as much 5% of the total weight of sieve gradation no 8 in AC-BC with LDPE plastic waste. Can reduce LDPE plastic waste of 122.85 tons along 1 km road.

SUGGESTION

1. Further research is required to determine the other properties of the AC-BC mixture using plastic waste as an addictive to the mixture.
2. Need to do further research by using other types of plastics as an alternative. This will maximize the plastic waste treatment solution.
3. Further research is required on the same or different mixture types using different plastic sizes with higher plastic content from this study, considering the plastic content used in this study still meets the specification requirements.

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