JOURNAL OF CIVIL ENGINEERING PLANNING and DESIGN
Journal of Civil Engineering, Planning, and Design Vol.1, No.2, November 2022: Page 118-121

POTENTIAL REDUCTION OF LOW DENSITY POLYETHYLENE (LDPE) PLASTIC WASTE AS A PAVING BLOCK MIXED MATERIAL

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Abstract. Paving blocks are the result of a mixture of portland cement, sand, water, and with or without other additives. Based on the results of sampling the composition of plastic waste in temporary shelter for 7 days, the percentage of plastic waste generated is 14%, where for the percentage of LDPE plastic waste is 8% and non-LDPE is 6%. This research was conducted with a ratio of cement and sand of 1: 4 with variations a mixture of low density polyethylene (LDPE) plastic at 0%, 0.5%, 1%, 1.5%, and 2% by weight of sand. Paving block quality testing was carried out at the Environmental Engineering and Quality Laboratory, Department of Environmental Engineering and Concrete Laboratory, Civil Engineering, Adhi Tama Institute of Technology Surabaya. The results of the study showed that the greatest compressive strength was obtained in paving blocks with a plastic variation of 0.5%, which is 24 ,83 MPa. While the lowest compressive strength value is obtained at the paving block variation of 1.5%, which is 12.32 Mpa. The test results for the largest water absorption were obtained on paving blocks with a plastic variation of 2% with an average absorption of 6.45%, while the lowest water absorption was found in paving blocks with 1% plastic variations with an average absorption of 4.65%. it was concluded that the addition of reduced density polyethylene (LDPE) plastic from 0.5% to 2% had no significant impact on the addition of compressive strength and water absorption but tended to experience a decrease in the quality of the comparison sample. The potential for reducing LDPE plastic waste is 203,376 grams/day and produces 8,135 paving blocks with quality B. The purpose of this study is the utilization of low density polyethylene (LDPE) plastic waste in paving blocks and the effect on the quality of compressive strength and water absorption.

Keywords: water absorption, compressive strength, LDPE, paving blocks

1. Introduction

Plastic waste is one of the biggest problems faced by the Indonesian nation. Plastic has several characteristics that other materials may not have, namely difficult to decompose, strong, flexible, and durable. Plastic waste contributes negatively to the environment. The reason for this negative development is that plastic takes a long time to purify and cannot be feared quickly [1]

Burning plastic waste will produce toxic gases that are harmful to breathing, whereas if it is disposed of carelessly it will have a negative impact on the environment such as flooding, damage to soil fertility, water and others [2]

The type of plastic LDPE (low density polyethylene) is the type of plastic that is most widely disposed of into the environment because LDPE plastic is very popular or very commonly used in society. LDPE has a density between 0.74-0.76 g/ml and has a boiling point of 1150C. LDPE plastic is usually used as wrappers (cracks), glass drink bottles, and medicine wrappers. This type of LDPE plastic as a wrapping material has the advantage that it has a low price, is flexible and easy to recycle and also LDPE plastic has good protection against water vapor, and high resistance to chemicals but is soluble in benzene and tetrachlorocarbon (CCI4) [3]

In response to this, the latest innovations are needed that aim to utilize this type of LDPE plastic waste so that it can have a selling value and can reduce waste in the environment. One of the innovations found in the construction sector is processing waste to be used as material for making paving blocks. Paving block is a product of a combination of building materials such as cement, sand, and air which does not reduce the strength of the paving block concerned. Paving blocks are widely used as a substitute for concrete in road construction and are used because the prices offered are cheaper and the maintenance costs are cheap [4]

Research on the Potential for Reduction of Low Density Polyethylene (LDPE) Plastic Waste as Paving Block Mixture Material was carried out with several stages of testing with the final results to find out how much LDPE plastic waste heaps in ITS temporary shelters and also to know the level of compressive strength and absorption of paving blocks as a result of the research.

2. Materials and Methods

The method used in this research is the experimental method, namely the research method to conduct experimental activities that get a result,

2.1 Research Location and Time The

Paving block manufacture was carried out at klampis aji 2 and then tested the quality of the paving blocks at the Environmental Quality and Engineering Laboratory, Department of Environmental Engineering and Concrete Laboratory, Civil Engineering, Adhi Tama Institute of Technology Surabaya. Sampling of the composition of the waste was carried out on 1 garbage cart at the ITS temporary shelter for 7 days.

JCEPD-ISSN: XXXX-XXX

2.2 Research Materials and Tools

The materials used in this research are chopped LDPE, Lumajang sand, Gresik cement, and PDAM water. As for the tools used in the form of: paving block molds and their compactors, digital scales and spring scales, moulds, stirrers and immersion containers.

2.3 Determination of LDPE Plastic Waste Generation

The selection of the ITS temporary shelter location was based on the service area factor, namely in the white area and part of the mulyorejo area which consists of many villages and housing, one of which is the ITS campus area (ITS lecturer housing). Using references from previous studies to determine the research area from Hapsari, DSA 2017 that the pile of garbage that enters per day at the ITS temporary shelter is quite large, around 2542.20 kg/day.

The survey composition process was carried out on one garbage cart. Garbage is pulled from the cart and then inspected according to the type of waste that has been determined. Garbage that was previously discarded is then repositioned and the weight of each individual is recorded.

2.4 Paving Block

Making Process Paving block making is carried out with several variations as shown in the table, including: Table 2.1 Paving block variations

Table 1
Paving Block Mix Composition

Mixed Composition 1 : 4				
Variation	Cement (g)	Sand (gr)	LDPE (gr)	Total Weight (gr)
0 %	756	2496	-	3252
0,5 %	756	2484	12,5	3252
1 %	756	2471	25	3252
1,5 %	756	2459	37,4	3252
2 %	756	2446	50	3252

The process of making paving blocks is carried out in several stages as follows:

1. Material Mixing (homogenization)
   Mixing consists of the composition of cement, sand, water and added chopped plastic. This mixing process takes approximately 8 minutes with the mixture being stirred until it becomes homogeneous
2. Pouring the Paving Block
   Mix The paving block mixture is inserted into a mold measuring 20 cm x 10 cm x 6 cm until it is full.
3. Compaction of Paving Block Mixture
   Compaction is carried out on a fully filled mold then compaction is carried out by mashing it until it is completely solid. After that, the paving blocks are removed from the mold for drying.
4. Testing of Test Samples
   Testing of test samples is carried out after the paving block has passed the maintenance stage for 28 days. The testing process consists of compressive strength and water absorption tests. The test refers to the standard of SNI 03-0691-1996.

3. Results and Discussion

3.1 ITS LDPE Plastic Waste Generation

The generation of ITS LDPE plastic waste is as follows:

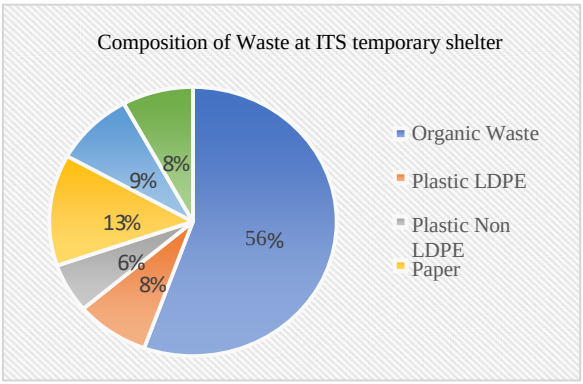

Fig. 1 Composition of Waste at ITS temporary shelter

The composition of waste at ITS temporary shelter consists of 56% organic waste, 14% plastic waste, 13% paper and cardboard waste, 9% diaper waste and 8% cloth waste.

The amount of organic waste composition is greater because the household's daily consumption produces kitchen waste. where most of the food waste still contains water so that the waste becomes heavy [5]

Types of plastic waste are divided into 2 categories, namely LDPE and non-LDPE plastics. LDPE plastic has a percentage of 8% and non-LDPE plastic is 6% of the total plastic waste. The percentage of LDPE plastic waste, especially crackle, which is quite large is due to the lack of interest in recycling or sorting by garbage officers because the selling price to collectors is very cheap.

3.2 Compressive Strength Test

The results of the compressive strength test are presented in graphical form as follows:

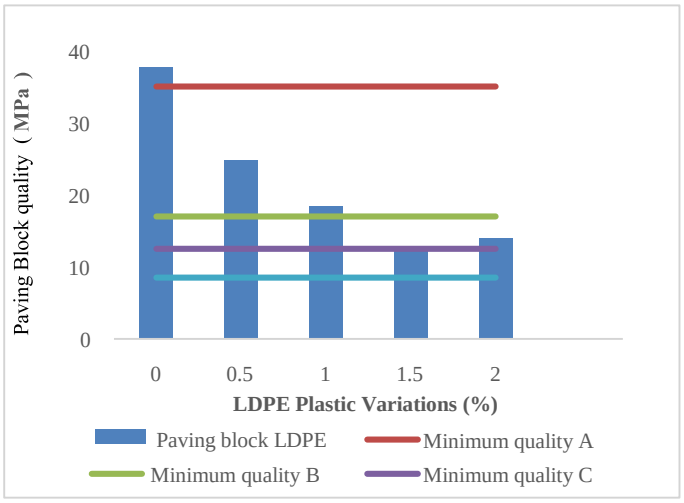

Fig.2 Compressive Strength Test Results

Results of testing the quality of paving blocks can be concluded that paving blocks without variation (0%) obtained a compressive value of 37.63 MPa. The results of the compressive strength of this 0% paving block have met the minimum quality standard of A quality which is 35 MPa, so that it can be installed and used for road vehicles. Then on paving blocks with variations of 0.5% and 1%, the compressive values are 24.83 MPa and 18.41 MPa. The results of this compressive strength meet the minimum standard of quality B, which is 17 MPa.

This B quality standard means that paving blocks can be installed and used for parking equipment. Paving block with a variation of 1.5% is included in the D quality standard because it obtains a compressive strength value of 12.32 MPa where the minimum quality standard is 8.5 MPa.

This D quality standard is the smallest quality standard classification whose utilization can only be used for gardens and other uses that do not receive too large a burden. Paving blocks with a variation of 2% obtained a compressive strength value of 13.90 MPa from a minimum quality standard of C of 12.5 MPa. The C quality obtained for the 2% variation means that this paving block can be used for pedestrians.

3.3 Water Absorption Test

Results of the compressive strength test are presented in graphic form as follows:

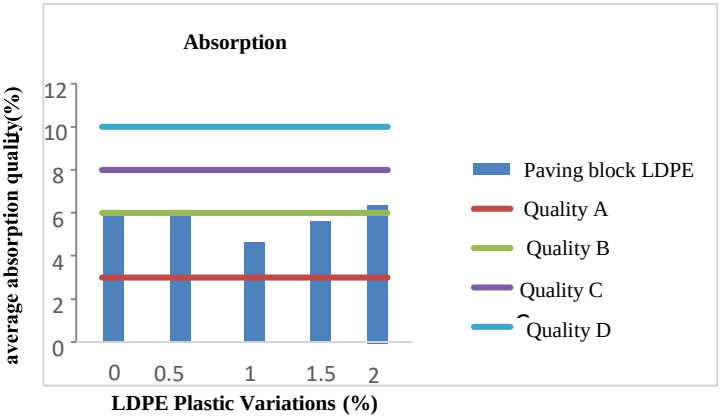

Fig. 3 Water Absorption Test Results

The results of water absorption can be concluded that the paving block sample without variation (0%), variation of 1% and variation of 1.5% obtained the percentage of absorption of each of 5.9%, 4.65%, and 5.55% of the standard maximum absorption average of 6%. The percentage of absorption results from these three variations meets the standard quality of maximum absorption average B. Quality standard B means that paving blocks can be installed and used for parking equipment. Then the percentage of absorption on the paving block with a variation of 0.5% and 2% obtained the percentage absorption value of 6.1% and 6.45%, respectively. The percentage value of absorption variation of 0.5% and 2% meets the average maximum absorption standard of C quality, which is 8%. The obtained quality standard C means that this paving block can be used for pedestrians.

3.4 Reduction Potential of LDPE Plastics

The results of quality testing of paving blocks showed that the best quality was found in paving with a variation of 1% with compressive strength and water absorption quality that met quality standards B. Paving with a variation of 1% utilizes shredded LDPE plastic waste as much as 25 grams per fruit. Based on the literature, it is stated that the waste generation of ITS temporary shelter is 2542.20 kg/day [6]

The calculation of the LDPE plastic reduction potential is as follows.

LDPE Weight at ITS temporary shelter:

= LDPE Composition x ITS temporary shelter Generation

= 8% x 2542.20 kg

= 0.08 x 2542.20

= 203.376 kg

Number of paving blocks

$$\frac{203.376\ kg}{25\ gram} = 8.135\ pieces$$

Based on the calculation results obtained that the total LDPE waste generation is 8% or equivalent to 203,376 grams / day, can produce paving blocks with a variation of 1% and quality B quality as many as 8,135 pieces.

4. Conclusions

Based on the results of the research that has been carried out, it can be concluded several things as follows:

1) The generation of plastic waste at temporary shelter ITS is 15%, consisting of 8% LDPE plastic waste and 6% non-LDPE
2) Strong test results compression using LDPE plastic for each paving block variation as follows: The greatest strength results are found in paving blocks with a mixed variation of 0.5% with a compressive strength value of 24.83 MPa. The variation of 0.5% meets the quality of class B paving blocks which can be used for pavement on the parking lot. Meanwhile, the lowest compressive strength results are found in paving blocks with a mixed variation of 1.5% with a compressive strength value of 12.32 MPa and meet the quality of class D paving blocks which can be used as non-structural pavement materials such as sidewalks, gardens, yard pavements. and other pavements with low loads.
3) The results of the highest absorption test are found in the 2% paving block variation with an absorption percentage of 6.45%, this result meets the quality of class C paving blocks and can be used as pavement for garages and pedestrians while the smallest absorption percentage is found in the paving variation. block 1% by obtaining an absorption percentage of 4.65%, meets the quality of class B paving blocks that can be used for pavement on parking lots.
4) The manufacture of paving blocks is able to reduce 8% of the total pile of LDPE waste or about 203,376 grams/day and can produce 8,135 paving blocks according to a variation of 1% with B quality.

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