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Making Paving Block by Using Plastic Waste Polypropylene (PP) as A Mixture Material of Sand Aggregate (Filter)

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Abstract

Polypropylane Plastics (PP) is one of the safe plastic materials to use because of the ability to prevent chemical reactions on plastic packaging with food or beverage packaged. The amount of PP plastic waste that is commonly used as a mineral water pack (plastic glass) has the potential to be utilized. Utilization of recycled PP plastic glass waste in this research is used as a mixture material of sand aggregate (filler) of paving-making basic material by testing on paving block sample. In this study determined the ratio of comparisons between raw materials in the form of cement, sand and plastic. The volume of paving material is set at 5 kg, 10% cement percentage by varying sand aggregate 40 - 90% while plastic mixture 0 - 50%, and analyzing compressive strength and water absorption at paving life: 7, 14 and 28 days. To fulfill the need of plastic aggregate in this research, the plastic is chopped up to 1-2 cm size which is meant to blend in making paving block. From the research, it is known that the best compressive strength value of 20% at 7 days to 28 days shows the value of compressive strength up to 13 Mpa and water absorption test reaches 10.17%, it is in accordance with SNI 03-0691 standard - 1996 is included in the quality of C and D used for pedestrian and park places.

Keywords: PP plastic waste, mixture material od dand aggregate, paving block

INTRODUCTION

Plastic waste is a fairly complex problem, especially in residential areas, industrial and campus environments. With industrial growth and population growth plastic impacts for the environment Among the toxic particles of plastic particles entering the soil will kill decomposing animals such as worms, cannot decompose even when eaten by animals and will become serial killers in the order of the food chain, plastic can disturb the soil fertility because it can block air circulation in the surrounding soil (Sen and Mishra, 2010).

Based on research on previous garbage Universitas Pembangunan Nasional "Veteran" Surabaya, East Java, Indonesia produces about 9.53 m^3 / day of waste, among others consists of several types of plastic that is HDPE and PP, so it has the potential to be utilized into several other forms of good organic waste as well as inorganic, where for the type of HDPE plastic has been used for briquette making materials (Cao et al., 2016), in order to support environmental sustainability and maintain campus with the achievement of eco campus. The phenomenon of plastic waste boom has become unpleasant. Not only in developing countries but also in developed countries like America,

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England and Japan. Currently the use of plastic materials in Western European countries reaches 60 kg per person per year. (Rajkumar, 2015; Etuonovbe, 2009 ; Saeki, 2006). The problem that often happens is the treatment of plastic waste that culminate in the disposable system without processing it first or plastic processing into goods that have more value and useful (Dixit, 2017; Kusumo, 2010).

This research will utilize potency of polyropylene plastic waste (PP) specially from mineral water glass container with various variation of mixed addition will be measured its effect on compressive strength and water paving block absorption. It will also review the technical and economic aspects of adding the mixture.

METHODS

This research will discuss about the utilization of PP plastic as an alternative aggregate for paving block making with required quality done with experimental trail and error, with direct experiment in field and laboratory. Experiment conducted by treatment administration to the variables studied so that the impact of the treatment can be drawn a correlational conclusion with the variables studied. Number of sample prototype experiments of each type made according to the Indonesian National Standard (SNI).

Materials and Equipment

The main material used plastic PP obtained from plastic waste glasses mineral water packaging, other materials is the manufacture of paving block cement Portland (PC) and sand. The equipment used is a paving molding tool specially designed for this research, as well as tools for mixing and molding the paving.

Preparation phase

Preparation of paving block with PP plastic mixture as filler is divided into two experiments that is preparation stage and main experiment.

1. Collect the PP type plastic waste in campus area
2. Prior treatment of plastic waste (cleaning, enumeration)
3. Mixing PP plastic waste that has been cut into the first paving dough with the following composition variations:
   a) Comparison of cement, sand and plastic in% = 10: 90: 0 with composition (in Kg) 0.5: 4.5: 0
   b) Comparison of cement, sand and plastic in% = 10: 80: 10 with composition (in Kg) 0.5: 4: 0.5
   c) Comparison of cement, sand and plastic in% = 10: 70: 20 with composition (in Kg) 0.5: 3,5: 1
   d) Comparison of cement, sand and plastic in% = 10: 60: 30 with composition (in Kg) 0.5: 3: 1,5
   e) Comparison of cement, sand and plastic in% = 10: 50: 40 with composition (in Kg) 0.5: 2,5: 2
   f) Comparison of cement, sand and plastic in% = 10: 40: 50 with composition (in Kg) 0.5: 2: 2,5

For the main experiment to prepare a mold of iron pipe with size (p x l x t) = 20.5 x 10 x 9 cm, the next step:

- Molding
- Treatment after molding
- Product Test

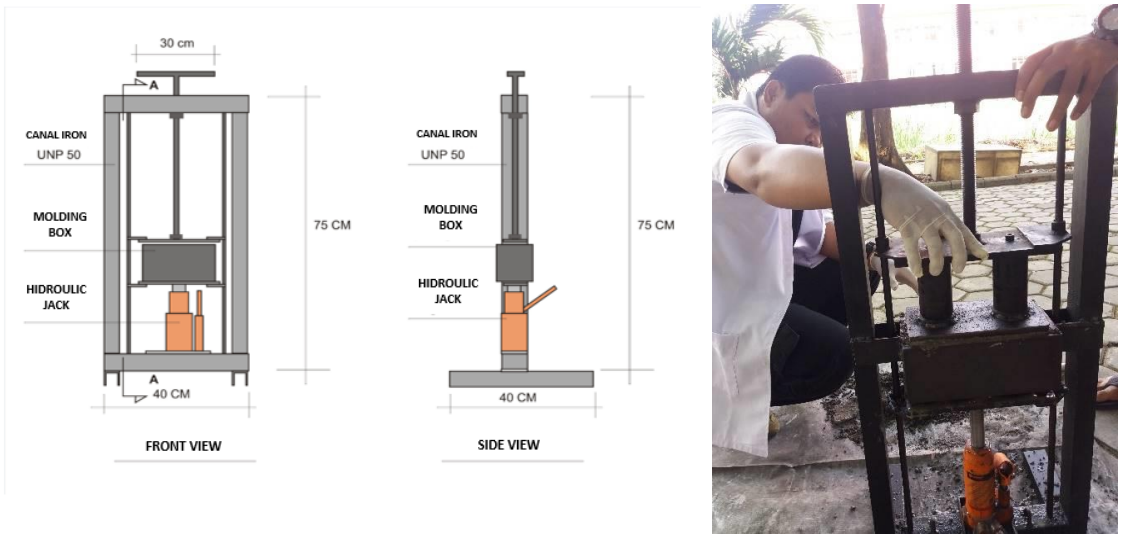

Figure 1. Hydroulic Press and Mold of Paving

Analyzes conducted for the quality of paving produced include: external test, compressive strength test and water absorption test.

RESULT AND DISCUSSION

External Test

Table 1. The outer-looking outcome of paving with PP plastic mixture

Cement	Aggregate		surface crack			not easily crushed		
	sand	PP Plastic	7 day	14 day	28 day	7 day	14 day	28 day
10%	90%	0	√	√	√	√	√	√
10%	80%	10%	√	√	√	√	√	√
10%	70%	20%	√	√	√	√	√	√
10%	60%	30%	√	√	√	√	√	√
10%	50%	40%	-	-	-	-	-	-
10%	40%	50%	-	-	-	-	-	-

Information: √ = Ok, according to SNI S – 04 – 1989- F

\- = it is not in accordance with SNI S – 04 – 1989- F

Fulfillment occurs on the ratio between cement and aggregate including pp plastic up to 30%. However, in paving with a plastic mixture of 40% and 50% did not meet the SNI S - 04 - 1989 - F this is because the more plastic that is mixed causes the cement binding power to the pp plastic to be reduced so as to affect the outer appearance of paving.

Compressive Strength Test

Paving press strength test is one of quality requirement of Paving in accordance with Indonesian National Standard (SNI). Compressive Strength test results can be seen in the following table 2:

Table 2. Effect of material composition and paving life on compressive strength of paving

Cement	Aggregate		Compressive strenght (Mpa)					
	sand	sand	7 day	quality	14 day	quality	28 day	quality
10%	90%	0	15	C	15.1	C	15.14	C
10%	80%	10%	14.5	C	14.1	C	13.13	C
10%	70%	20%	13.8	C	13.2	C	13	C
10%	60%	30%	10.12	D	10.5	D	9.7	D
10%	50%	40%	7.5	D	7.1	D	6	-
10%	40%	50%	6.6	-	5.6	-	5	-

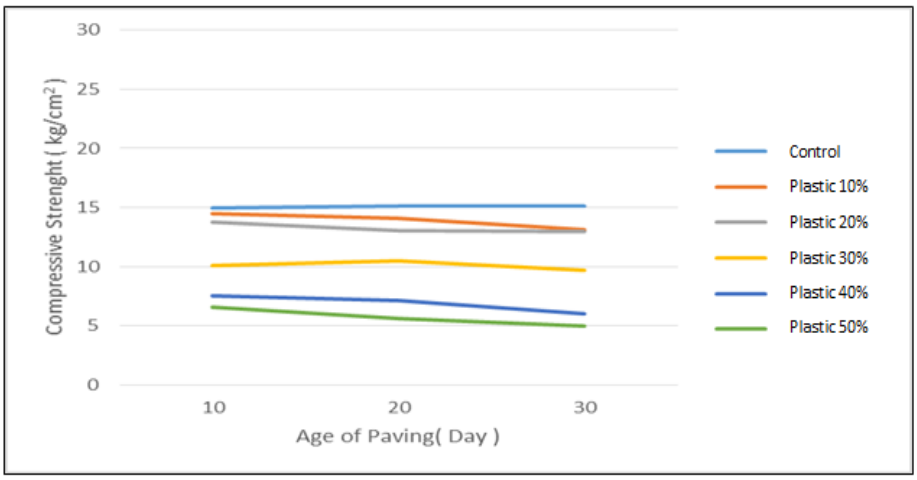

Figure 2. Graph of age relationship of paving PP plastic mixture with compressive Test of Press (Mpa)

On the control of paving (0%) age 7 days meet SNI Standard 03-0691-1996. For paving ages 14 and 28 days showed a compressive strength between 15.1 to 15.14 MPa. In percentage of mixture 10% age paving 7 meets SNI 03-0691-1996 Standart. For paving life 14 to 28 days showed a compressive strength between 14.1 to 13.13 MPa. For percentage of plastics 20% lifespan of paving 7, 14 and 28 days indicates compressive strength between 13.8 to 13 MPa. Percentage of plastic 30% lifespan of paving 7, 14, 28 days showed a compressive strength between 10.12 to 9.7 MPa. percentage of plastic 40% age 7, 14 days showed a compressive strength between 7.5 to 7.1 MPa and at age 28, and at percentage 50% did not meet SNI 03-0691-1996 standard so the best result in the compressive strength test is the percentage 20% plastics with yield 13.8 to 13 MPa at 7 to 28 days paving life.

Starting from a percentage of 10% plastic mixture to 50% plastic mixture, the decrease of compressive strength as influenced by the addition of pp plastic waste is also influenced by the age of paving. This suggests the compressive strength for pp plastic waste decreases with the amount of pp plastic waste used, and increases with the amount of sand used. So the best result in the compressive strength test is the percentage of 20% plastic with the result 13.8 to 13 Mpa at the age of paving 7 to 28 days (Kusumo, 2010).

Water Absorption Test

Water absorption test is conducted to find out how much power absorbed by paving water. The results of absorption test for pp plastic mixing can be seen in the following table 3:

Table 3. Effect of material composition and paving life on paving absorption

Cement	Aggregate		Water Absorption					
	sand	PP Plastic	7 day	quality	14 day	quality	28 day	quality
10%	90%	0	9%	C	9,4%	C	9,11%	D
10%	80%	10%	10,2%	D	10,2%	D	9,45%	D
10%	70%	20%	10,4%	D	10,15%	D	10,17%	D
10%	60%	30%	10,11%	D	11,42%	—	12%	—
10%	50%	40%	11,01%	—	12,01%	—	12,8%	—
10%	40%	50%	12%	—	13,5%	—	13,65%	—

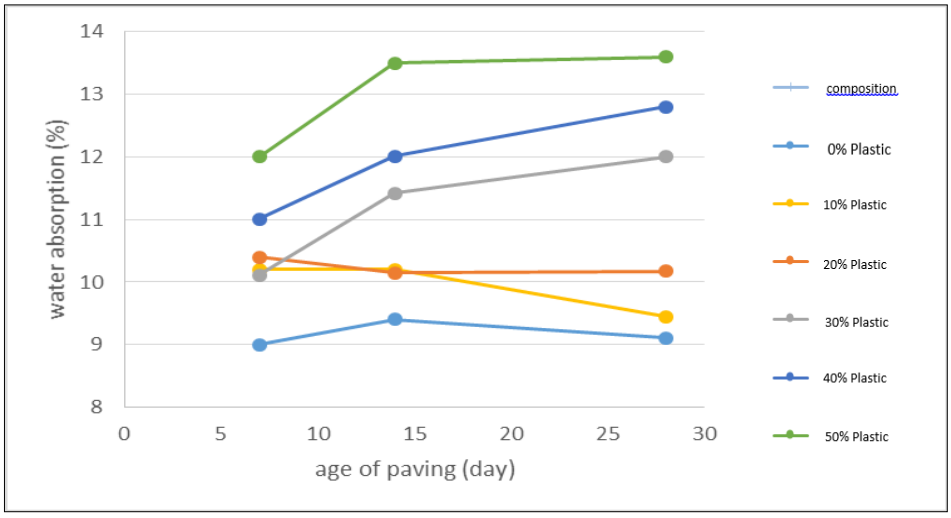

Figure 3. Relationship between paving age (day) and percentage of absorption at various percentages of composition

In percentage of plastic starting 30% age of paving 7 days, and 40% day 14 and day 28 not in accordance with Standard SNI 03-0691-1996. From the results of the research that has been done, it is found that the longer the paving life is increasing also the absorption of water, and the more plastic used causes the absorption to increase as water enters through the plastic sides in the paving. The comparison of the composition of cement with aggregate

affects the water absorption value, where the water absorption value of the research results has been done that the longer the increase also the absorption of water.

CONCLUSION

From the results of research in the laboratory can be concluded aggregate from plastic PP plastic waste can be used as a mixture of paving block with best mix of plastic glass waste 20% at age 7 days until 28 days showed the value of compressive strength until 13 Mpa meet SNI 03-0691-1996 ago water absorption reaches 10.17% fulfill SNI 03-0691-1996 so this paving is included in the quality of C and D used for pedestrian and park place, more waste of plastic pp wastewater used to influence paving block result.

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