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The Effect of Addition of Plastic Waste and Styrofoam Waste Against Powerful Concrete Brick Press

1st Priyadi
Departement of Environment Health
Politeknik Kesehatan Kemenkes Palembang
Palembang, Indonesia
Email: priyadi7470@yahoo.co.id

2nd Navianti Diah
Departement of Environment Health
Politeknik Kesehatan Kemenkes Palembang
Palembang, Indonesi
Email: dnaviantidiah9@gmail.com

Corresponding author: : priyadi7470@yahoo.co.id

***Abstract* - Inorganic waste such as plastic and Styrofoam are very difficult to decompose/degrade in nature. This study aims to provide a solution for utilizing plastic and styrofoam waste in brick making and to determine their effect on the compressive strength. This research was an experimental research with independent sample t- test. Data on the compressive strength test result of the two types of brick were analyzed by independent t-test to determine the effect of the addition of plastic waste and Styrofoam waste against the powerful concrete brick press. The results of the study with the addition of plastic waste and styrofoam waste in the manufacture of brick had a compressive strength of an average of 44,62 kg/cm^2. The result of the independent t-test was known to the value of Sig. (2-tailed) of 0,000<0,05, it shows the average value of the compressive strength test results in the control sample group with the treatment sample group. This research was proved that plastic waste and Styrofoam waste provide benefits related to the compressive strength of the concrete brick so that it is expected to provide an alternative treatment for plastic waste and Styrofoam waste in reducing the negative impacts of environmental pollution that caused by the disposal. The processing of plastic and styrofoam waste currently was done by combustion and hoarding in the ground.**

Keywords: plastic waste, styrofoam waste, powerful concrete brick press.

I. INTRODUCTION

Environment as one of the main factors in improving the degree of public health needs to be structured, managed and procced so not to have a negative impact on public health and the environment itself [1]. One of the conditions that will cause a negative impact on the environment and public health is the presence of waste. Waste is the rest of human activities or natural processes in the form of solid waste, while in specific meaning waste is waste which due to its nature, concentration, or volume requires special processing [2]. The composition of waste in Indonesia, referring to the statistical data an average of 74% in the form of organic waste and the remaining 26% in the form of fabric, metal, plastic, styrofoam, and various packaging.

The national target in 2025 is that Indonesia free from waste, it is 30% of waste can be reduced, 70 % of it can be handled, so there is no more pollution from the environment, especially rivers and the sea [3]. Waste produced by Indonesia as a whole reaches 175,000 tons per day or 0,7 kilograms per person. In 2014, waste statistics in Indonesia noted that Indonesia became the second-largest producer of plastic waste in the world after China. National waste production reaches around 65,8 million tons annually with 16 percent of plastic waste. The amount of waste in Indonesia will continue to increase if the handling of waste has not been serious. It is predicted that in 2019 waste production in Indonesia will touch 67,1 million tons of waste per year [4]. Waste distribution in Palembang has increased from 700 tons per day to 1,400 tons per day. The waste management paradigm that relies on the final approach is the time to change to a new cycle that suitable with the concept of ecology. This Integrated waste management system at least combines the approach of reducing waste sources

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through recycling and composting [5]. Recycling is one of the solid waste treatment strategies that consist of sorting, collecting, processing, distributing and manufacturing used products. The recycling approach was applied especially to non-organic waste such as paper, plastic, aluminium, glass, metal and others [6]. Plastic waste and Styrofoam (inorganic) rubbish are types of rubbish that not easily decomposed in the ground and if it carried to the sea will damage marine ecosystems and biota. According to Hasibuan it takes 500-1000 years to decompose plastic bag waste it takes 10.000 years or it can't even be destroyed to styrene beads, which are processed using benzene. Benzene is a substance that can cause many diseases [7]. Also, Styrofoam is not environmentally friendly, because it cannot be deciphered at all. Even in the production process itself, it produces a lot of waste so it is categorized as the 5th largest producer of hazardous waste in the world by EPA (Environment Protection Agency) [8][9].

Plastic waste has the potential to contaminate soil and air through open burning or incineration. Incineration is often considered the easiest solution to the problem of large-scale land-based plastic pollution, whereas this incineration can produce the most carbon dioxide (CO_2) and dioxin [10]. Emissions among plastic waste management methods. As dependence on incineration grows, emissions directly from plastic waste will also increase. Combustion of plastics and rubbish is expected to emit carbon equivalent to 189 megawatts of coal-fired power plants by the end of 2019. Besides burning rubbish that is carried out in an open area not by the use of an incinerator so that it is difficult to carry out air pollution control treatment. Management with the hoarding and accumulation of plastic waste and styrofoam waste in the ground currently can cause disruption to the air / oxygen supply in the soil because it is blocked by the presence of plastic waste and styrofoam waste which will ultimately affect the soil ecosystem [11].

Based on Marzuki's research it could utilize Styrofoam waste into earthquake-resistant bricks. Marzuki decided to manage Styrofoam waste into concrete bricks because it was easy to find around the environment. Styrofoam raw materials are superior because Styrofoam contains a lot of fiber. Styrofoam brick has physical characteristics similar to red brick. Styrofoam has advantages compared to red bricks because of its light weight that can reduce sound.This is because high fiber content in Styrofoam as a raw material in brick making. The nature of styrofoam that binds will make the brick stronger As an alternative to process plastic waste and styrofoam waste, the researchers mixed these 2 types of waste in the process of forming concrete blocks that followed by testing the compressive strength of the results [12].

II. METHODS

The research design was Experimental Research to determine the effect of the addition of plastic waste and Styrofoam waste against the powerful concrete brick press. Data analysis used the independent t-test method which tested the compressive strength of the control brick sample with the intervention brick, the research was conducted at the Workshop of the Department of Environmental Health, while the sample testing was carried out at the Sucofindo Technical Laboratory, branch of Palembang. The brick press test equipment was used the compressive power method of the object which would be tested in Mega Pascal or Mpa (kg / cm2) units using the *Electro-Hydraulic Compression Testing Machine (TYA-2000).*

III. RESULT

The results of the compressive strength test showed that the average compressive strength value of the control group was 26.49 kg / cm2, while the average compressive strength value of the treatment group was 44.62 kg / cm2. If it is compared to SNI 03-0349-1989 about the specifications of concrete bricks for wall pairs, the compressive strength of the treatment group has a classification of compressive strength on the quality level of Class III solid concrete with an average of 40 kg / cm^2 [13]. Meanwhile, according to SNI 03- 0691-1996 specification of concrete brick (paving block), the sample of treatment is included in the classification of Concrete Brick quality A with the specified standard that is 40 MPa [14]. Furthermore, the compressive strength data of the sample groups were analyzed using the independent t-test method as follows;

Table 1 Concrete Compressive Strength Test Results

Sample group	Quantity of Sample	Average compressive strength (kg/cm^2)	Std Deviation
Control	22	26,49	14,025
Treatment	22	44,62	10,771

Source: Primary Data, 2019

Table 2 Output t-test independent Compressive Strength

	Equal variances assumed	Equal variances not assumed
F	1,231	
Sig.	,273	
t	-4,807	-4,807
df	42	39,378
Sig. (2-tailed)	,000	,000
Mean Difference	-18,125	-18,125
Std. Error Difference	3,770	3,770
Lower	-25,734	-25,749
Upper	-10,516	-10,501

Based on the output above, it is known that the Sig. Levene's Test for Equality of Variance was 0.273 > 0.05, which means that the data variance between the control sample group and the treatment sample group was homogeneous or equal to the Sig. (2-tailed) of 0,000 <0.05 than with the independent sample t-test that H0 is rejected and Ha is accepted. It can be concluded that there was a significant (real) difference between the average compressive test results in the control sample group and the treatment sample group.

IV. DISCUSSION

The treatment sample group and the control sample group had different average compressive strength values. The addition of plastic waste and styrofoam waste can increase the compressive strength value of the concrete block with a difference of 18,13 point. The compressive strength data of the treatment sample group was included in the brick classification according to the Indonesian National Standard (SNI) 03-0349- 1989 and SNI 03-0691-1996 [13][14]. Physically, it showed that the mixture of cement and sand were strongly bonded together so that plastic waste and Styrofoam waste in the cement and sand join in the bond. Furthermore, if it observed and compared with the physical control sample, the treated sample showed a bond that occurs between cement and sand had the same texture as the composition of cement and sand (1:2) and the position of plastic and styrofoam waste is between these compositions. Strength in cement arises from the formation of Calcium Silicate Hydrate ($C_3S_2H_3$) or Tobermorin which is hard and does not dissolve easily in water, this is the nature of the plastic aggregate adhesives and styrofoam rubbish on the adobe. This result can be a reference in processing plastic waste and styrofoam waste because of its compressive strength. Based on the results of the research by Abdul Halim et al., The ideal mixture in the manufacture of concrete blocks used the composition of 1PC: 5 PS: 5 Sty, compressive strength of 33,1 kg / cm^2, it means that styrofoam can be used as much as 50% of the amount of sand that used (15). Based on the research by Yessi Rismayasari et al., showed that the addition of a variation of 4% of plastic waste has the greatest compressive strength [16]. This result technically has a predetermined standard and it can be used as a method for processing plastic waste and styrofoam waste which has been processed in ways that can cause negative impacts in the form of air pollution also harmful gases such as CO, Chloride, CO_2, Dioxin and Furan, moreover, if it carried out by combustion has a negative impact on the soil because of hoarding/accumulation of chemicals can kill decomposing microorganisms and inhibit the circulation of air/oxygen which entering the soil that needed for the activity and metabolism of soil microorganisms [10].

Block with styrofoam mixture has advantages over red bricks because of its lightweight, Styrofoam can reduce sound. Styrofoam contains lots of fibre. The binding properties of styrofoam will make the bricks strong [15]. Whereas in the study using block-shaped blocks using fine plastic aggregate with different yarn fibre compositions tested for compressive strength and flexural strength with variations in the number of yarn fibres, it fulfils the requirements of lightweight concrete. As an alternative to processing plastic waste and Styrofoam waste, the researchers mixed these 2 types of waste in the process of forming the concrete blocks which was followed by testing the compressive strength of the concrete blocks resulting from mixing the waste [17].

Based on other research it is stated that rather than the waste plastics going into the landfill or incinerators it can be used as construction materials at a much lower cost after undergoing certain specific processing. It also reduces the construction cost by eliminating the use of mortar during construction by using recyclable plastic/composite bricks and floor interlocks. From the compression testing results we come to know that waste plastics material when effectively mixed with Rubber powder and Calcium Carbonate gives the highest compressive strength and sustains high compressive load [18]. With this research waste management plastic and styrofoam, trash can be as a complement to the aggregate mixture in the manufacture of hollow brick which is in line with the new waste management paradigm that there to be new solutions that do not cause impact to the environment and public health.

During this dispose of waste to landfill to be stacked and burned can give a negative impact on the environment and will ultimately have an impact on public health due to air pollution due to burning of garbage and pollution of soil on the accumulation of trash carried out.

V. CONCLUSION

The compressive strength data of the treatment sample group was included in the brick classification according to To Indonesia National Standard (SNI) 03-0349- 1989 and SNI 03-0691-1996 [13][14]. Utilization of plastic waste and styrofoam waste as an additive to concrete brick can be an alternative in waste management.

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