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PLASTIC MATERIAL DEVELOPMENT AS ALTERNATIVE WALL MATERIALS ENERGY SAVING

Juhana Said[1] & Sungkono[2]

[1] PhD, University of Moslem Indonesia, Makassar, Indonesia
[2]PhD Cand, University of Brawijaya, Malang, Indonesia

Abstract

Architecture made a major contribution in rising of the air temperature in urban areas while increasing load energy use in buildings. The heat emitted by the sun's heat reflection in particular building by a wall can increase the air temperature. Heavy materials such as brick and concrete block a detrimental effect on the thermal environment. Instead of lightweight materials such as glass and plastic gives a better effect on the thermal environment. The higher the surface aspects (heavy material and pavement) the higher the temperature of the radiation, so that the built environment is getting uncomfortable. Plastic materials including lightweight building materials category, which has properties, such as not easily broken, no corrosion, and resistance to weather. This research carried out recycling plastic waste into plastic material as an alternative wall material that supports energy savings. Conducted more in-depth development of value related to variations in the form of high aesthetics and energy savings can be maximized. Testing to provide assurance of material strength to support its function as a quality building materials.

***Keywords**: Plastic Material, alternative wall materials, energy saving*

INTRODUCTION

Cities in the tropics require a concept of heat balance between the physical area of the city and the thermal environment. Valsson (2008) suggests that physical characteristics such as density of buildings, building materials, land cover material, color and albedo material greatly effects of climate change on the environment. The city that has many buildings is composed of heavy building materials will absorb and trap heat in large quantities and have a hot thermal environment.

Melby (2002) and Olah (2012) suggested that the architecture made a major contribution in raising the temperature of the air in urban areas while increasing the burden of energy use in buildings. The heat emitted by the sun's heat reflectance particular building by a wall can increase the air temperature. Heavy building materials such as brick and concrete block aMelby (2002) and Olah (2012) suggested that the architecture made a major contribution in raising the temperature of the air in urban areas while increasing the burden of energy use in buildings. The heat emitted by the sun's heat reflectance particular building by a wall can increase the air temperature. Heavy building materials such as brick and concrete block a detrimental effect on the thermal environment. Instead lightweight building materials such as metal and glass panels give a better effect on the thermal environment. This is caused because of heavy building materials have a large heat capacity, so it can absorb and store heat from the sun and then released back into the air during the day and night. Juhana, Sudradjat (2010) and Juhana (2013) be explained that the higher the surface aspect (heavy building materials and pavement) the higher the temperature of the radiation, so that the built environment is getting hot and uncomfortable. Juhana research results (2013) in Makassar found that the reduction of 50% by weight building materials can reduce the value Physiologically Equivalent Temperature (PET) ± 1 ° C.

Makassar in Indonesia, particularly in the most popular building material is brick, concrete, glass and metal panels. Brick and concrete building materials categorized as heavy as glass and metal panels

as lightweight building materials. Indonesian society generally uses brick and concrete as a building material. They have long since left the bamboo and wood on the grounds of social status or the environment.

Metal and glass panels are lightweight building material category that is often used as a wall material, but it is still a complementary component. This is because material prices are still high, and the nature of the glass tends to be transparent and requires no maintenance and special care due to break easily.

Plastic materials including lightweight building materials category, which has a general nature, such as; not easily broken, non-corrosive, weather resistant, and strong, so that is one alternative that is expected to be a solution of the issues mentioned above. Juhana (2010) began exploring the plastic material is to be made in alternative building materials by utilizing plastic waste. In Makassar plastic waste has increased every year. Data Parks and Sanitation Makassar (2012), that the urban waste around 3800 m^3 per day and 9.68 % is plastic waste. That is 367.84 m^3 stacked plastic garbage every day without handling and clear management. This condition is a great opportunity to utilize plastic waste into a product in the form of "technological packages" that has a sale value.

METHODS

Research singer is a departure point plays performed on subscription laboratories. Main ingredients hearts singer research inorganic garbage (waste plastic) that used goods such as tapes, VCD, points cosmetics, jars and so on lying sourced of points landfill, with help scavengers.

Fig. 1. Plastic waste through a process of washing and drying

Fig. 2. Material reinforcement of water hyacinth plants

The main tool in the form of:

Stove and pans, serving to melt the materials, software to create image design forms the wall material alternatives are high aesthetic and respond to energy savings, the mold material / model according to the image of the aluminum material, thermocouple digital and box testing levels of conductivity, and universal testing machine for impact test.

The course of the research done by 4 (four) stages:

Phase I (melting)

After the samples collected plastic waste, washing and drying. Then the heating process at a temperature of molten or between additional phase, which is between solid phase and liquid phase are among addition, when the material is in a state of 'soft plastic'.

Fig. 3. The melting of plastic waste

Phase II (Preparation of alternative wall materials)

Design the shape of alternative building materials with consideration of aesthetics, strength of materials and respond to energy savings. Mold making material (pattern) of aluminum. Once the mold is complete, do the assembly and installation of the reinforcement rods water hyacinth plants that have been dried. Then the next process is to enter a plastic material that has been melted on mold that has been assembled with careful attention so that this plastic material fills the whole pattern of indentations in order to obtain a neat shape as desired. Last is the drying process to get a good result, which is an alternative wall material.

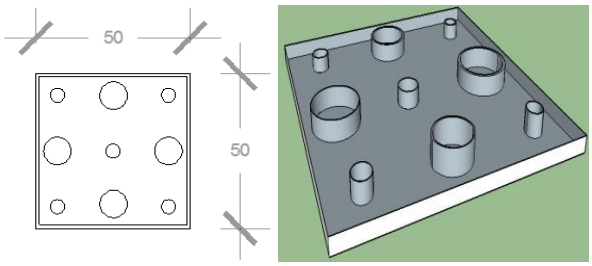

Fig. 4. Design of alternative wall material which has holes

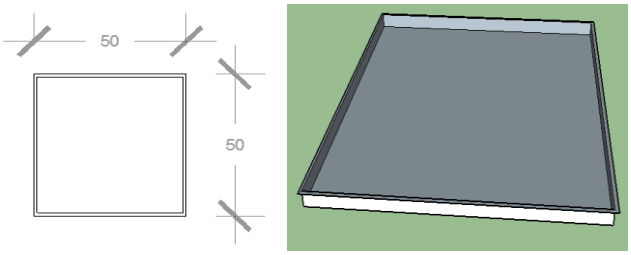

Fig. 5. The design of the wall material alternatives plain and flat

Fig. 6. The mold material of aluminum

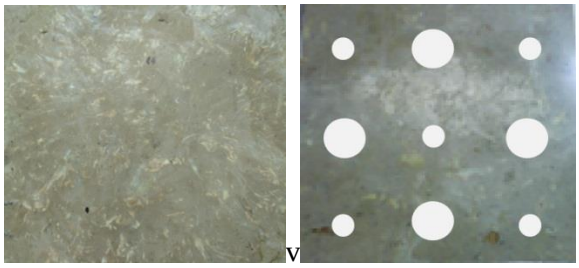
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Fig. 7. Products produced alternative materials plain and perforated wall

Phase III (Testing the conductivity of the plastic material)

At this stage will be held testing conductivity level of plastic material. Plastic materials that have been printed and dried, sampled for conductivity level was tested by using the tool box testing and digital thermocouple. The results of the level of conductivity of the material will determine the level of energy savings obtained and the contribution of heat to the environment.

Fig.8. Test the conductivity of the plastic material

Phase IV (Level Strength Testing / ductility material)

In this stage testing material level of strength and ductility. Plastic materials that have been printed and dried, sampled for testing the level of strength and tenacity with tensile test and impact test using a universal testing machine. The results of the testing of materials matched with quality standards to obtain a strong and resilient material.

Fig. 9. Test impact plastic material

RESULT

3.1 Shape Plastic Material Wall Alternative

Based on research that has been done it appears that the form of the plastic material wall design alternatives depending on the shape of the mold. While the surface roughness is highly dependent on the use of oil lubricants and mold materials used. The use of lubricant oil significantly influence the smoothness of the surface. Printing without the use of a lubricant oil tends to lead to surface textured or fibrous materials. Forms slippery material and textured or fibrous aesthetic value of its own as an alternative material walls (figure 10 and 11). It is designed with a combination of smooth and textured material provides a high aesthetic value on the buildings (Figure 12)

Fig. 10. Plastic materials with the slippery surface

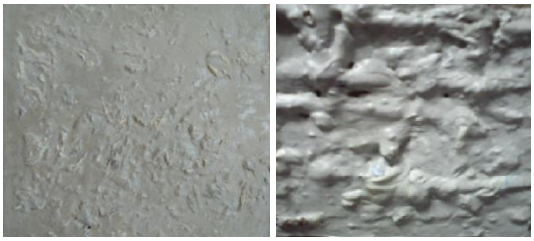

Fig. 11. Material plastic with smooth and textured surfaces

Fig. 12. Examples of buildings with the application of smooth and textured surface material

The color of the material after the melting process is highly dependent on the dominant color of plastic waste. If the color of garbage melted the dominant white color tends to approach the results of melting white or a light color, and if the green or yellow, the color of the melting becomes green. In other words, the color of the wall material produced from plastic waste is very diverse, so that it can give a distinct impression on the character or appearance of the building as a whole .

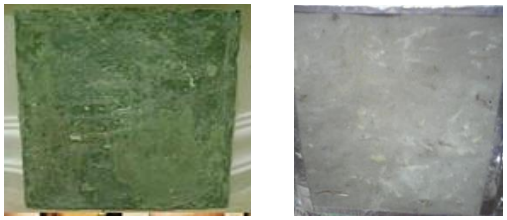

Fig. 13. The color of the material resulting from the melting of plastic waste

3.2 Conductivity Material Value

Based on observations and measurements have been performed on two samples of wall materials from plastic waste are obtained data as follows:

Table 1. The observed data

Wall sample	Size Sample (m)			Temperature (°C)			
	Thick	Long	High	Outside Air	Outer Wall	Wall In	Air Space
textured material	0.012	0.18	0.16	55.00	41.00	39.00	35.00
slippery material	0.013	0.18	0.16	55.00	42.00	40.00	34.00

Table 2. Data sample conductivity

Wall sample	Conductivity Value (Watt/m/°C)
textured material	0.6830
slippery material	0.6829

Based on the results of measurements in the table above can be said that the textured material and slippery material has a conductivity value which is considered the same as the difference is very small, which is around 0.0009 Watt/m/°C. But for the size of the same material, textured material wider sides of the surface that receives too hot so that more heat flow. This is evident from the results of temperature measurement in two of the sample material textured walls can lower the room temperature of about 20 °C. While the slick wall material can lower the room temperature of about 21 °C.

Level material plastic wall heat flux (0.6829 Watt/m°C) is quite good compared to a brick wall (0.69 Watt/m/°C) and glass (0.78 Watt/m/°C), which is commonly used as a building shell. For the plastic wall material well-textured and smooth enough to use as an insulating material between the skin of the building and the space as a wall material that is more energy efficient alternatives.

3.3 Strength Measurement Results / Tenacity (Impact Test)

Based on test results obtained by the level of impact strength / ductility material plastic wall, which were 3.57 Joule / mm^2. Meaning that it has an excellent level of brittleness is similar to the glass fiber material (3.6 Joules / mm^2) and aluminum (3.8 Joules / mm^2). Although small compared to the impact strength and fiber glass aluminum but has excellent ductility for impact based on test results obtained specimens of the test materials were mostly indirect broken but just bent. For the plastic material is excellent to be used as an alternative wall or skin of the building

CONCLUSIONS

After doing research, it can be concluded that:

- Material wall of plastic waste is an energy-efficient alternative wall material which has a high responsibility to the thermal environment so that it can be used as an outer wall material or space within a building.

- The resulting surface has interesting color variations so that these materials can be used as an insulating material between spaces in the building as well as the skin of the building without going through the process of painting again.

- Material wall of this plastic waste is an alternative wall materials which have high levels of strength and toughness are very high so it is best used as a wall material and may even door as floor and ceiling materials.

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About the authors

Juhana Said: was born in Bone on December 27, 1971. Complete her education S1 Architecture Department, Unhas Makassar (1997) and a Masters of Architecture in Science and Technology Building, Undip Semarang (2000). He holds a Doctorate in Science and Technology Building, ITB Bandung (2013). Worked as a lecturer in the Department of Architecture, UMI Makassar (2000-present). Active in research funded by UMI, local government, Dikti. Studies that have been done are: Young Lecturer (2010), Competitive Grant (2013-2014), Competitive Grant (2015-2016). Active write articles in the national

and international seminars, international, national, and local journals. Once wrote a book published " *Arsitektur dalam Kehidupan Masyarakat* " (2001).

Sungkono: was born in Ngawi on November 15, 1958. Complete her education S1 Engineering Department, UMI Makassar (1988) and a Masters of Engineering, ITB Bandung (1996). PhD candidat in University of Brawijaya, Malang (2013-present). Worked as a lecturer in the Department of engine, UMI Makassar (1989-present). Active in research funded by UMI, local government, Dikti. Studies that have been done are: Competitive Grant (2011-2012), Competitive Grant (20131-20142),Competitive Grant (2015-2016). Active write articles in the national and international seminars, national, and local journals.