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Valuation of Ecobricks as an Artificial Resource in Hardscape Materials

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Abstract

The Medan City TPA in the Waterfall Village, Medan Marelan District is the final disposal site for the City of Medan. The composition of the waste at the Waterfall TPA in 2017 consisted of 71.5% organic; Paper 2%; Plastic 10.1%; wood 2%; fabric 2.5% rubber 2.5%; metal 0.6%; glass 0.8%; 1 % chunks; pampers / sanitary napkins 3, 1% and others 3.8% (Department of Hygiene and Parks City Medan). Based on this condition, if waste management efforts are not carried out properly, the service level based on the MDGs (Millineum Development Goals) target of 80% will not be achieved. The composition of plastic waste of 10.1% is quite high. The Ministry of Environment and Forestry (2017) stated that plastic waste increased by 15% from 10% in 2005. The increase will continue in line with the need and use of plastic. Plastic is difficult to decompose, so one thing that can be done is only with 3 R's, namely reuse, reduce and recycle. Reuse by using plastic over and over again, reduce by reducing the use of plastic and recycle by recycling plastic. one of the recycled plastics is with eco-bricks. Ecobricks are a collection of all types of used, clean and dry plastic in used plastic bottles so that they reach a certain density and function as building blocks that can be used over and over again. Ecobrick is a simple solution and simple technology in recycling plastic. Ecobricks can provide direct benefits of Rp. 289,000, - / m2 - Rp. 471.000, - / m2, the price of waste utilization is 57.800-78.500 gr/m2, the price of indirect utilization is Rp. 404,600 – Rp. 549,500 m2

Keywords
Medan districts; ecobrick; clean; dry

I. Introduction

Garbage is the remains of human daily activities and/or natural processes in solid form (Law No. 18 of 2008). The growth and population density continue to increase as well as the development of urban development that continues to cause problems in urban areas, one of which is the problem of waste. The more the population increases, the waste generation will also increase, both in terms of characteristics, diversity, and types of waste. The more the population increases, the waste generation will also increase, both in terms of characteristics, diversity, and types of waste.

The Central Bureau of Statistics states that the population of Medan City as of 2019 is 2,279,894 people. if waste production reaches 0.5 - 0.8 kilograms (kg) per person per day; Therefore, the city of Medan produces around 1,140 -1,824 tons of waste per day. Of this amount, only 40-50 percent of the final disposal site (TPA) accommodates, and the rest ends up in vacant land or is burned. If this is allowed to continue, it will accelerate the age of the landfill. The only thing that needs to be done is to deal with waste directly from the source.

The Medan City TPA in the Waterfall Village, Medan Marelan District is the final disposal site for the City of Medan. The composition of the waste at the Waterfall TPA in 2017 consisted of 71.5% organic; Paper 2%; Plastic 10.1%; wood 2%; fabric 2.5% rubber 2.5%; metal 0.6%; glass 0.8%; 1 % chunks; pampers / sanitary napkins 3, 1% and others 3.8% (Department of Hygiene and Parks City Medan). Based on this condition, if waste management efforts are not carried out properly, the service level based on the MDGs (Millineum Development Goals) target of 80% will not be achieved. The composition of plastic waste of 10.1% is quite high. The Ministry of Environment and Forestry (2017) stated that plastic waste increased by 15% from 10% in 2005. The increase will continue in line with the need and use of plastic. Plastic is difficult to decomp5ose, so one thing that can be done is only with 3 R's, namely reuse, reduce and recycle. Reuse by using plastic over and over again, Reduce by reducing the use of plastic and recycle by recycling plastic. one of the recycled plastic is with eco-bricks.

The filling process was manual, using a ram to compact the filler within the bottle in several layers of recycled material. The manufacturing method was selected to replicate the real manual process that nowadays is followed to elaborateEco-bricks. Once the bottles were completely filled with a single material, each bottle was closed and sealed with a cap (Figure 1). Samples were preserved at controlled laboratory temperature and humidity (20-25°Ctemperature andbelow 50% relative humidity) conditions until testing. Bottles were also saved in a dark space to avoid photo degradationbefore testing. The amount of collected materials allowed preparing4 Eco-bricks of each filler.

Densitiesof the Eco-bricks were determined by estimating the ratio between mass and volume of each sample. Eco-bricks mass was determined using a scale. Volume of Eco-brick was estimated following Archimedes principle. Eco-bricks were submerged in water at room temperature (25°C) using a cylindrical container with capacity for 5 liters approximately (150 mm of diameter and 300 mm long). The selected container allowed havinggood resolution of the water displaced when bottles were submerged. Using a measure tape within the container, the level of water was recorded and the volume of water displaced was estimated. Bottles were dried out after testing and preserved in the same conditions described in the previous section up to the following test. As volume of filler increases, voids within the Eco-brick are reduced. The amount of filler is expected to affectphysical and mechanical properties such as: volume stability, elastic modulus and elastic-plastic recovery behavior of an Eco-brick. Consequently, the weight of each empty bottle and cap were measured. After the filling process, the final weight of the Eco-brick was recorded. The weight of the empty bottle and the cap were subtracted to determine the weight of the filler inside each Eco-brick.

II. Research Method

Green open space is an area or city space that is not built so that the surface is filled with plants to protect habitats, environmental facilities, secure infrastructure networks, agricultural resources, atmosphere quality, and support water and soil sustainability. In ecological functions, green areas act as pollution filters, provide fresh air, maintain water quality, regulate microclimate, absorb noise and maintain the diversity of life. In the social function, the green area provides a resting area, recreation for city residents, either directly or indirectly. The economic function of green open space affects the cost of houses and land that are close. The existence of green open spaces will improve the quality of the city area which ultimately triggers the health and quality of life of city dwellers, influences new lifestyles, values , and behavior that will increase respect for the environment and the establishment of the city and become a major aspect in future urban planning.

2.1 Hardscape Materials

Landscape architecture is closely related to the formation or creation of open spaces. The formation of space depends on the components that make up the space consisting of the base plate, the wall plane, and the roof plane. The concept of urban farming has become popular in many cities in the world. Urban farming is considered a means of promoting public health and economic development, building social capital, and reusing vacant land in urban areas. In recent years, cities in America such as Detroit, San Francisco and Washington DC have prepared programs to encourage citizens to plant crops on vacant land or on rooftops (Bo'do, 2019). The quality of the space value depends on the function of the space and the composition of the components that make up space. There are elements of materials that are engineered according to the shape, texture, color, and size of the dimensions created. In landscape architecture, there are 2 (two) major parts of landscape materials, namely soft materials and hard materials.

1. Soft materials such as plants, trees, and water
2. Kesar materials consist of natural materials (wood), hard materials of geological potential (rocks, sand), hard materials made of metal (aluminum, iron, bronze, copper, and steel), synthetic hard materials (plastic), combined hard material (concrete or plywood)

2.2 Ecobricks

Ecobricks are a collection of all types of used, clean and dry plastic in used plastic bottles so that they reach a certain density and function as building blocks that can be used over and over again. Ecobrick is a simple solution and simple technology in recycling plastic. manufacture of eco-bricks without the use of machines, special skills, or capital. Ecobrick is one way to increase awareness and be directly responsible for the plastic we use, reduce environmental problems by using it as land construction or as infrastructure. Ecobricks are designed to take advantage of the longevity and durability of plastic materials into reusable building blocks. Ecobricks are made by:

1. Clean and dry all types of plastic
2. Put the plastic into a plastic bottle until solid. Do not leave any cavities or empty spaces in the compact the plastic bottle.
3. Once packed solid, Ecobricks can be used.

III. Discussion

Results Use of Eco-Bricks as an Artificial Resource

Artificial resources are goods or substances that have value for human life that does not occur in nature. Examples of artificial resources include plastic, paper, soda, sheet metal, rubber, and brass. This contrasts with natural resources, such as water, plants, sunlight, crude oil, wood, and gold. Protected areas are places where conscious efforts are made to preserve not only wild species but also the ecosystems in which species live. Protected areas may be the only natural or near-natural ecosystems remaining in large areas (Cardinale et al. 2012). According to IUCN (1994), a protected area is an area of land and/or sea, especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means. Protected areas are important tools for the conservation of biodiversity by protecting species, habitats and other biodiversity features within their boundaries (CBD, 2010). Throughout the world, protected areas are the key to conserving biodiversity, and they providing food, fiber, and other ecosystem services essential for human sustenance (DeFries et al. 2007). The plants grow in communities; each community is characterized by species diversity, growth forms, and structures, dominance successional trends. A certain analytical character such as

frequency, densities, and the abundance of species in a community is expressed in quantity to know their dominance (Alftisi, 2019). The application of the community partnership program is continued with the improvement of farmers' skills through demonstration training activities by actively involving all participants. Training activities include the introduction of PBKo pest attack symptoms, PBKo damage assessment (calculation of attack percentage and attack intensity) followed by training in mixing liquid spray (Sanfat 75 SP insecticide) and spraying method. Improvement in the skills of the participants was measured by observing the number of participants who were able to make spray liquid in accordance with the recommendations for use in the insecticide packaging (Suswati, 2020).

Technical natural resource issues include how quickly the existing natural resource stock (wealth) is utilized. How quickly changes in the natural environment should occur, for example from natural resources to man-made resources. The use of eco-bricks is expected to be a change in the use of Resources. Ecobrick waste is the development of products and services for environmental production and vice versa. Production processes and consumption patterns can be modified to allow the substitution of previously useless materials to be utilized.

Partner problems are overcome by a number of technological solutions carried out by the technology transfer method through education, training. The training material was delivered using counseling methods, discussion and practice to increase the knowledge and insight of farmers and students about the propagation (Suswati, 2020).

The recommended eco brick weight is around 200-500 gr. Based on the experiments carried out, eco-bricks using 1200 ml bottles produced a weight of 200 grams and eco-bricks with 1500 ml bottles produced 500 grams. The use of eco-bricks for 1m2 hardscape material is 289 bottles measuring 600 ml or 57.8 Kg and 157 bottles measuring 1200 ml or 78.5 Kg. The use of plastic waste as an eco brick material is 57.8 – 78.5 Kg. price aqua bottle price Rp. 5,000/kg, the price of a dirty aqua bottle is Rp.4,000/kg, the price of mixed clear plastic waste is Rp. 1,000/kg, the price of plastic waste is Rp. 2,000/kg. Then the price used is the following comparison table:

Table 1. Use of Eco-Bricks as Hardscape

	600 ml bottle	1500 ml bottle
Ecobrick Weight	200 gr/bottle	500 gr/bottle
Use of 1 m2 ecobrick	289 bottles	157 bottles
Ecobricks . Price	Rp. 1,000, - / bottle	Rp. 3,000, - / bottle
Direct Utilization Price 1)	Rp. 289,000, - /m2	Rp. 471.000, - /m2
Waste utilization price 2)	57.800 gr/m2	78.500 gr/m2
Indirect Utilization Price 3)	Rp. 404,600 /m2	Rp. 549,500/m2

1) Direct Utilization Price: ecobrick price x m2 usage = Rp. 1,000/bottle x 289 bottles = Rp. 289,000
2) Waste Utilization Price: Use of 1 m2 x weight = 289 bottles x 200 gr/bottle = 57.800gr
3) Price of indirect use: price of aqua bottle (clean or dirty) + price of mixed clear plastic waste x use of ecobricks /m2 = (Rp. 5000/kg x 0.2 kg x 289 bottles) + (Rp. 2000/kg x 0.2x 289 bottles) = 404,600
Source: Calculation Analysis

The valuation of the use of plastic waste is analyzed based on an economic valuation by calculating the value of direct use, the value of waste utilization and the value of indirect benefits. The direct utilization value is calculated from the use of ecobricks per m2 multiplied by the value of waste utilization

Figure 1. *Plastic Waste as Hardscape*

Figure 2. *The Use of Plastic Waste as a Man-Made Resource and Natural Resource*

IV. Conclusion

1. The recommended weight of eco brick is around 200 – 500 gr. Based on the experiments carried out, eco-bricks using 1200 ml bottles produce a weight of 200 grams and eco-bricks with 1200 ml bottles produce 500 grams. The use of eco-bricks for 1m2 hardscape material is 289 bottles measuring 600 ml or 57.8 Kg and 157 bottles measuring 1200 ml or 78.5 Kg. The use of plastic waste as an eco brick material of 57.8 – 78.5 Kg can reduce plastic waste that goes to the TPA by 200-300 tons/day.
2. The use of eco-bricks is expected to be a change in the use of Resources. Ecobrick waste is the development of products and services for environmental production and vice versa. Production processes and consumption patterns can be modified to allow the substitution of previously useless materials to be utilized.

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