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Composition of Coastal Waste in Ambon Bay Waters

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Abstract:
The results of activities originating from community activities include waste. Increasing population of Ambon City who settled in the area around the waters of the Ambon Bay increasingly increased resulting in an increase in the amount of waste produced. The purpose of this study is to determine the composition of coastal waste based on its type and determine the density and weight percentage of coastal waste in the waters of Ambon Bay. The research method used field observation methods with sampling locations on the coast of Rumahtiga-Poka and Laha, Sub-district of Teluk Ambon. The waste data obtained consisted of meso and macro waste, which were then identified and classified according to the United Nations Environment Program (UNEP) waste classification system. Analysis of waste data included density and percentage of specific gravity of waste. The results of the analysis of meso and macro waste densities in the two highest locations were owned by broken glass and ceramic waste with values ranging from 1.32 species / m^2 - 8.84 species / m^2. In the making process, glass and ceramics use heavy metal as a coating to make it glossier. If broken glass and ceramics enter the waters, there will be an increase in concentrations of heavy metals in the waters. The weight percentage of waste is dominated by building material waste in the form of cement which is found on the shores of Rumahtiga-Poka which are sourced from bridge construction activities. It can be concluded that the density of waste types in both observation locations is dominated by broken glass and ceramic waste, while the highest percentage of weight is owned by building material waste.

Keywords: *Waste, Ambon bay, Coastal*

I. INTRODUCTION

An increase in the population has a negative impact (pollution) on the environment [1]Environmental pollution is one of the results of anthropogenic activities originating from community activities. One of the pollutants produced is waste. Waste has become an environmental issue not only in Indonesia but also globally. At present, large waste production can increase the concentration of greenhouse gases (GHG).[2] As it is known that increasing GHG in the atmosphere can increase the surface temperature of the earth (global warming). [3]The accumulation of unprocessed waste will release methane gas. Based on the data, every 1 ton of solid waste produces 50 kg of methane gas. With Indonesia's population increasing, it is estimated that by 2020, the waste produced will be around 500 million kg / day or 190 thousand tons / year. This means that Indonesia will emit 9,500 tons of methane into the atmosphere[1].

The population of Ambon City in the last five years has increased from 363,771 in 2012 to 427,934 people in 2016. Based on data from the Ambon City Environmental and Waste Management Office, the waste produced by Ambon City community is 1.8 kg / day / person. So that it can be said that with the population of

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Ambon City in 2016 waste production of 770 tons / day will be produced. Waste problems are very worrying because waste is the result of community activities that are discarded every day. [4]

The coastal waters of Ambon Bay get high ecological pressure, this is very evident from the production of waste produced during the rain. [5][6]Coastal waste in the waters of Ambon Bay comes from surrounding residential areas, industries and supporting infrastructure development activities. All of these activities produce organic, inorganic, dangerous and toxic waste. Production of coastal waste will damage important coastal ecosystems in the waters of Ambon Bay, namely mangroves, seagrasses and coral reefs.

The condition of Ambon Bay waters which are flowed by five major rivers and the semi-enclosed area characteristics influence to increase waste production on the coast and sea. The location of settlements that are very close to the banks of the river affects the behavior of the people throwing garbage directly into the river, which will be carried away when it rains. Disposal of garbage into coastal and marine waters is based on the assumption that the vast waters will not be affected by the dumped waste. [7]Furthermore, it is said that normally the sea has assimilation power to process and recycle pollutants that enter it. Based on data from the Ambon City Environmental and Waste Service, the production of waste in the sea that is transported using a speed boat is 6-8 tons / day.[8]

This proves that there is a need for proper waste management to support the high population growth. There have been many waste management efforts carried out by the City Government, the community and other related institutions. These efforts can be in the form of counseling and socialization about waste issues and their impact on all levels of society, clean action through government programs and related institutions, as well as ongoing research to obtain accurate data series on waste. Based on the explanation above, it is very necessary to conduct a study on the composition and density of waste in Ambon City by using accurate methods so that it can produce the latest data and information about waste to be managed properly. The purpose of this study is to determine the composition of coastal waste based on its type and determine the density and weight percentage of coastal waste in the waters of Ambon Bay.[5]

II. RESEARCH METHODS

Method of collecting data

This research was conducted in November 2017 with the sampling locations in the Pantai Pantai Rumahtiga-Poka and the Coastal Areas of Laha Pantai Teluk Ambon (Figure 1). Observation of waste composition is carried out directly in the field. The selection of locations on the coastal areas of Rumahtiga-Poka and the coastal areas of Laha Village is based on the criteria of the beach segment for waste sampling, as follows [9](Can be accessed throughout the year or seasonally (for continuous monitoring)

a) Sandy or gravel
b) There are no breakwaters, jetties, docks or other buildings
c) Minimum 100 m long, and can be extended to 1000 m parallel to the water edge
d) Moderate gentle slope (low-moderate 15^0-45^0)
e) There is no clean up activity during the time adjacent to the sampling time
f) There is no waste management at that location
g) Not a sensitive habitat, or there are no threatened species that might be disturbed by this sampling.[9]

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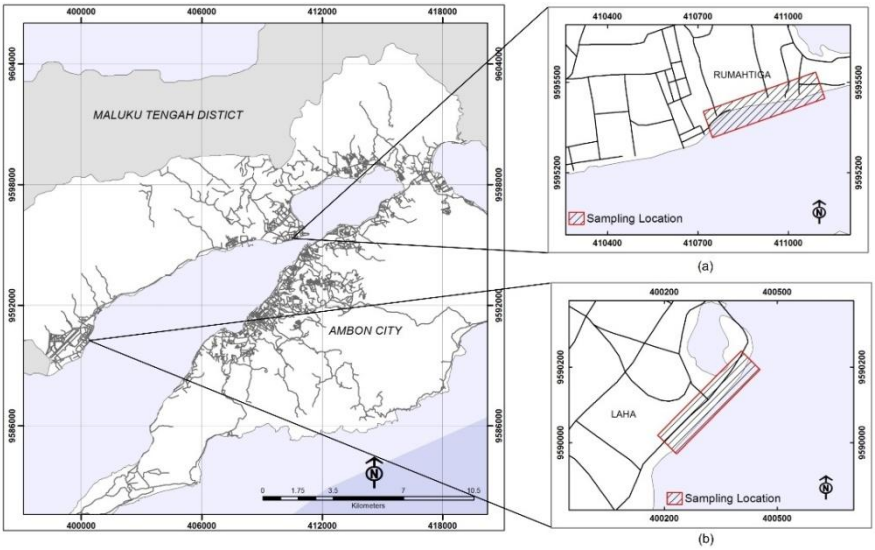

Fig. 1. Research Location (a) Coast of Rumahtiga-Poka and (b) Coastal Village of Laha

Waste data consists of macro and meso waste. Macro waste is obtained through a screening process with a 2.5 cm sieve, while for filtered meso waste with a screen size of 0.5 cm. Garbage extraction is carried out in a 100 m long observation area divided into 5 sections (transect plots) with a size of 5 m x 5 m. The distance between one and the other transect plot is 20 m. Furthermore, in each plot of transect, a sampling plot of 1 mx 1 m size was chosen which randomly selected 5 sampling plots. Macro waste data collection was carried out in 1 m x 1 m sampling plots, while meso waste was carried out in the same sampling plot with the size divided into 50 cm x 50 cm (Figure 2).

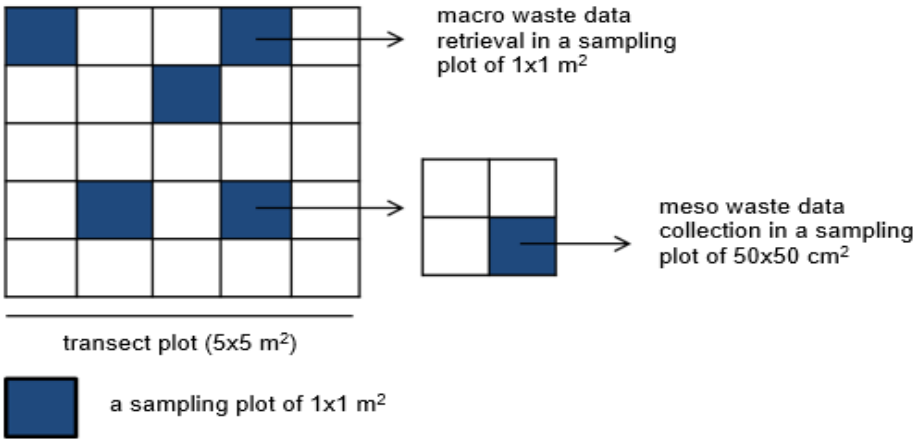

Fig. 2. Transect plots and sampling plots for data collection on macro and meso waste

Data analysis

Waste data that has been obtained is then identified and classified according to the United Nations Environment Program's (UNEP) garbage classification system. [10]The results of the coastal waste data recapitulation include:

a. The density of macro and meso waste is calculated based on the number of types of waste per observation transect plot.

$$\text{Density} = \frac{\textit{The total number of each type}}{\textit{Transect plot area}}$$

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b. Specific weight percentage (%), which is the weight of waste per type per overall weight of waste in the observation area

$$\text{Percentage } (\%) = \frac{x}{\sum_{i=1}^{n} xi} \times 100\%$$

x =weight of waste per type

III. Results and Discussion

Visually the conditions of land use on the beaches of Rumahtiga-Poka and Laha are dominated by settlements. Some activities are seen in the coastal waters of rumahtiga-Poka, namely the construction of bridges and transportation of fishing boats. On the Laha beach there is a fishing industry so that the loading and unloading activities of fishery vessels are carried out every day. [11]In both beaches there are also several spots or small areas of coastal vegetation. Overall types of waste obtained at the Pantai Rumahtiga-Poka and Laha consists of organic and inorganic waste (Table 1).

Table 1
Classification of waste in the area of observation based on UNEP

Material Type	Waste Code	Waste Classification
Plastic	PL01	bottle cap
	PL04	Knives, forks, spoons, straws, stirrers and cooking utensils
	PL05	Drink equipment package
	PL06	Food containers (fast food, cups, lunch boxes and the like)
	PL07	Plastic bag (opaque or clear)
	PL16	Tarpaulin (tarpaulin or other woven plastic bag, wrap of pallet)
	PL19	Ropes
	PL22	Fiberglass Flakes
	PL24	Other plastic materials
Plastic Foam	FP05	Other cork ingredients
Fabric	CL04	Rope and mine canvas
Glass and Ceramics	GC01	Building material (brick, cement, pipe)
	GC07	Broken glass and ceramics
	GC08	Other categories of glass and ceramics

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Metal	ME01	Tableware (plates and glasses)
	ME06	Wrap of foil
	ME08	Metal flakes
	ME09	Wire, wire mesh, barbed wire
	ME10	Other metal categories include used equipment
Paper and Cardboard	PC02	The cardboard box and the splinters
	PC05	Other paper categories
Rubber	RB06	Rubber bracelet
	RB08	Other rubber categories
Wood	WD06	Other wood categories
Other Materials	OT02	Cleaning tools (diapers, cotton buds, tampons and pads, toothbrushes)
	OT03	Equipment and electronics
	OT05	Other ingredients

Waste Potential at Rumahtiga-Poka Beach

a. Meso Waste

The results of meso waste density analysis at the Pantai Rumahtiga-Poka (Figure 3) showed five types of highest density waste. They were glass and ceramic fractions of 8.84 types / m^2; then followed by other materials in the form of marbles and leaves remnants with a density of 1.16 species / m^2; metal and metal chips with a density of 1.04 types / m^2; wood with a density of 0.76 species / m^2; and other plastic materials with a density of 0.68 types / m^2. The types of waste were derived from the activities of the surrounding community who also often throw garbage to the beach. In addition, based on observations, waste in the research area also originated from other places, especially the type of plastic waste that is light and easily carried by the current.[8] The lowest density of waste types was owned by cleaning tools in the form of cotton buds, rubber bands, bottle caps and plastic in the form of mat flakes with densities ranging from 0.04 to 0.36 species / m^2. The highest percentage of waste type is shown by glass and ceramics by 76%; metals and metal chips were 8% and 5%, respectively; other plastic materials by 6%. Metal waste has a greater weight than plastic so that in small quantities, but has a high percentage of weight. Metal waste located on the beach of Rumahtiga-Poka has undergone a corrosion process. Household waste containing iron and corrosion will cause poisoning to humans through the food chain process. [12]Solubility of heavy metals in waters is related to the pH of the waters. In acidic conditions, heavy metals will settle and are difficult to dissolve so that they will cause poisoning in the waters.[2]

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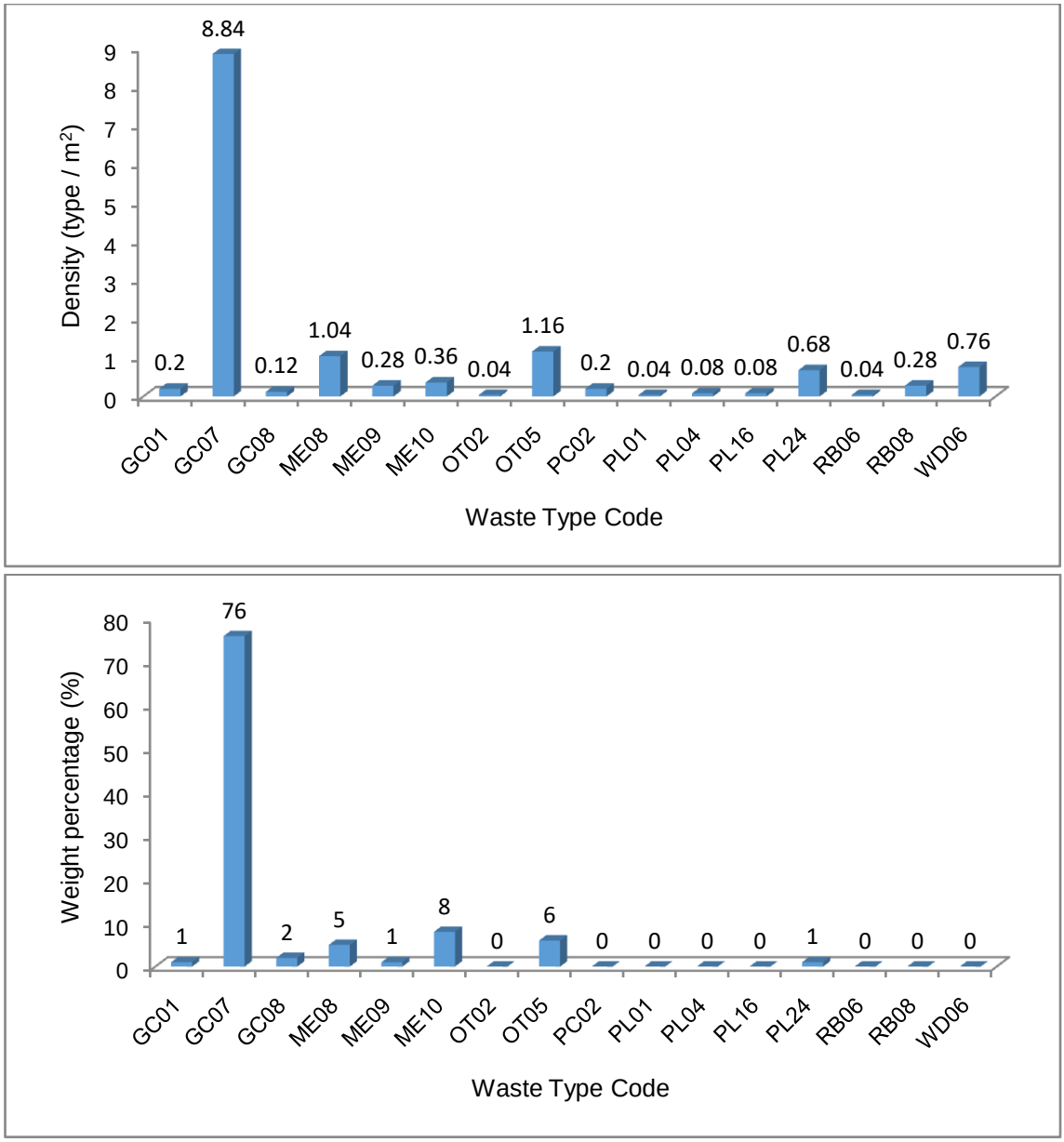

Fig. 3. Density and Percentage of Meso Waste Weight at Rumahtiga-Poka Beach

b. Macro Waste

Compared to meso waste, the number of types of macro waste on the Rumahtiga-Poka beach was more diverse and numerous. The results of the analysis of the density of macro waste at the Pantai Rumahtiga-Poka (Figure 4) showed the type of broken glass and ceramic waste has the highest density value of 6.76 species / m^2. It was followed by building materials with a density value of 3.32 types / m^2; other ingredients in the form of remaining leaves with a density value of 1.68 species / m^2; metal flakes with a density value of 1.36 species / m^2; and cardboard box flakes with a density value of 1.08 types / m^2.

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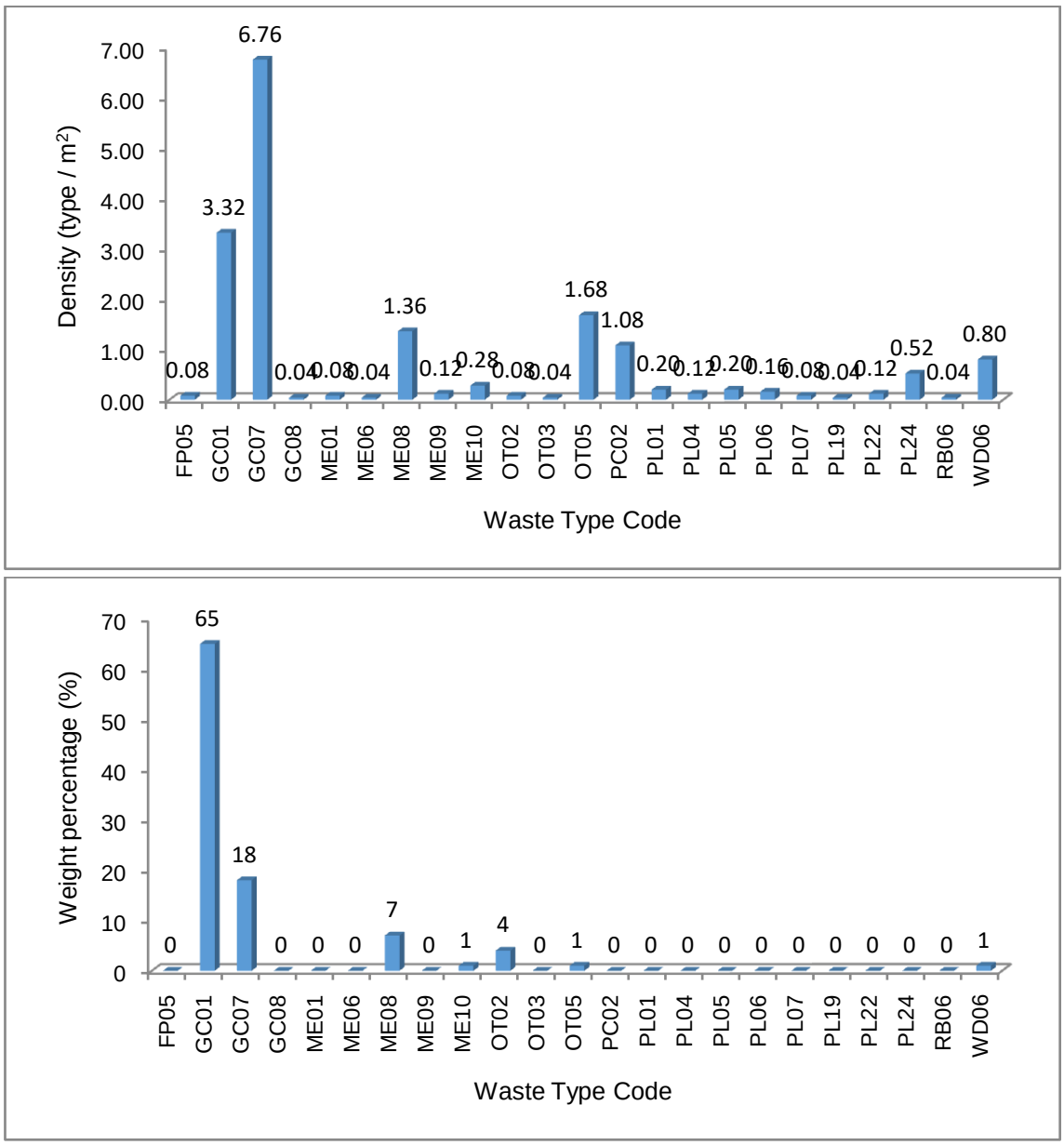

Fig. 4. Density and Percentage of Macro Waste on Rumahtiga-Poka Beach

The type of waste type of building material found in the form of large chunks. This was indicated by the higher percentage of this specific waste, which was 65% compared to the type of broken glass and ceramic waste which was only 18%. Recently, it has been carried out the construction of bridges on the beach Rumahtiga-Poka. The increasing population growth also increases the fulfillment of people's living needs, one of which is the construction of settlements and supporting infrastructure such as roads, bridges and others. Development in all fields should aim at the welfare of the community, but on the other hand the impact of the development sacrifices the surrounding environment. The process of carrying out the construction of the bridge to completion results in the discharge of building materials in the form of cement, brick and pipe. Like glass and ceramic waste, building materials also have a negative impact on society, especially coastal environmental organisms. [13]The lumps of cement obtained at the observation site will disturb the habitat of coastal organisms, especially benthos. Benthos organisms are very susceptible to habitat changes, although coastal organisms have a high ability to adapt to

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environmental changes.[14]

Waste Potentialin Laha Beach

a. Meso garbage

The type of meso waste at Laha beach with the highest density is glass and ceramics, which is 7.68 species / m^2 and the weight percentage is 85% (Figure 5). There is a restaurant is opened at night along the Laha beach. The existence of thisrestaurant supports the activities of ship's crew who carry out loading and unloading activities. There are many fragments of glass and ceramics were obtained. they have been in a long period of time buried deeper into the sand.

Manufacture of glass and ceramics using heavy metals Cadmium (Cd) and Lead (Pb) which are used as coatings to be glossier. If broken glass and ceramics enter the waters, there will be an increase in the concentration of heavy metals in line with the increase in the pH of the waters [15] pH in acidic conditions causes low levels of solubility of heavy metals in the waters so that there will be toxic transfer at the trophic level above it through the food chain process.[16]

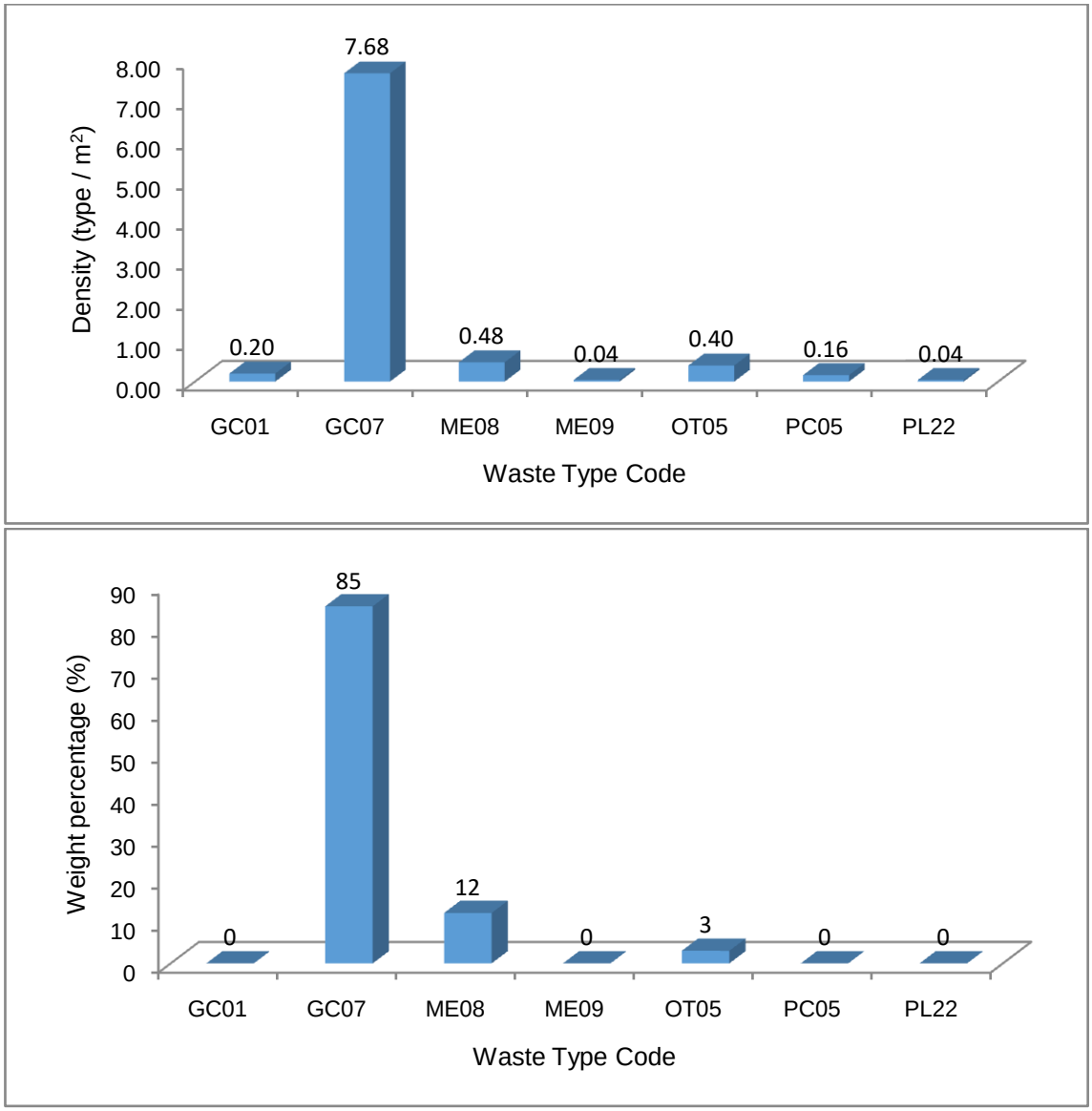

Fig. 5. Density and Percentage of Meso Waste Weight on Laha Beach

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b. Macro Waste

The results of the identification of waste show that the types of macro waste deposited on the Laha beach (Figure 6) with the highest density values are glass and ceramic fractions of 1.32 species / m^2. It is followed by the type of building material waste of 0.8 types / m^2; other materials in the form of leaves with a density value of 0.52 species / m^2; other metal and paper flakes of 0.24 types / m^2; and other types of plastics of 0.2 type / m^2. The lowest types of macro waste at Laha beach are fast food, nails and metal materials, tableware, raffia, and tarpaulin with a density value of 0.04 types / m^2.

Glass and ceramics are inorganic waste that will not biodegrade biologically. The waste has a negative impact on the environment because the flakes of glass and ceramics are not used and disposed of on the beach. [17]The main impact is the inconvenience of the community when they are on the beach to enjoy beauty or other activities. For the community, flakes of glass and ceramics will be trampled on and hurt parts of the body, while the coastal environment will disturb the life of the beach organisms, especially the habitat for the growth process.

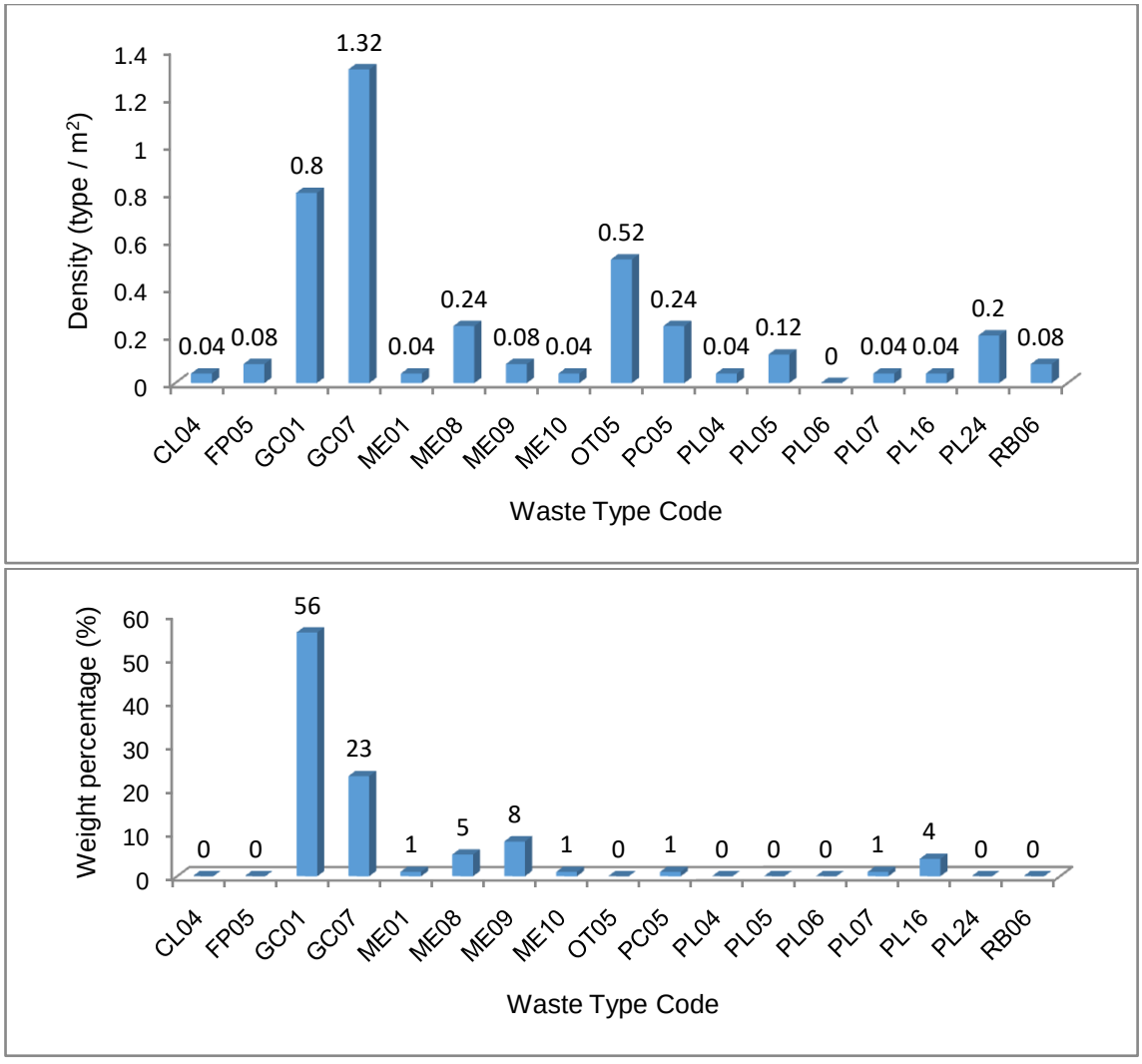

Fig. 6. Density and Weight Percentage of Macro Waste on Laha Beach

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As overall, it can be said that at both beaches, the dominating type of waste is inorganic waste and comes from surrounding activities. Compared to the types of broken glass and ceramics and building materials, this type of plastic waste in the form of food and beverage packaging does have a small density value because plastic waste is easily carried away by tides. However, the existence of this waste greatly disrupts the stability of the coastal ecosystem considering that this waste is produced every day by humans [18] Plastic waste disposal decreases the aesthetic value of Ambon Bay waters. In addition, plastic waste entering the mangrove ecosystem will cover the roots of mangroves and inhibit the respiratory system which will later interfere with mangrove growth. Based on the results of research on several river estuaries (Waiheru, Wairuhu, Wailela, Wai Batu Merah, Waitomu) in Ambon Bay, the total density of the type of plastic waste dominated the type of garbage in the Bay of Ambon with the highest density found at the mouth of the Waiheru river which was 3.26 species / m^2 (Tuhumury, et al., 2012). At the estuary of the Waiheru river, there is a mangrove community so that the incoming plastic waste will be left behind, especially in the mangrove roots. As is known, polyvinyl chloride (PVC) is one of the most common plastics produced in the world. Polymerized PVC from vinyl chloride monomer (VC) is carcinogenic to animals and humans [19]

Based on observations it was found that there were no permanent landfills near the settlements so that the community had been accustomed to throwing garbage to the beach. The other problem is that waste production in Ambon City is not entirely transported to integrated waste processing plants due to several obstacles, namely inadequate supporting facilities and infrastructure for solid waste management. Based on data from the Ambon City Department of Environment and Solid Waste, there were 22 operational vehicles in the form of trucks, 7 units of amrolls, 7 units of pickup trucks, 16 units of garbage motorcycles, 4 units of garbage speed boats, 2 units of mini loaders and other 3 units of heavy equipment. If waste production is increasing, the need for solid waste supporting facilities and infrastructure must also be increased to manage waste in Ambon City.

IV. CONCLUSIONS

Based on the results of the study, the types of garbage in the waters of Ambon Bay (the beaches of the Rumahtiga-Poka and Laha houses) are dominated by the highest density of inorganic waste owned by glass and ceramic fragments and the largest weight percentage owned by building materials.The suggestion that can be given is the need for further research to obtain data series on the composition of coastal waste in the same observation area since the increasing population growth and the high level activity of the surrounding community.

V. REFERENCES

[1]. N. Heluth, J. Matinahoru, and F. Latumahina, "Peranan Ekologi Dusung Dan Non Dusung Dan Kontribusinya Pada Konservasi Lingkungan Di Desa Ureng Kecamatan Leihitu Kabupaten Maluku Tengah," *J. Hutan Pulau-Pulau Kecil*, vol. 2, no. 1, pp. 28–48, 2018.

[2]. R. Dahiya, "Projections for the Population Growth and Its Impact on Solid Waste Generation of a Medium Sized North," *Int. J. Tech. Res. Appl.*, vol. 3, no. 6, pp. 57–61, 2015.

[3]. R. Joshi and S. Ahmed, "Status and challenges of municipal solid waste management in India: A review," *Cogent Environ. Sci.*, vol. 2, no. 1, pp. 1–18, 2016.

[4]. R. R. Plai, L. L. R. Roodrigues, A. O. Mathew, and S. Hebbar, "Impact of Urbanization on Municipal Solid Waste Management : A System Dynamics Approach," *Int. J. Renew. Energy Environ. Eng.*, vol. 02, no. 01, pp. 31–37, 2014.

[5]. A. E. Terhadap, D. I. Teluk, and A. Dalam, "JURNAL MANAJEMEN SUMBERDAYA PERAIRAN THROUGH THE

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ISSN: 0193-4120 Page No. 3285 - 3295

REPRODUCTIVE STATUS OF MUD CRAB AND SOCIO-ECONOMY AND INSTITUTIONAL ASPECTS OF THE FISHERMEN (Inorganic Waste Composition and Density in," vol. 8, no. 1, 2012.

[6]. F. Latumahina, M. Borovanska, Musyafa, Sumardi, N. S. Putra, and M. Janda, "Ants of Ambon Island – Diversity survey and checklist," *Zookeys*, vol. 472, pp. 43–57, 2015.

[7]. T. B. Laksono and A. D. Rarastri, "Kontribusi Sampah terhadap Pemanasan Global," 2007.

[8]. M. Mukhtasor, "Ekonomi dan Teknologi Pencemaran Laut," pp. 1–44, 2010.

[9]. K. G. Gemilang W A, "p-ISSN 1978-8096 e-ISSN 2302-3708," *EnviroScienteae*, vol. 13, no. 2, pp. 171–180, 2017.

[10]. A. Karuniawan and B. Waluyo, "Petunjuk teknis budidaya ubi jalar di bawah tegakan," in *Prosiding Inovasi Pengelolaan Hutan Lestari Berbasis Hutan Non Kayu - Pemberdayaan Masyarakat*, 2012.

[11]. F. Latumahina, "Patterns and Mechanisms of Ant Diversity in Two Types of Land Use within Protected Forest Area Sirimau City of Ambon Maluku Province," *Adv. Soc. Sci. Res. J.*, vol. 5, no. 3, pp. 184–189, 2018.

[12]. N. Gupta, K. K. Yadav, and V. Kumar, "A review on current status of municipal solid waste management in India," *J. Environ. Sci. (China)*, vol. 37, pp. 206–217, 2015.

[13]. I. C. Enete, "Potential impacts of climate change on solid waste management in Nigeria," *J. Sustain. Dev. Africa*, vol. 12, no. 8, pp. 101–110, 2010.

[14]. C. Lakhan, "Calculating the Emissions Impacts of Waste Electronics Recycling in Ontario, Canada," *C*, vol. 2, no. 2, p. 11, 2016.

[15]. F. Fiskanita, B. Hamzah, and S. Supriadi, "Analisis Logam Timbal (Pb) Dan Besi (Fe) Dalam Air Laut Di Pelabuhan Desa Paranggi Kecamatan Ampibabo," *J. Akad. Kim.*, vol. 4, no. 4, p. 175, 2017.

[16]. M. M. Solihin, "Sustainable Waste Management through Trash Bank in Ragajaya Village , Bogor Regency , West Java Province , Indonesia," no. 2, pp. 190–198, 2018.

[17]. F. Latumahina *et al.*, "RESPON SEMUT TERHADAP KERUSAKAN ANTROPOGENIK DALAM HUTAN LINDUNG SIRIMAU AMBON (Ants Response to Damage Anthropogenic in Sirimau Forest Ambon) Program Doktor Ilmu Kehutanan , Universitas Gajah Mada Yogyakarta , Penulis korespondensi . No Tel : 0911-3621," vol. 22, no. 2, pp. 169–178, 2015.

[18]. J. Siddiqui and G. Pandey, "A Review of Plastic Waste Management Strategies," *Int. Res. J. Environ. Sci. Int. Sci. Congr. Assoc.*, vol. 2, no. 12, pp. 84–88, 2013.

[19]. S. Fatimah and F. Indrawati, "Higeia Journal of Public Health," *Higeia J. Public Heal. Res. Dev.*, vol. 1, no. 3, pp. 84–94, 2018.