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Study of Identification of Microplastic Waste in Sand Sediment at Lambutoa Beach, Takalar Regency

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Abstract

Indonesia is currently one of the countries in East Asia which produces around 50% of the world's coastal waste. Microplastics in Indonesian seawater range from 30 to 960 particles/liter. The purpose of this study was to determine the size, amount, type, and microplastic polymers present on Lambutoa Beach in Takalar Regency. This study uses quantitative methods to examine certain populations or samples. Quantitative research methods are used to examine populations or certain samples, data collection uses research measuring instruments, and data analysis is quantitative/statistical in nature, with the aim of testingand proving the hypotheses that have been made/defined. The stages carried out during the research process were sand sediment sampling, sand sediment sample processing, observation and identification of microplastic types, and testing using the FTIR tool. From the results of this study, it was found that there were49 samples of microplastic waste with an average size of 1-5 mm. There are three types of microplastic contained in the sand sediments that have been tested, namely films, fragments, and foam. For the type of polymer that is most often found in testing sediment samples using the FTIR tool on microplastic samples, these are Other (Nylon) and PET (Polyethylene Terephthalate) polymers.

Keywords: FTIR, Microplastics, Polymers, Garbage

1. Introduction

Indonesia is the largest archipelagic country in the world and has a very strategic geographical position. There are 16,056 islands in Indonesia that are officially registered. The Indonesian coastline is 99,093 km2 long. Its land area reaches about 2,012 million km2 and the sea is approx. 5,800 million km2 (75.7%), 2,700 million km2 of which are included in the Exclusive Economic Zone (EEZ). The Indonesian Sea, which is 2.5 times the area of the land area, certainly has greater potential, both in terms of natural resources and environmental services that can be utilized to support economic development at the local, regional, and national levels. Behind it all, Indonesian beaches have various problems, one of which is garbage. Waste is a material that is wasted or disposed of from sources resulting from human activities or natural processes that do not yet have economic value, (UNCSGN and UNGEGN, 2017). Coastal waste has become a global problem and is an issue that is being widely discussed. At least 60-80% of the waste produced in the world is plastic waste, and 10% of this waste is dumped into the open sea and will take a very long time to degrade. However, the source of coastal waste is difficult to determine because coastal waste is strongly influenced by currents and wind direction (Djongihi, et al. 2022). From time to time, the threat of damage to ecosystems in the Indonesian seas is becoming more real and difficult to stop. These threats, among others, come from microplastics in

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seawater. Unmitigated, it is estimated that currently the number of microplastics in Indonesian seawater is in the range of 30 to 960 particles/liter. This fact was described by sea pollution researchers at the Oceanographic Research Center (P2O) of the Indonesian Institute of Sciences (LIPI), who stated that every 1 m2 of beaches in Indonesia there are 1.71 pieces of garbage/m2, with an average weight of 46.55 gram/m2 (Revelation, 2019). Meanwhile, based on rough calculations and simple assumptions, the plastic waste in the sea that is produced by the Indonesians themselves is predicted to reach 100,000 to 400,000 tons per year excluding plastic waste that enters from outside Indonesian waters (Setyadi, 2018). Likewise, the amount of microplastic waste in Indonesian seawater is the same as the amount of microplastic found in seawater in the Pacific Ocean and Mediterranean Sea. "But it's also lower when compared to microplastics on the coast of China, the California Coast, and the Northwest Atlantic Ocean." However, even though the amount is relatively lower compared to the locations mentioned, the presence of microplastic waste with the current amount in Indonesian seawater needs to receive vigilance from all parties. Pollution of the environment in coastal areas causes disruption of ecosystems in coastal areas. One of the most abundant human wastes on the coast is plastic waste. Plastics are often used in everyday life at relatively low prices and are made from synthetic organic polymers. World plastic production figures from 2005 to 2015 increased by around 92 million metric tons (Fadilah, 2021). Plastics can be fragmented by chemical and physical factors such as sunlight, currents and waves into microplastics in 3 different forms such as fragments, films, granules, pellets, fibers and foams (Mahadika, 2022).

Based on research conducted, the highest average plastic waste was found on the coast of Sulawesi, reaching 2.35 pieces/m2, followed by the Java coast with an average of 2.11 pieces/m2 of waste. One of the coastal areas in South Sulawesi that has plastic waste is in Takalar Regency where the capital is located in Pattallassang. This district has an area of 566.51 km² and a population of 304,856 people (Setyadi, 2018). From the explanation above, it is necessary to carry out research that aims to identify the amount of waste and what types of plastic are in Lambutoa Beach, as well as the sizes of the existing waste and the chemical groups present in each microplastic sample using Fourier Transform Infrared Spectroscopy (FTIR).

2. Materials and Methods

2.1 Sediment Sampling

Sampling of sand sediments was carried out at Lambutoa Beach in Takalar Regency. Sand sediment collection is done by taking sand according to a predetermined point. The sand sediment collection location is divided into seven points where each location is ± 200 m apart. Where the sediments taken are on the backshore and at the time of collection of sediments, seawaterconditions are in a low tide. Sampling was carried out using a 40x40 cm rectangular box, sand sweeper, iron scope as shown in Figure 1, where the depth is 4.8 cm. After taking the sample, the sample will be put into the sample plastic that has been provided.

Fig.1. Sediment Sampling

2.2 Processing of Sediment Samples

The sand sediment sample that has been taken and placed in a plastic sample is then poured onto a flat surface, which is then stirred and separated to form 4 diagonal parts using a plastic scraper. Then 2 parts of the intersecting sediment are taken to be put into the container, where the next step will be pouring a salt solution (NaCl) to sterilize the sample from the organic particles thatare still attached and at the same time separate the plastic material from

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the sand sediment. Stir until all the sand sediment is evenly mixed with the NaCl solution and wait around ±30 minutes until the plastic material rises or appears on the surface of the water. After that, do the filtering using a 4.75 mm and 0.3 mm filter, where the results of the screening will be transferred using tweezers into a Petridic dish which has been added with Medicine Wrapping Paper to dry the microplastic samples.

Fig.2. Sediment sample processing

2.3 Observation and Identification of Microplastics

The size of microplastics is divided into two, namely large microplastics that are 1 mm to ≤ 5 mm in size and small microplastics, namely microplastics that have sizes of 1000 µm to 1 µm (Valasia, 2021)). Microplastics have various types, including pellets, fragments, fibers, films and foams. The type of microplastic is determined by the source of the microplastic itself. In addition, the type of microplastic is determined by environmental factors. The forms of microplastic found in sand sediments on Lambutoa Beach are films, foam and fragments. The microplastic obtained from the previous screening was then counted and observed using the microplastic that was equipped with the Dino Eye device and connected to a laptop that had the Dino Capture application installed. Observations were made using a calibration magnification with a size of 10 mm.

Fig.3. Sample Observation Process on a Microscope connected to the Dino Eye tool andthe Dino Capture 2.0 application

2.4 FTIR (Fourier Transform Infrared Spectroscopy) Test

Sample testing using FTIR (Fourier Transform Infrared Spectroscopy) aims to determine the chemical constituents present in microplastic samples. FTIR makes use of the differences in the functional groups of each chemical element to distinguish the chemical elements contained in the test sample. Presentation of data from FTIR is in the form of tables and graphs which describe a list of chemical elements that are read in the test sample (Mahadika, 2022). The sample testing process using FTIR was carried out seven times according to the quadrants that had been divided when observing microplastics using a microscope.

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Fig.4. FTIR Test

2.5 Data Analysis

Data obtained from observations using a microscope will be analyzed for abundance and quantity. The results of the identification of microplastic content in sand sediments are displayed inthe form of photographs resulting from microscopy. Data on the amount and type (shape) of microplastics are presented descriptively in the form of tables and graphs. Microplastics have various types such as pellets, fragments, fibers, films, filaments, and foams. Microplastics also come in various colors, such as black, blue, white, transparent, red, green and so on. The abundance of microplastic sediments at each sampling point was calculated based on the number of microplastics found in 49 samples which can be calculated using the following formula:

$$microplastic\ abundance = \frac{microplastics\ in\ sand\ sediments}{dry\ weight\ of\ the\ sediment\ sample}\ x\ 100\% \quad (1)$$

3. Result and Discussion

3.1. Description of the Sampling Area

The location for microplastic sampling on Lambutoa Beach in Takalar Regency was carried out at seven different points with a distance of ± 200 m. Of the seven locations that have been visited, it was found that almost all of the trash around the beach comes from residents' homes. Most of the waste also comes from the fishermen who are there because the average population living around the coastal area has a job as a fisherman.

3.2. Microplastic Identification Based on Amount and Type

Observation of the results of microplastic samples that have been carried out using screening produces data that is used to identify microplastic results. Identification was carried out based on the number and type of microplastics.

a. Microplastic Based on Amount

Number of microplastics from seven different points on sand sediment sampling at Lambutoa Beach. The highest number of microplastic samples were obtained at points 1, 2 and 6 where the number of microplastic samples obtained was 8 samples.

Table 1. Microplastic Sample Amount

Point	Organic	Non-Organic	Total
Point 1	24	8	32
Point 2	18	8	26
Point 3	34	7	41
Point 4	28	5	33
Point 5	5	6	11
Point 6	8	8	16
Point 7	8	7	15

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b. Microplastic by Type

The types of microplastic waste that have been found are microplastic films, fragments, and foam. Of the three types of microplastic above, the type that dominates at all sampling points is the type of microplastic foam and film waste. Microplastics in the form of foam were most commonly found at the first point with 6 samples/161 gram dry weight of sediment. While the lowest abundance was at the fourth and fifth points in 4 samples.

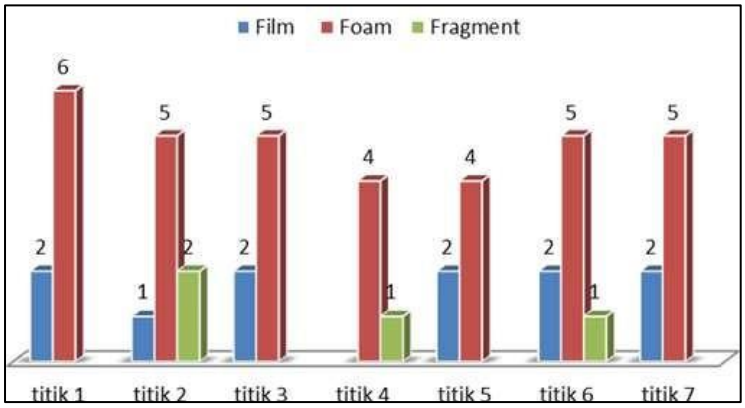

Figure 5. Graph of the number of types of microplastics on Lambutoa Beach

3.3. Observation Results Using a Microscope

Each microplastic sample that has been examined at each point using the Dino Eye and the Dino Capture application shows the size, area, and shape of each sample. The following is the size of each sample that has been tested using the Dino Capture application.

Table 2. Microplastic Size

Point	Around (K)	Area (A)	Length (P)	Width (l)
Point 1	16,183 mm	14,822 mm2	5,045 mm	4,156 mm
Point 2	14,473 mm	8,256 mm2	4,033 mm	4,156 mm
Point 3	9,071 mm	8,256 mm2	4,033 mm	3,267 mm
Point 4	10,532 mm	8,170 mm2	3,089 mm	3,456 mm
Point 5	9,306 mm	2,907 mm2	2,922 mm	1,622 mm
Point 6	13,643 mm	2,907 mm2	2,922 mm	1,622 mm
Point 7	12,090 mm	7,513 mm2	4,367 mm	3,011 mm

3.4. Microplastic Sample Polymer with FTIR

Of the total 49 samples that have been tested, only one sample will be analyzed using the FTIRtool to represent 7 microplastic sampling points. From the test results using the FTIR tool, results were obtained where five out of seven microplastics had the same number of spectra. As for the remaining two, the number of spectra is somewhat different. Microplastics that have a different number of spectra are in the foam and yellow fragment type microplastics and one representative of the type of microplastics that has the same number of peaks is a transparent film. For microplastics of the foam type, a spectra value of 3446 cm-1 is obtained, which is included in the category of Other (Nylon) polymer types. Nylon is around the spectra of 3500-3300 cm-1 which indicates it has the N-H functional group because the resulting spectra are widened and divided into two. For microplastic samples on transparent films, a spectra value of 3448 cm-1 was obtained, which is included in the category of PET (Polyethylene Terephthalate) polymers. PET is around the spectra of 3500-3300 cm-1 which indicates it has the O-H functional group, this is because the resulting spectra are wide and not split in two. Meanwhile, for the type of yellow microplastic fragment, a spectra value of 3450 cm-1 was obtained, which is included in the category of PET (Polyethylene Terephthalate) polymer. PET is around the spectra of 3500-3300 cm-1 which indicates it has the O-H functional group, this is because the resulting spectra are wide and not split in two.4.1Hazard Identification and Risk Assessment with Confined Space Risk Analysis

Further hazard identification is carried out at each stage of the hot working work in the ship's

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manhole according to the hazard category of the confined space. Then for the risk assessment carried out by expert judgment, the likelihood and severity of each hazard variable will be known. To calculate the likelihood and severity index using the equation below:

5. Conclusions

Based on the data above, there are three types of microplastic contained in sand sediments, namely film, fragment, and foam where each type has a different color, such as blue, yellow, white, gray, and transparent. The microplastics in each sample which consisted of 49 samples had an average size of 1-5 mm. Where the type of polymer that was most commonly found in testing sediment samples using the FTIR tool on Lambutoa Beach was Other (Nylon) and PET (PolyethyleneTerephthalate) polymers.

References

[1] Djongihi, A., Adjam, S., & Salam, R. Dampak Pembuangan Sampah di Pesisir Pantai Terhadap Lingkungan Sekitar (Studi Kasus Masyarakat Payahe Kecamatan Oba Kota Tidore Kepulauan). Jurnal Geocivic, (2022).

[2] Fadilah, S. S. Analisis Faktor Hidro-Oseanografi Terhadap Kerusakan Pantai Kecamatan Pondok Kelapa Kabupaten Bengkulu Tengah dan Penentuan Konsep Penanganannya. Jakad Media Publishing, (2021).

[3] Mahadika, R. S. Identifikasi Mikroplastik Di Perairan Dan Pesisir Laut Kabupaten Purworejo, (2022).

[4] Setyadi, F. Pantai Sulawesi Paling Tercemar Sampah Plastik. Valid News, (2018).

[5] United Nations Conference on Standardization of Geographical Names (UNCSGN) dan United Nations Group of Expert on Geographical Names (UNGEGN). Jumlah Pulau di Indonesia. Amerika Serikat, DPR-RI, (2017).

[6] Wahyu, E. TA : Pencemaran laut. Universitas Muhammadiyah Makassar, (2019).

E-ISSN: 2828-6669; P-ISSN: 2828-7010