



## MARINE DEBRIS COMPOSITION IN BATUPAHAT, JOHOR: A COMPARISON BETWEEN SUNGAI LURUS AND MINYAKBEKU BEACHES

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### ABSTRACT

The increment of population growth and rapid economic development near the beaches area enhance the generation of marine debris annually thus has become an environmental concern. In BatuPahat, Johor, determination of marine debris compositions on the beach provide a preliminary caution on the level of contamination and also enable to identify the most abundant waste. For this study, a comparison between two beaches namely Sungai Lurus and Minyak Beku in Batu Pahat district and located in the same coastline, were carried out. The composition, density and moisture content of the marine debris collected were determined. The results demonstrated that plastic waste was the most abundant item at 80% of the total amount of debris and represents 54% by weight of marine debris composition in Sungai Lurus beach. Meanwhile, glass waste predominates at 60% with 39% by weight of marine debris composition at MinyakBeku beach. The moisture content of debris composition at Minyak Beku beach represents up to 12.61% compared to 8.68% at Sungai Lurus beach. High density of debris composition was obtained at Minyak Beku beach with 94.56kg/m<sup>3</sup> followed by 66.15kg/m<sup>3</sup> at Sungai Lurus beach. As a conclusion, the economic activities and solid waste management along the beaches highly influence the amount of marine debris composition at Sungai Lurus and Minyak Beku beaches. Due to the number of marine debris that is still littered along the beaches has indicated that environmental concerns among Malaysian are still low.

**Keywords:** marine debris, pollution, beaches, littering.

### INTRODUCTION

The beach area is characterized by rich biodiversity of natural flora and fauna, given significant economic resources and most valuable assets among shorelines countries. Nowadays, the pollution of marine debris is a rising environmental problem on worldwide beaches. Marine debris is also known as marine litter and it is human created waste that has deliberately or accidentally been released in a lake sea, ocean, beaches or waterway. Malaysian beaches also not excluded from littering problems of solid marine debris waste on the beach. Environmental group today criticize Malaysian for their littering behavior on the beach without any serious concern on the consequence to the environment, human health and marine biota. This situation worsen due to human actively transform the beach area as a permanent disposal site of solid waste since this area strategically located far away from residential and commercial area.

Generally, types of debris found on the beach are similar to municipal solid waste. Economic activities greatly influence the debris composition on the beach. The percentage and amount of debris is varied and highly dependable on the economic activities of the relevant beaches. Sources of debris on the beach are contributed from recreational activities, fishing, shipping, tourism and coastal development. Recreational activities such as picnicking, swimming and boating generate debris massively along the beach including polystyrene container, plastic bottle, plastic bag, sweet wrapper and

food packaging. Moreover, nature factors such as wind and oceanic wave movement enhance the potential of debris transports to the beach area. In addition, the marine debris composition on the beach shows the similar types of debris that were brought by the beachgoers that enable it to become an indicator of the cleanliness level at the beach.

Many studies have enumerated the debris composition and amount of debris found on worldwide beaches. The United States of America especially California coast has been exposed to pollution of beach debris. The study of composition and distribution in Orange County beach indicates three categories of plastics which is pre-production plastic pellets, foamed plastics and hard plastic accounted for 99% and cigarette butt, paper, wood, glass, rubber with less than 1% (Moore and Gregoria, 2001). European coast such as Slovenian coast also not escaped from the contamination of marine debris. Slovenian coast located in the Mediterranean Sea and are used as port industry and tourism activities. According to Palatinus (2009), plastics waste predominated at 64%, cigarette butts with 17%, glass with 9%, metal and composites with 3%, fabric with 1% and paper with 2% at Slovenia coast. Apart from that, the debris composition study varies at different region such as Middle East countries as most of the cities in this region located strategically near the coastal area that actively surrounded by various types of economic activities. More than 75% of the litter was plastic origin and the rest were from wood,



metal, glass and paper materials found at Obhur coastline, Saudi Arabia in 2011 (Kitto *et al.* 2011).

Previous studies have also documented the presence of marine debris in Malaysian beaches. Plastic is the most abundant type of marine debris found on Malaysia beaches (Chan, 2006). Maritime Institute of Malaysia (MIMA) conducted Clean Coast Index (CCI) for cleanliness assessment of coastal areas in Malaysia in 2010 and the results indicated plastic waste has been proven to be major contributor of coastal litter in Malaysia beaches with 66% of the overall litter collected (Hagir *et al.* 2013). The Malaysian researchers have involved actively determining marine debris composition in Malaysian beaches. According to Agamuthu *et al.*, (2012), the study of two beaches selected in Port Dickson, plastics waste is the most abundant type of debris with 64% in TelukKemang and 46% in Pasir Panjang. A relatively high amount of debris was also recorded in Seberang Takir beach, as plastic contribute 75% of the debris followed by 9% of glass, 5% of paper and 10% of others. In comparison, density of debris found in BatuBurok beach demonstrated plastic as the most abundance with 57% of debris, followed by others with 29% and paper with 10% (Agamuthu *et al.* 2013). Therefore, marine debris is also one of the problems that occurred in Malaysian beaches and it is important to be investigated.

## MATERIALS AND METHODS

### Sampling area

Two beaches namely Sungai Lurus and Minyak Beku in Batu Pahat, Johor were selected for the comparison of debris composition in terms of types and weight. All the visible debris was collected by walking randomly along the length of 500m x 50m transect and parallel to the water line. In order to maximize collection of the samples, the sampling process was conducted during a low tide period and suitable weather.

The collected debris was stored in a pre-market trash bag, labelled and transported to the laboratory for identification and quantification process. The collected debris classified into seven categories which are plastic, glass, metal, paper, rubber, wood and cloth. Then, it was classified into another sub category to determine the composition and abundance of the beach debris. Figure-1 illustrates the transect area and walking pattern established in Sungai Lurus and Minyak Beku beaches.

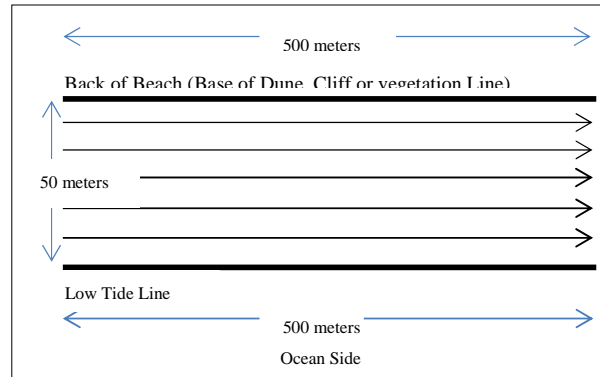


Figure-1. Transect or a walking pattern of the beaches.

### Marine debris disposal

The amount of marine debris disposal on the selected beaches was counted manually and recorded in the debris composition worksheet after sampling process was conducted. The amount of marine debris also expressed as number of items per unit area.

### Classification of debris composition

The cleaning process of debris was conducted in the laboratory. The samples were cleaned and dried from the impurities. The collected debris were manually sorted, separated and divided into seven categories regarding material which are plastic, glass, metal, paper, rubber, wood and cloth. After that, the debris was classified into 32 types of sub-categories which are polystyrene, cigarette butts, sweet wrappers, plastic bag, plastic cutlery, straws, drink cans, plastic bottle, glass bottle, aluminium tin, fishing line, paper particles, newspaper, bottle caps, footwear, fabric pieces, glass fragment and others. Classification of marine debris composition is based on guidelines from UNEP/IOC Guidelines on Survey and Monitoring of Marine Litter (Cheshire and Adler, 2009) and NOAA Marine Debris Shoreline Survey Field Guide (Opfer *et al.* 2012) of the monitoring program of marine litter. After separation and categorization, the amount of each type of debris was expressed as number of items. The debris composition was counted and recorded in the Table in worksheet classification of debris composition. Then, the classification list of debris composition was sorted from highest to lowest based on the amount and types of debris. The most abundant items were determined and compared between the two selected beaches.

### Determination of weight, density and moisture content of marine debris

Analysis of weight from the debris composition was conducted according to types of debris that has been sorted and separated into their categories. The weight of debris was recorded in the worksheet classification of debris composition. Apart from that, the moisture content and density of debris composition on both beaches were

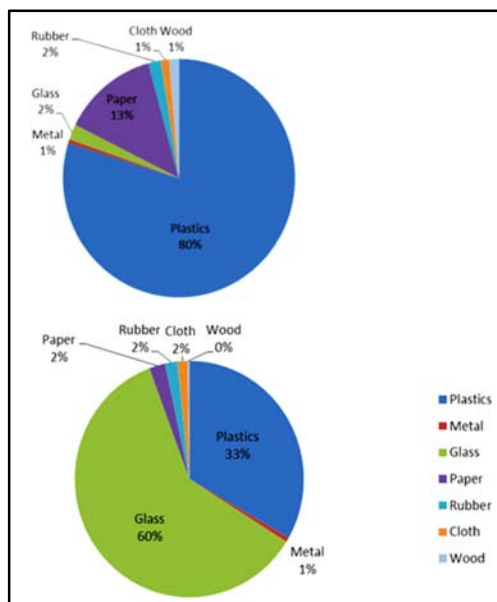


also determined and it is expressed as a percentage of the dry weight of the material.

## RESULTS AND DISCUSSIONS

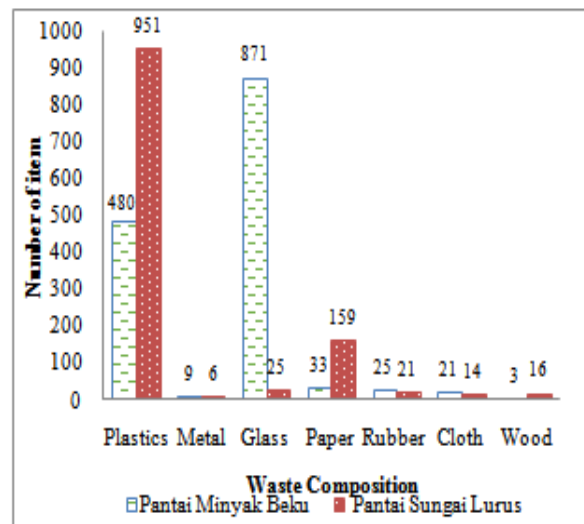
According to the debris collected, plastic wastes highly predominate with 80% (951 items) of the debris composition followed by paper waste with 13% (33 items) at Sungai Lurus beach area. Other wastes are metal (1%), glass (2%), rubber (2%), cloth (1%) and wood (1%) with 6, 25, 21, 14 and 16 items, respectively. This is in line with previous studies that also found plastic as the most abundant type of marine debris on Malaysian beaches (Agamuthu *et al.* 2013). Most of the plastic debris was found in form of plastic bag, plastic bottle, polystyrene and sweet wrapper which are believed due to the beachgoers and local community during picnicking activities. Through observation, the main activities conducted on Sungai Lurus beach are recreational and fishing.

On the other hand, at Minyak Beku beach, glass waste represents the most abundant items with 60% (871 items) from debris composition. Meanwhile, plastic waste only accounted with 33% (480 items). Other wastes that are contribute as marine debris at Minyak Beku beach are metal (1%), paper (2%), rubber (2%), cloth (2%) and wood (0%) with 9, 33, 25, 21 and 3 items respectively. Similar observation also has been found that recreational, fishing, and tourism attraction are the main activities at MinyakBeku beach. Figure-2 illustrates the percentage of waste composition at Sungai Lurus and Minyak Beku beaches.



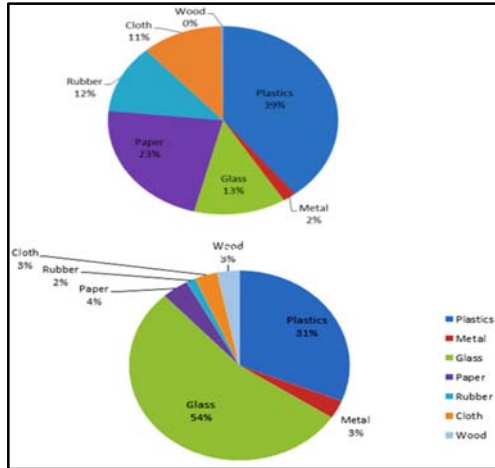
**Figure-2.** Percentage of debris (number of item) between Sungai Lurus and Minyak Beku beaches.

The total amount of debris recorded at Minyak Beku beach was 1442 items compared to 1192 items accounted at Sungai Lurus Beach within two months of investigation. The results indicated that economic activities and number of visitors visited on the beach influence the generation of marine debris as well as contributing to the different amount of debris found on both beaches. Moreover, lacking of solid waste management also highly play a vital role as lack of facilities were provided at the beach. Figure-3 shows the comparison total amount types of debris found on the two selected beaches.



**Figure-3.** Comparison number of debris littered between Sungai Lurus and Pantai Minyak Beku beaches.

In terms of weight, the most abundant debris for each beach represents the highest weight on both beaches. Weight of plastic debris collected was 2170 gram (39%) from the composition in Sungai Lurus beach. Most of the plastic wastes were found in dry condition. Meanwhile, at Minyak Beku beach, glass represent 7455 gram (54%) of debris based on weight and followed by plastic with 4305gram (31%). Therefore, it was found that a total of 13839 gram of waste by weight were accounted at Minyak Beku beach represent higher weight compared to 5350 gram recorded at Sungai Lurus beach. Figure-4 indicated the comparison percentage of debris based on weight on both beaches.



**Figure-4.** Percentage of debris (by weight) between Sungai Lurus and Minyak Beku beaches.

Apart from that, the moisture content of debris composition at MinyakBeku beach is from 7.40% to 24%. On the other hand, the moisture content at Sungai Lurus beach was approximately lower in the range of 4.67% to 12.90% throughout the study. A relatively low moisture content on both beaches probably due to unexpected dry weather occurred during the investigation. Nevertheless, a relatively high amount of density was recorded with 94.52 kg/m<sup>3</sup> at Minyak Beku beach compare to 66.15 kg/m<sup>3</sup> accounted at Sungai Lurus beach. The density of marine debris on both beaches are highly influence by the weight and volume of debris composition. Table-1 shows the comparison of debris composition based on moisture content and density on both beaches.

**Table-1.** Comparison of moisture content and density between Sungai Lurus and Minyak Beku beaches.

Month	Week	Moisture content (%)		Density (kg/m <sup>3</sup> )	
		Pantai Minyak Beku	Pantai Sungai Lurus	Pantai Minyak Beku	Pantai Sungai Lurus
February	1	12.94	12.93	77.00	71.20
	2	11.27	4.67	132.50	45.00
	3	24.00	6.80	140.00	50.00
	4	7.82	12.00	110.00	80.00
March	1	10.10	4.76	73.30	105.00
	2	7.40	12.00	46.67	26.67
	3	14.72	7.64	82.20	85.20
Total		88.25	60.80	661.27	463.07
Average		12.61	8.69	94.52	66.15

#### Factors effecting debris composition at Sungai Lurus and Minyak Beku beaches

Plastics and glasses represent the largest portion of marine debris disposed on Sungai Lurus and Minyak Beku Beaches. The study was conducted at Sungai Lurus Beach found that plastic is the main type of debris disposed and marred by the sight of litter strewn about by irresponsible beachgoers. This is probably contributed by human activities conducted on the beach and assisted by nature factors. The main reason is the extensive use of plastic for a variety of purposes. The major problem on Sungai Lurus Beach is the non-existence of appropriate litter bins and lack of solid waste management. Moreover, this beach is not under supervision by the authority and due the reason has only one litter bin provided by the local community. The litter bins not regularly emptied contributes overfilling of litter and increase potential blown by wind has only worsened the situation. The sale

of food and beverage services increase the amount of solid waste disposed on this beach such as plastic cup and bag and food packaging.

Meanwhile, the massive amount of glass found shows that plastics is not the most item littered at Minyak Beku Beach as expected and obtained by previous studies. Most of the glass fragments embedded on the beach sand and already half buried in the shoreline that only can be collected during low tide period. This probably contributed by human activities such as picnicking activities and assisted by nature factors. The sources of glass fragment originated from broken glass bottles that were brought by beachgoers. On the other hand, glass bottles might hit by a wave and then broken up into pieces due the movement of ocean water to the beach and time.

It was found that number of item and weight of debris composition on Minyak Beku Beach is higher than from Sungai Lurus Beach due difference the number of



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visitors, economic activities and nature activities that influence disposal of marine debris on both beaches. The economic activities in Minyak Beku Beach based on recreational, fishing and historical landmark, meanwhile recreational and fishing activities are the primary economic activities at Sungai Lurus Beach. The result also found that the density of debris is highly influenced by economic activities along the beach. Interestingly, the most abundant item directly becomes the highest weight of debris on both beaches.

## CONCLUSIONS

The economic activities, number of visitors and nature event are the main contributor to the abundance of debris on the beaches. Moreover, lack of solid waste management also enhances the debris on the beach. Plastic wastes are visibly the most abundant types of debris found at Sungai Lurus beach. Based on this study, the debris compositions on the beach are various but the types of debris are similar with previous study on beaches in Malaysia. Due to the number of debris that is still littered shows that environmental concern and the marine debris management among Malaysians away are still low.

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