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Distribution and Abundance of Stranded Tar balls in Marintaman Beach, Sipitang, Sabah, Malaysia

Erma Hani Baharudzaman, Piakong Mohd Tuah

P.G. Student, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia
Associate Professor, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia

ABSTRACT: Tar balls pollution was monitored at 10 stations along the coastline of Marintaman Beach at Sipitang, Sabah on weekly visit in February 2016. This project is aimed to determine the distribution and abundance of the existence of tar balls in that monitored week. The tar-balls were collected from ten points along 1.63 km of coastal area at Marintaman Beach, Sipitang. These stations selected based on the distance and geographical of the coastal surround with ship that anchoring and the distance from Federal Territory Labuan that only 39.93 km away and 56.98 ˚ northwest from the sampling location. On week one has the higher total of tar balls presents and decreasing by week 2, 3 and 4 respectively. The distribution and abundance of the presence of tar balls shows that station 6 have high distribution and also as the most abundance station consists of 87 pieces in total of tar balls and the total weight is 161.62 g. Thus, the stranded tar balls collected from the coastline decreasing by week may because of the weathering that happen in surrounding of the sampling station and the coastline surface may undergo a constant change as sand is redistributed by waves and wind during each tide. Therefore, any materials that are stranded at the water line are constantly subject to removal or burial.

I. INTRODUCTION

Oil spill is one of environmental pollution that commonly occurs along the coastal area [1]. The marine environment is subject to contaminate by hydrocarbon or organic pollutions from variety of sources. This organic contaminate result comes from uncontrolled releases oil from the spillage during transportation, manufacturing and run-off from terrestrial sources. Petroleum in marine is distillate products that are immediately subject to a variety of biological, physical and chemical changes.

The East Coast of Peninsular Malaysia faces the South China Sea is vulnerable to oil pollution because of intense petroleum production activities in the area. The potential sources of oil pollution in the East Coast of Peninsular Malaysia is mainly attributed to oil fields in Terengganu as well as accidental spills from super tankers transporting oil from the Western Hemisphere to the North East. Oil spills can occur and causing pollutions and contamination in the surrounding areas. Residual oil spills stranded on coastal beaches usually end up as tar-balls [2].

Tar-balls is one of marine oil pollution that can be found in varying quantities on beaches, open ocean surface and the seafloor [3]. The floating tar-balls area a product of weathering of crude oil in the marine environment and they have been found to be prevalent in the world ocean particularly in the 1960's before the stricter controls on petroleum transport and handling were in effect [4]. Tar-balls can be define as oil which has been exposed to biological, chemical, physical and geological processes that change its chemical composition and physical form. The textures are diverse because of the exposure to the environment [5]. Tar-balls can be assess after they have been washed up on beaches or when they are seen floating on the sea. Beach contamination by tar-balls mainly cause to operational losses of fossil fuel hydrocarbons from drilling platforms and tanker-derived oil spills is a common phenomenon in areas where there is oil exploration and exploitation [6].

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When oil is present in the marine environment, there are various process undergoes in the water. The form of oil in lower density than seawater may cause the oil float on the ocean's surface. The suspended oil usually comes with varies and irregularly shaped and their size form in ranging less than 1 mm (< 1 mm) to ten of centimetre across [4]. Oil pollution also has severe impacts to aquaculture fisheries in Malaysia [7].

The formation of marine tar residues from liquid oil is not a fully understood process. There is theory that assumes the tar residues originate directly from the weathering of oils at the surface of the sea. Weathering is a combination of processes that including spreading, evaporation, dissolution, biodegradation, emulsification, sedimentation, dispersion and oxidation, leaves behind oil components that are heavier and more viscous. In addition, water in oil mixture forms that are referred as "chocolate mousse" or "mousse". Thus, this weathered emulsion breaks into pieces and forming pelagic tar-balls or tar-balls patties. The pelagic tar-balls may become benthic after being subjected to processes that increase their gravity [3]. Figure 1 shows the tar-balls that less dense than sea water will be floated and stranded to the coastal or island beaches and for the heavy tar-balls or tar-mats will sinking or submerge to the sea floor.

The floating tar balls result from the petroleum input. The petroleum input comes from the production of oil onshore and offshore to the marine environment from the processing and handling, shipping operations and from natural oil seeps [4]. On the other hand, aquatic pollution in most environments also can occur naturally and not always related with oil spills or oil pollution [2]. Abiological weathering processes include the process of evaporations, dissolution, dispersion, photochemical oxidation, water-in-soil emulsification, sinking and sedimentation. Besides that, the biological processes include ingestion by organisms as well as the microbial degradation.

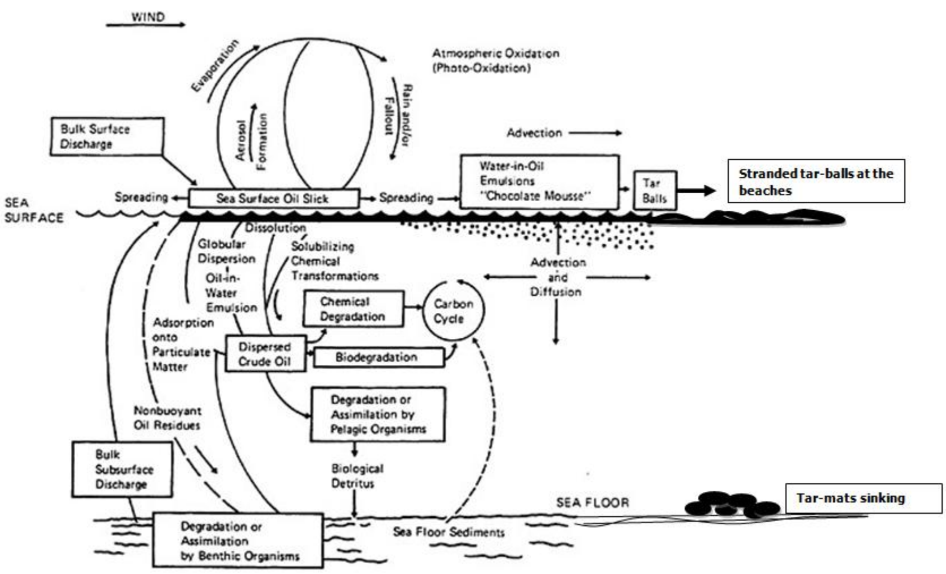

Fig.1.0 The fate of the tar-balls in the marine environment (Hassanshahian et al., 2013). – Modified

Weathering process related to the process of tar-balls formation where the condition of oil slick according to the wind and currents. When the oil spill, it will immediately starts to spread over the sea surface. Viscosity and volume spilled of oil will affect the speed. The oil spreads also affected by waves, turbulence, and tidal streams. Besides that, the more volatile components of oil will evaporate to the atmosphere and the rate of evaporation also depends on ambient temperature with a boiling below 200˚C that will evaporate within 24 hours in temperate conditions. The residues of oil remaining after the evaporation process have increased the density and viscosity which that affect the subsequent weathering processes.

This paper describes the distribution and abundance of stranded tar balls at the coastline of Marintaman Beach, Sipitang, Sabah. The resulting from the distribution and abundance of stranded tar balls at these coastline shows that the existence of oil-spill near or around the coastline area. The analysis allowed better understanding about the

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precautions to the oil spill on the marine environment and the cause of variability in tar accumulation nearby the coastal waters to the study site.

II. MATERIALS AND METHOD

Sampling area: As shown in Figure 2.0, the tar-balls were collected from ten points along 1.63 km of coastal area at Marintaman Beach, Sipitang. These points were selected based on the distance and geographical of the coastal surround with ship that anchoring and also near to Federal Territory Labuan with the 39.93 km away and 56.98 ˚ northwest from the sampling location, as we know Labuan is an Island that produce a huge number of oil and gas industry. On that area, there are many oil production activities are carried out on shore and also at the off shore. Activities are includes the shipping of materials in and out of Labuan, the processing of petroleum and also the excavation of crude oil in the deep waters.

Fig. 2.0 Sampling location of tar-balls of coastal area of PantaiMarintaman, Sipitang, Sabah.

Sample Collection: The total of 229 tar balls from coastal locations were collected on each week in February 2016. Samples were collected from one meter strip that running across the beach from high tide line to the present water level. The samples were collected in 10 stations that assign along the 1.63 km of the coastline of Marintaman Beach. The distance between each station is 100 m and the samples that available 50 m surrounding the stations will be collected. While sampling need to wear clean or non-contaminating gloves and the sample will collect by scooping into the sample container using clean utensil such as spoon. Wrap utensils in foil and discard foil between samples. Avoid from stone, sticks and other debris. Wrap the solid tar-balls with aluminium foil and put inside glass jar and Ziploc bag to avoid contamination. Collected samples kept into coolers for laboratory analysis and keep on ice until the shipment are prepared and ship to lab as soon as possible but if not possible to shipment on same day, do not freeze the samples.

Analysis of Distribution and abundance of Tar balls: The distribute sampling are according to 10 station that show in Figure 1. The distribution and abundance of tar balls is collected weekly and the analysis will distribute according to the weight of the sampled tar balls that been classify into class of weight such : A (0.01-5.00g), B (5.01-10.00g), C (10.01-15.00g) and D (15.01-20.00g).

III. RESULTS AND DISCUSSION

In this result, the data presented in Table 1 cover the period for week 1 until week 4 in February 2016. In Table 1 and Fig. 3.0 shows the distribution of tar balls in different stations along the coastline and Table 2 and Fig. 5.0 shows the stations that most abundance with tar balls based on the weight of the total stranded tar balls that found at the sampling site. Majority of tar balls stranded on the beach were less than 20 g. At the Figure 3 shows the weight A (0.01-5.00) g of tar balls have the highest total following to weight B (5.01 – 10.00), C (10.01 – 15.00) and D (15.01 – 20.00) respectively. The existence of stranded tar balls in each station along the coastline is decreasing by week.

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Table 1
Distribution and Abundance of Tar balls Sampling Stations

Stations	Weight of tar-balls (g) per pieces																								Grand Total	%
	0.01 – 5.00						5.01 – 10.00						10.01 – 15.00						15.01 – 20.00							
	W1	W2	W3	W4	Total	%	W1	W2	W3	W4	Total	%	W1	W2	W3	W4	Total	%	W1	W2	W3	W4	Total	%		
S1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S3	2	4	0	0	6	2.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2.6
S4	11	5	0	0	16	7.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	7.04
S5	19	13	6	2	40	19.04	1	0	1	0	2	18.2	0	1	0	0	1	25	0	0	0	0	0	0	43	18.9
S6	23	32	10	9	74	35.2	3	3	1	1	8	72.7	2	0	1	0	3	75	2	0	0	0	2	100	87	38.3
S7	18	14	3	1	36	17.1	0	0	1	0	1	9.1	0	0	0	0	0	0	0	0	0	0	0	0	37	16.3
S8	13	9	0	1	23	10.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	10.1
S9	7	3	0	1	11	5.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	4.8
S10	4	0	0	0	4	1.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1.8
Total	97	80	19	14	210	-	4	3	3	1	11	-	2	1	1	0	4	-	2	0	0	0	2	-	227	-
%	46.2	38.1	9.04	6.7	-	-	36.4	27.3	27.3	9.1	-	-	50	25	25	0	-	-	100	0	0	0	-	-		--

W1-week 1 W2-week 2 W3-week 3 W4-week 4
0-Not Available

The distribution and abundance shows that Station 6 (S6) recorded total 87 pieces of tar balls in four weeks that located at the centre of the coastline of the beach has the highest total of tar balls and the lowest are from Station 1 (S1) and Station 2 (S2) that has no tar balls presence. The total of the tar balls was decreasing towards the left and right of the coastline as S6 > S5 > S7 > S8 > S4 > S9 > S3 > S10 > S1 = S2. In addition, the distribution of tar balls for week 1 is highest and decreasing by week 2, week 3 and week 4 respectively.

Many oceans and coasts worldwide been reported by the existing of the pelagic tar balls and stranded tar balls [8]. Unfortunately, there is no report has been reported about any oil spill happen on the sampling surrounding. The presence of tar balls on the coastline in the area may affect by the small spill from that come from the local petroleum-related industry or from the ship that anchoring near to sampling area or other sources that may cause the stranded of the tar balls along the beach.

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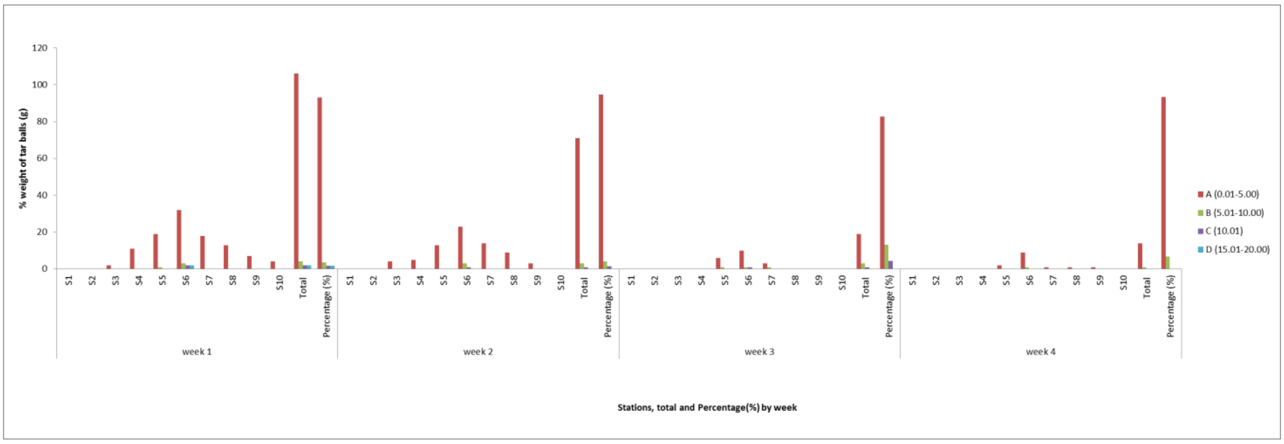

Fig. 3.0 Total weights of tar balls for each station in week 1, week 2, week 3 and week 4

The distribution of tar balls along the Marintaman coastline sandy beach mayhave been affected by the dynamic of the shore zone. The coastline surface may undergo a constant change as sand is redistributed by waves and wind during each tide. The erosion and deposition occurs at the same time within short distances. Therefore, any materials that are stranded at the water line are constantly subject to removal or could be burial in sediment. According to Adolphe*et. al.* (1995), on sandy beaches, with relatively high levels of turnover of buried tar due to wave action, the difference between first collections and repeat collections could conceivably turn out to be negligible.

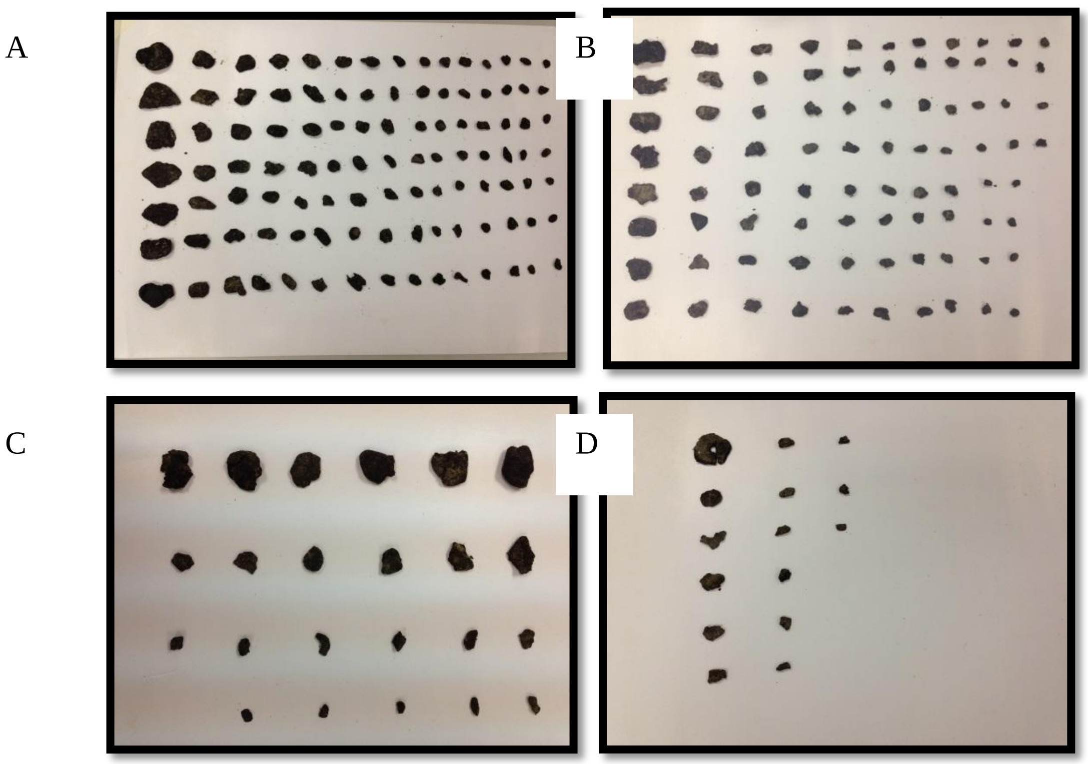

Fig. 4.0 Total of tar balls by difference week and size: A (Week 1), B (Week 2), C (Week 3) and D (Week 4).

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Fig. 4.0 shows the decreasing amount of tar balls collected and also the decreasing of size of each tar balls in each week. The decreasing of the tar balls may cause by the ocean current or wave, wind and other causes that may related to the decreasing amount of the tar balls and decreasing in size at the same time. The tar ball could be stranded on the coastline for long period and going through several of weathering processes such as the evaporation, dissolution, photochemical oxidation, dispersion, emulsification, adsorption onto suspended particulate material, ingestion by organism and also sinking and sedimentation. All those process may affect the distribution and abundance and also affect the decreasing in size and total amount of the tar balls.

Based on Jordan and Payne (1980) said that categorized spreading and drifting of oil on water as substantial processes amid first hours of a spill with regard to the oil pour point is lower than the surrounding temperature. These processes are effectively accelerated by the influence of wind, waves and currents which disrupt the oil slick into discontinuous stripes and patches.

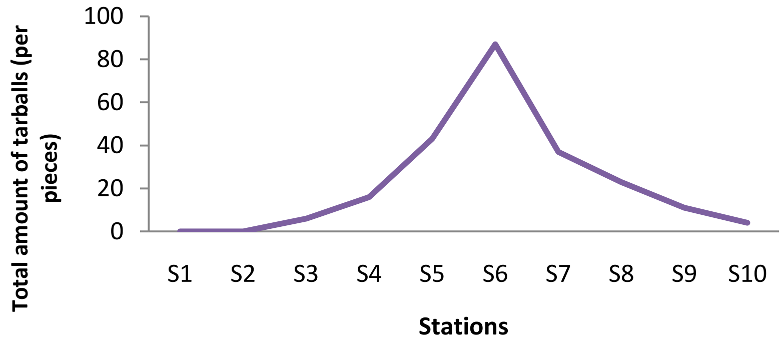

Fig. 5.0 The abundance of tar balls in each station during the 1– month sampling period.

Fig. 5.0, shows the station 6 is the most abundance with the highest amount of tar balls compare to other stations and this result may obviously cause from the current, wave and wind from the sea. Station 1 and station 2 shows there is no sample tar balls available and this may because of the area that been covered by the rock near to the station area. The tar balls may come from the industry that near to the sampling stations such as the oil and gas industry that located at the Labuan Federal Territory.

The tar balls contamination in Marintaman beach may not only be ascribed to the local petroleum-related industry and shipping but also to the islands location with respect to Labuan Federal Territory that major petroleum producing and exporting industries of the borneo. However, the possibly confounding effects of differences in beach type between studies that must not be excluded may also can be as potential factors in the apparent differences in tar balls contamination as compared to other area of Sipitang. Therefore, very large spills spread faster compared to small spill. The area of oil spreading will reduced in waves and the rate of reduction is larger for light oil as reported by Jordan and Payne (1980).

IV. CONCLUSION

Thus, this study provides the information that the presence of tar balls in the Marintaman Beach shows there are small oil spill had occurred near the area but maybe it is in low concentrations. These findings indicate that the sources may. Probably, the present of tar balls could be from small spill incident at localized area near the sampling area and have been leaking tar ball over a long period of time and the coastline currents transport the tar balls over long distance. Otherwise, it is also important to do a research or studying the contaminant record to identify either the sources may from the natural sources and always attribute them to anthropogenic contamination. By the presence of tar balls on the beach of Marintaman shows that this oil spill problem need to be more strictly monitored to prevent and avoid this small pollution to become a huge problem that may be hard to control in the future.

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AUTHOR'S BIOGRAPHY

Erma Hani Baharudzaman, born in 1992, Kota Kinabalu, Sabah.M.Sc candidature at FSSA, UMS. She started her research on environmental sciences in 2015 until now. She is a part time Tutor at Universiti Malaysia Sabah since 2016 until now. Her research focus on Characterize Polycyclic Aromatic Hydrocarbon in Tarballs and Treatment of Tarballs by Bioaugmentation using Locally Isolated Beneficial Microorganisms (LIBEM).