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Oil and Grease content of Bilge Water obtained from Ships Docked at the Warri Seaport, Delta State, Nigeria

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ABSTRACT: This study is aimed at empirically investigating the impact of oil and grease content of bilge water on Nigeria's Coastal environment. Literatures were reviewed and the study adopted an experimental research design. The researchers applied laboratory experimental analysis, physicochemical parameters of ship generated wastewater from vessels against the DPR standard was measured. The results of the analysis showed that the value of oil/Grease content of Bilge water is 72µg/L while the DPR limit value is 48 µg/L, however, the mean value of Oil/grease content of wastewater is 35.0 µg/L. Based on the findings, the researchers rejected hypothesis one and accepted hypothesis two, hence concluded that the value of oil/grease content of bilge water is significantly different from the mean DPR Limit. They also concluded that the mean value of oil/grease content of wastewater is not significantly different from the mean DPR Limit. Based on the result, the researchers recommended appropriate measures for the disposal of ship wastewater; better policy implementation and enforcement for strict compliance on bilge water disposal as well as adequate treatment of onboard wastewater.

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The MARPOL Convention, adopted at the International Maritime Organization (IMO) in 1973 and modified by the Protocol of 1978, deals with the prevention of pollution from ships and the protection of the marine environment from discharges of harmful substances to the sea (Onwuegbuchunam, *et al.* 2017), Bamanga, *et al*. (2019). It establishes criteria for discharges at sea and also an obligation for the ship master to report any pollution incident which is defined as 'a discharge above the permitted level'. It also imposes a duty to cooperate between States parties to the Convention in the sanctioning of such violations, (Onyema, *et al*. 2015). According to International Maritime Organisation, IMO (2017), Annex I, Regulation 15 provides that 'any discharge into the sea of oil or oily mixtures from ships shall be prohibited'. Regulations 15 (D) of annex I provide that whenever visible traces of oil are observed on or below the surface of the water in the immediate vicinity of a ship or its wake, a prompt investigation should be undertaken, taking into account such elements as wind and sea conditions, the track and speed of the ship, other possible sources of the visible traces in the vicinity and any relevant oil discharge records (Encheva, 2015). Operational discharges are estimated to make up 45% (and shipping accidents 36%) of vessel-sourced oil entering the environment (Andersson *et al.,* 2017) and (Altug *et al.* 2012). The

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environmental and socio-economic damage caused by oil pollution is determined by a range of factors, including: type of oil; physical, biological and economic characteristics of the location; amount and rate of spillage; and time of year (EMSA, 2010).

The Nigeria's coastal environment plays a crucial role in global trade and transportation as well as the health and well-being of human and aquatic organisms, yet the management of ship-generated wastes like oil and grease content of bilge water presents a complex challenge with far-reaching consequences, (Rocha, *et al*. 2015). The existing gaps in understanding the various types of wastes and effects of ship wastes (oil and grease contents of bilge water) on marine coastal environments pose a significant problem. Despite regulatory efforts, the environmental implications and operational influences of ship waste especially the oil and grease contents of bilge water disposal remain inadequately explored. The lack of comprehensive insights into waste types, management practices, and their direct impact on vessel efficiency hinders the formulation of effective strategies for sustainable coastal management. Therefore, this study seeks to address these knowledge gaps by investigating the impact of oil and grease content of bilge water on Nigeria's coastal environment. The review of related literatures carried out in this work indicated that studies have been carried out and have recognized the impact of ship-source pollution on coastal environment both in Nigeria and outside Nigeria. Specifically, (Prapisala, *et al*. 2012) carried out a study on portside reception facilities in ports in the North Sea. Also, Gokce, *et al*. (2014) in their study investigated the effects of shipping accidents on marine environment especially at the coastal region in Turkish Seas, (Özdemir, *et al.* 2015). Salt water together with sanitary water goes to a biological wastewater treatment plant situated at the end of sewage system where salt destroys bacteria (biomass) needed for the process of purification. Sodium Chloride (NaCl) has a negative impact on the purification process and can cause a delay in the treatment when concentration is greater than 10 percent (Bamanga, *et al.*2019).

Ironically, the above problem has never been given adequate national attention. Unwholesome practices of ships engaged in coastal trade in Nigeria territorial waters such as sewage disposal at sea, introduction of hazardous substances into sea, Chemicals, ship ballast water, wave erosion, offshore, pipelines, factories and sewage plants directly into the sea or water sources, discharge of sewage, agricultural and toxins from industries, fishing activities and even abandonment of wrecks has equally constituted a serious problem of marine environmental pollution and this has continued to go on unchecked, (Asariotis, *et al.* 2016). This problem has invariably alienated the indigence of the affected geographical regions from their traditional sources of earning good leaving which is fishing and agriculture, thus subjecting them to untold hardship. Pollutants including oil, chemicals, garbage, sewage, and food waste are all being dumped into the ocean and ports. At the same time, ports find it difficult to manage all of the waste received. This paper therefore is on the impact of oil and grease content of bilge water on Nigeria coastal environment. The objective is to find out if the oil/grease content of bilge water and the wastewater are significant when compare to the DPR value.

MATERIALS AND METHODS

In this study, laboratory research design was employed. The laboratory design has to do with conducting a laboratory test. Bilge water, black waste and ship ballast water were subjected to laboratory test.

Sample Collection: Waste samples were collected from vessels berthed at different locations. The samples were: black waste, bilge water and ship ballast water. These samples were collected with sterile 75 cm screwed top plastic bottles; they were stored in a temperature of 4°C. In order to avoid staleness of samples, some of the pollution indicator parameters were determined within six hours of sample collection.

Laboratory Analysis: The analysis covered physical, chemical and microbiological parameters of the water samples. The parameters tested for were: pH, temperature, conductivity, total dissolved solids, total suspended solids, turbidity, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total oil and grease, copper, iron, lead, zinc, aluminium, cadmium, mercury, total coliform count, total heterotrophic bacteria, and total heterotrophic fungi. Data collection utilized a sampling method whereby water samples from marine cargo vessels at berths were subjected to physico-chemical and microbiological analysis according to the American Public Health Association (APHA) method to determine the level of concentration of identified parameters. Standard procedures were applied to prepare our sample for the analysis. Thus, for the sake of brevity, we have in this section omitted the laboratory procedures which followed. These are however attached in Appendix. In the following sections, we discuss the results from the analysis of our samples. Significant values of parameters

obtained from the laboratory analysis are compared to the Department of Petroleum Resources (DPR) specified standards for effluent discharges from barges to guard against: hazards to human health, harm to living organisms (fauna and flora) and aquatic life and impairment of quality of adjacent land, surface and ground waters.

RESULTS AND DISCUSSION

The above figure 1 shows the distribution of the chemical parameters of shipborne wastewater. From the figure, and from table 1 above, it is evident that the value of the oil/grease content of Bilge water is 72.0 µg/L, and the value of the oil/grease content of Ballast water is 20.1 µg/L while the value of oil/grease content of Black water is 15.9 µg/L, from this experimental analysis, it can be seen that the oil/ grease content of Bilge water is the highest in value. However, from figure 2 and table 1 above, Bilge water recorded the least value in the distribution of the microbiological parameters of ship borne wastewater (total Coliform). Bilge water has the highest turbidity and COD, with turbidity of 250.0 mg/L when compare with Ballast water 160.0 mg/L and Black water 21.00 mg/L while the COD of Bilge water is 121.0 Mg/L, Ballast water 68 Mg/L and Black water 3.4 Mg/L. From the above table 1, the value of oil/Grease content of Bilge water is 72µg/L while the DPR limit value is 48 µg/L, however, the mean value of Oil/grease content of wastewater is 35.0 µg/L. Based on the findings, the researchers rejected hypothesis one and accepted hypothesis two, hence concluded that the value of oil/grease content of bilge water is significantly different from the mean DPR Limit. They also concluded that the mean value of oil/grease content of wastewater is not significantly different from the mean DPR Limit.

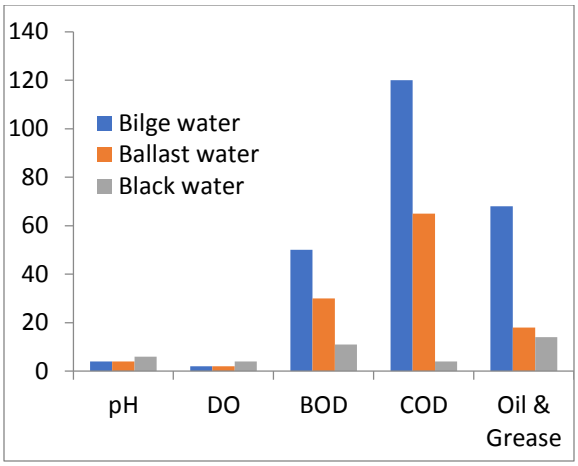

Fig 1. Distribution of chemical parameters of shipborne wastewater.

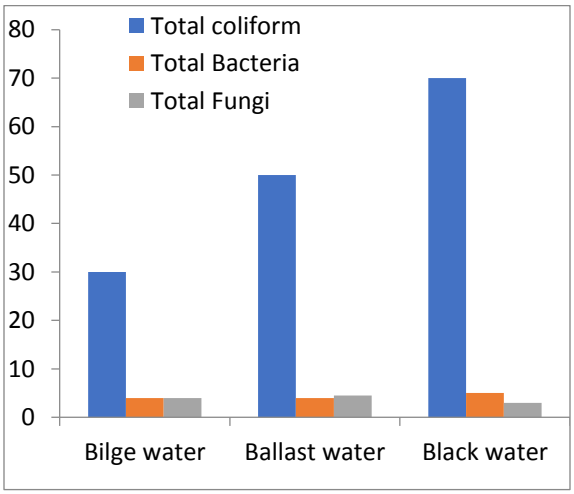

Fig 2. Distribution of the microbiological parameters of ship borne wastewater

Table 1: Oil/Grease content of Bilge water obtained from Ships Docked in Warri Port

Parameters	Unit	Bilge Water	Ballast water	Black waste	Mean	SD	DPR * Std.	Significant (Mean * > DPR Limit)
Date sampled		9/07/24	24/07/24	24/07/24				
pH	-	6.25	6.73	7.4	6.78	0.28	6.5–8.5	NO
Temperature	OC	29.50	29.75	29.75	29.75	0.36	30	NO
COD	Mg/L	121	68	5.4	65.1	40.60	40	YES
OIL/Grease	µg/L	72.0	20.1	15.90	35.67	12.5	48	NO

*Source: Results of the experiment based on fieldwork 2024 * Extracts from DPR.*

Conclusion: This study has been able to identify major biochemical and physical parameters of ballast water and bilge water in the study area. This research found out that, the mean value of oil and grease contents of the three samples is not significant or below the recommended DPR limit, that is to say that the mean oil and grease content in bilge water, ballast water and black waste is within the DPR standard. However, this study contributed that Oil and grease content of bilge water alone significantly impact on Nigeria's coastal environment. Therefore, Oil and Grease content of Bilge water obtained from Ships Docked in Warri Port, Delta State is high and appropriate measures for the disposal of ship wastewater is necessary to reduce this value especially policy implementation and enforcement

for strict compliance on bilge water disposal and adequate treatment of onboard wastewater is highly recommended.

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Data Availability Statement: Data are available upon request from the first author or corresponding author or any of the other authors

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