International Journal of Engineering Applied Sciences and Technology, 2024
Vol. 8, Issue 12, ISSN No. 2455-2143, Pages 187-196
Published Online April 2024 in IJEAST (http://www.ijeast.com)

IMPACT OF SHIPPING POLLUTION ON WATER QUALITY IN THE LAGOS SEAPORTS ENVIRONMENT, NIGERIA

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Abstract: **The aim of the study is to assess the impact of shipping pollution on water quality in the Lagos seaports environment, Nigeria. The study adopted experimental design to sample water collected from the Lagos seaports through physiochemical analysis. The results shows that TDS, chloride, nitrate, sulphate, sodium, lead, nickel, cadmium and copper were higher and at variance with water quality standard. The study suggests regular monitoring and evaluation of waste management practice by the monitoring agencies.**

Keywords: **Pollution, shipping, environment, seaport and water quality**

I. INTRODUCTION

Pollution occurs in a wide range of ways but is primarily due to introduction of contaminants to the natural ecosystem (Spellman, 2017). Marine pollution occurs due to introduction of contaminants into marine ecosystems (Vikas & Dwarakish, 2015). United Nations Convention on the Law of the Seas (1982) definesmarine pollution as the introduction by man, directly or indirectly of substances or energy into the marine environment. This result in negative effects on living resources, hazardous to human health, a hindrance to marine activities including fishing and other legitimate uses of the sea, which cause an impairment in quality for seawater uses and reduction of amenities. Marine pollution is due to human activities based on land and much less by human activity taking place at sea (GESAMP, 2017). A significant number of marine pollution was due toshipping and its activities. US legal (2016) indicated that oil is the most important pollutant stemming from shipping and its activities. Some parts of the globe experience oil spillage back to the discovery of crude oil in various parts of the world. Human factors result in oil spillage that affects various water bodies (rivers, oceans and seas). This phenomenon has been one of the major sources to environmental degradation for coastal regions.

Practical reasons triggered the distinctions between ship generated waste and cargo residues. Cargo residue comes from a vast of cargoes e.g. hazardous chemicals. Some residues remain the property of the cargo owners. Others require specialised facilities for collection, storage and treatment (Europeans Maritime Safety Agency, 2010).Ship wastes Article 2(3) of the directive (EU) 2019/883 explicitly employs the terminology of "waste from ships" concerning operational residues generated in machinery spaces, cargo and living spaces of ships, "which falls within the scope of annexes I, II, IV, V, & VI of MARPOL". As such, it is common practice for ship operators to contract private waste management operators with little or no involvement of port authorities. In fact, port authorities in Europe generally consider that cargo residues are somehow outside their responsibilities, placing accountability on the ship operators and individual terminals (EMSA, 2010; Ramboll, 2012).

Some of the pollution caused by ship arises due to routine operation of ships (Tutuncu, 2004). Pollution occurs through discharged by ships into the sea while sailing, such as cargo residues, ballast, sewage and garbage, which do not comply with international rules on waste management

(Fitoz, 2009; Cerik, 2004). Shipping pollution is responsible for different pressures affecting the port environment, air quality and human welfare. To ensure the sustainable use of marine resources, there is need to understand what unintended impacts these activities have on ecosystems and human health. Oneof the significant sectors is shipping, which has affected the marine environment in many different ways through discharges of contaminants as grey water (Yteberg, 2020) sewage (AADEC, 2018) bilge water (Tiselius & Magnusson, 2017) scrubber water (Koski, Stedmon & Trapp, 2017) and antifouling paints (Thomas & Brooks, 2010).

II. STATEMENT OF THE RESEARCH PROBLEMS

The growing concern about pollution centres on the potential for shipping business to negatively impact the ports environment, and the related biodiversity within the maritime fields (Helen et al., 2016). Shipping pollution causes acidification and eutrophication to the ports environment by forming poisonous compounds that cause lung infiltration, blood poisoning, heart failure and consequently, premature death (Cullinane & Bargqvist, 2014).

A survey conducted at the Baltic Sea area concerning collection of cargo residues shows that 52% of waste handled atports were by external management operators (Arguello, 2019). Article 6 of Directive 2000/59/EC, obliges shipmasters to notify in advance of the number of ship wastes and cargo residues to port waste reception facilities or kept on-board before entering European Union ports. Such information must be available to the relevant authorities.Despite the obligation, communication between the port authorities and the individual terminals regarding cargo residues are limited (Pantera & PWC, 2015). In the Baltic Sea area for instance, 45% of ports information concerning cargo residues "actually delivered" are not available because port authorities are not engaged in the collection of this waste and do not file or handle this data (Arguello, 2019). This had a negative impact on the implementation andenforcement of Directive 2000/59/EC. If the relevant authorities have little or no knowledge of cargo residues, it is not possible for them to assess whether ships are complying with their discharge obligations as provided in Articles 10 and 11 of Directives 2000/59/EC. Lack of information also hinders compliance with obligations set out in the waste Framework Directives, which include an obligation to ensure the traceability of hazardous waste. Overall, control, monitoring of waste reception facilities and management of cargo residues at ports are weak.

The distinction between ship-generated waste and cargo residues has generated complications for port users. Shipmasters find difficulties in assessing the different categories of waste according to MARPOL Annex and Directive 2000/59/EC. Research carried out by T and Eorganization (2017) shows a single carnival proportion of pollution. Its cruisers' ships emitted ten times more surplus oxide (SO) than 260 million automotive vehicles in the European Union. Emissions from 100 million cars equal emissions from 47 cruise ships (IMO, 2009). Shipping emitted 1046 million tons of CO_2 in 2007, which corresponds to 3.3% of the global emissions, contributing to climate change and ocean acidification (IMO, 2009)Emissions in the port environment from shipping pose harmful health effects to the people living along the port's locations and thus, ought not to be ignored nor undermined (Jiang, 2014). Shipping pollution control inseaports of developing countries is marred with lack of administrative control and inadequate provision of waste reception facilities. Apart from the seaport's authority, other government agencies are also involved in pollution monitoring and control.Lack of adequate waste reception facilities in developing countries' ports is such that vessels have no choice but to discharge waste at sea. However, some vessel operators prefer to dump waste at sea, where there is low risk rather than use the provided facilities and thus pay the required user fees (Anstey, 2017).

III. OBJECTIVE OF THE STUDY

The specific objective of the study is to assess the impact of shipping pollution on water quality at Lagos seaports.

IV. LITERATURE REVIEW

4.1 Conceptual Review

Rapid growth of international trade goes back to the early 1960s when economic growth and technological advance goods became rapidly available from all over the world. World trade volume today is roughly 4000% the volume of 1960s (WTO, 2022). Recent estimates foresee a demand growth of almost 40% for seaborne trade by 2050 (Serra & Fran cello, 2020). While marine transport enables mass movement of goods, it comes with high costs of shipping pollution of water and air. Pollution is the process of making natural environment unsafe for use.As people live on ships, a certain quantity of "grey water" (polluted sewage water) is being produced in the kitchen and the showers, part of that goes overboard to the high seas. The oceans are able to deal with the raw sewage through natural bacterial action. On the other hand, the regulations in Annex IV of MARPOL prohibit discharging sewage water within a certain distance of the nearest land, unless the ship is equipped with a certified installation. One specific compartment designed to capture all the water that does not drain off over the side of the deck is the bilge, the compartment directly above the keel. This water may be from rough seas, rain, minor leaks in the hull or interior spillage. Bilge water are on aboard in almost every vessel depending on the ship's design and the functions. Bilge water may contain water oil, urine, detergents, solvents, chemicals, pitch, particles and other minerals. Cleaning out bilge tank is therefore bound to release a quantity of pollutants. Customarily, there is a distinction between engine bilge and all other forms of bilge water. International Maritime Organization has imposed a number of strict rules to limit the impact of shipping sector on the marine environment. In this case, no water exceeding 15parts per million (ppm) of oil can be discharges overboard (MARPOL Annex I)

The risk of biological contamination is trickier to contend. Ballast water is bound to contain a number of microscopic life forms such as algae and larval forms of invertebrates that belong to a specific region ship resides. When ballast water is pump out even after a few weeks, organisms may end up thousands of kilometres away from the region they belong. There are organisms that attach themselves to the ship's hull in a process called, bio-fouling. Calcareous fouling organisms include barnacles, bryozoans, mollusks, polychaetas and tubeworms. Examples of non-calcareous (soft) fouling organisms are seaweed, hydroids, algae and bacterial bio-films. These organisms form fouling communities on all kinds of maritime objects (Ismail, 2015).Ninety percent of the world trade is transport by sea, thereby making ships potential sources of biological risk for transportation of invasive species (FAO, 2007).

Ships can carry different elements of risk ranging from food used by the crew or passengers to the cargo transported containers. The treats are into different areas such as health care, waste treatment, invasive species and ship stores. Each of these possible threats represents a high risk for people's health, the economy and the environment. According to FAO (2007), ship stores relate to the storage and use of food products for the crew or the passengers. Customs or other sanitary authorities do not control products such as uncooked meat, vegetable or fruit, which can result to pests or diseases.Non-native marine organisms (plants, animals and diseases) are one of the greatest threats to biochemistry and health of the world's ocean eco-systems. This phenomenon is continuously growing and unlike oil spills, instead of decreasing over the years, it has been increasing (Raaymakers, 2002). Ships play an essential role in transporting non-native marine organisms through ballast water from the ships, which contain sediments with millions of small living organisms and bio – fouling, whether attached to the external surface of the vessels or within its local seawater system. According to Molnar (2008), 39% species are introduce by bio- fouling and 30% by ballast water (Department of Fisheries, 2009).Marine biological fouling is the accumulation of undesirable marine organisms such as plants or animals on the surface of seawater (Yebra, kill & Dam-Johansen, 2004). One of the effects of marine fouling on ship is an increase of frictional resistance, which leads to reduction of ship's speed. This will result to increase in the weight of the ship and will require more fuel consumption, which in turn generates contaminants to marine environment (Abbott et al. 2000).

Shipping operations and their associated activities present potential environmental impacts. Such impacts include physical changes to bottom substrate and habitats from sources such as anchoring, mooring and vessel groundings, alterations to the physiochemical properties of the water column and aquatic biota through application of antifouling paints, operational and accidental discharges (ballast and bilge water, hydrocarbons, garbage and sewage), fauna collisions and various other disturbances. Shipping activities affect physical habitat and vegetation destruction, anchor damage, vessel groundings, wash and fauna behaviour modification (e.g. negatively impacting aquatic mammals, roosting birds and fish) from vessel noise emissions and movement (La Manna et al., 2016; Maxwell & Zolderdo, 2018; Marley & Kent, 2017). Sources of sewage from ships include occupants defecating or urinating directly into the water body, discharges from on-board holding tanks or sewage treatment systems (Leon &Warnken, 2008; Byrnes, 2008).Shipping operation also act as a source of trace metals into receiving aquatic environments through pathways such as ballast water discharge, corrosion and use of sacrificial anodes, mechanical abrasion and engine exhaust (Moldanova & Fridell, 2009; Rousseau & Baraud, 2009; Dobaradaran, Soleimani & Nabipour, 2018). The variable array and persistence of such sources ensures potential metal accumulation in the sediments of lakes, estuaries and coastal waters, most particularly in the high traffic and density setting within the protected water.

Biological impacts arising from vessel operations is the introduction and secondary spread of alien (non-native) species into receiving aquatic biomass. Vessel operations and onshore associated infrastructure alter water column, height conditions and potentially affect the system condition. Shipping acting as vectors for alien (non-indigenous) species, pose significant environmental and economic threats to freshwater, estuarine and marine systems (Burgin &Hardiman, 2011; Simard & Clarke, 2017) (Simberloff, 2013). The introduction and spread of alien species beyond their native range is an environmental impact issue worldwide. Relocation of such species may include fouling on hulls of recreational vessels, foreign sourced, ballast water, internal water systems, vessel ropes, chains, vessel cavities and sediments (Bax& Mathews-Amos, 2001; Hewitt & Campbell, 2004; Hewitt & Gllaschi, 2009; Coutts, 2003). Shipping and associated marina and infrastructure contribute to artificial light pollution altering natural colours, cycles and intensities of night and light(Merkel & Johansen, 2011; Kamrowski & Limpus, 2012).

According to National Standard for Drinking Water Quality (2007), water quality is a measure of suitability of water for a particular use based on selected physical, chemical and biological characteristics. It describes the condition of the water including chemical, physical and biological characteristics, usually with respect to its suitability for a particular purpose such as drinking or swimming and the factors of measurements. Poor water quality can pose a health risk for people and ecosystems, while good water quality is essential to healthy marine ecosystems.High levels of turbidity can occur due to higher concentrations of silt, clay and organic materials. Suspended materials may damage fish gills, reduce growth rates and decrease resistance to diseases. Temperature is another aspect of water quality, which include odours, chemical reactions, solubility, palatability and viscosity. The ideal water temperature ranges from 50-60 degrees Fahrenheit. Colour is effectively measure by comparing a water sample to colour glass disks or standard colour solutions. The true colour of water is identify after all suspended materials are filter out of the water. Colour is on a scale that ranges from 0-70 colour units. Pure water contains no colour units, because it is essentially colourless.

Taste of water can change and odours can develop due to foreign items being introduce to the water. The items may contain organic materials, dissolved gases and inorganic compounds. Fresh water is less than 1,500mg/L TDS. Brackish water is 1,500-5,000mg/L TDS, while Saline water is more than 5,000mg/L TDS.Conductivity is another physical parameter use to measure water quality. Conductivity levels will increase as the ions in the water increases. High conductivity means high contaminants in the water. On the other hand, potable water and ultra-pure water are practically unable to conduct an electrical current.pH sensor or test kit is used to measure acidic or basic water quality. Acidic water contains more hydrogen ions, while basic water contains more hydroxyl ions.pH reading ranges from 0-14. Reading at 7.0 means the water is neutral. Readings below 7.0 means the water is acidic, while reading above 7.0 means the water is alkaline. Pure water has a neutral pH. Water is safe for drinking with pH of 6.5-8.5.

4.2Empirical Review

Onwueguchuan et al. (2017) titled "Analysis of Ship-Source Marine Pollution on the Nigeria's seaports resonates with the impact assessment of shipping pollution on water quality in the Lagos seaports environment, Nigeria. The reviewed work determined the significance of physiochemical and microbiological parameters of ship generated waste water from vessels berthed at ports, compared the values of parameters with the Nigeria's Department of Petroleum Resources (DPR) and examined the significant effects of the parameters (by the type of waste water on the marine environment). The samples were bilge water, ballast water and black water. These samples were collected with sterile 75CM screwed top plastic bottles, stored in a temperature of 4^0C in order to avoid staleness of samples. Pollution indicator parameters were determined within the six hours of sample collection.Physical, chemical and microbiological analyses were conducted on 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 heterotrophic bacteria and total heterotrophic fungi. The study also determined the physiochemical and the microbiological parameters. Data collection adopted sampling method. Water samples from marine cargo vessels at berths were physiochemical and microbiological analyses according to the American Public Health Association (APHA) method of determining the level of concentration of identified parameters.

Findings from the laboratory analyses indicated that there was pollution in the Nigeria's seaports environment. This occurred despite the pollution control and the legislation enforcement framework currently in place at ports. A number of inferences were evident from the findings. It was possible that the pollution control contractors in place were unmonitored for effective service delivery. Considering the multiplicity of pollution regulatory parameters, effective monitoring might be lacking since there was overlapping functions of supervising authorities. The study developed use of an integrative model that combined a legislative framework of input from continuous scientific analysis based on the scientific evidence from laboratory analyses to monitor the performance of its contractors. The model assesses the effectiveness of marine pollution control measures in the port sector. The physiochemical and the microbiological analyses of ship at berth did not reflect the true effects of marine pollution since wastes generated by ships were usually discharge at a distance to their places of berth according to the standard practice recognized by IMO.

V. METHODOLOGY

5.1 Research Design

This study adopted experimental design to sample water collected at Lagos seaports and the findings were comparedwith water quality standard that was obtained through ex-post facto design.

5.2 Study Area

The study area comprises Apapaport, the oldest and the biggest port in Nigeria and Tin Can Island port. Both of them are located at close proximity within the commercial hub of the city of Lagos, Nigeria. Apapaport also known as Lagos port established in 1913, located in Apapa Local Government Area of broad western branch, off the main channel of the harbour on latitude 6.45528°north and on longitude 3.364084° east. Tin Can Island port is located on latitude 6.435316° north and longitude 3.334329° east and located at a close proximity to Apapa port in Apapa Local Government Area of Lagos State, Nigeria.

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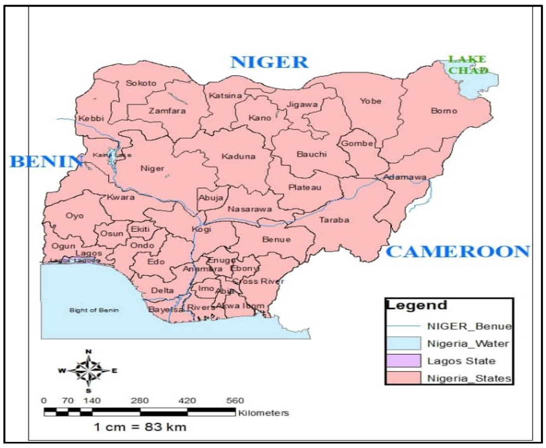

Figure 3.1: Map of Nigeria showing Lagos State
Source: Warnock-Smith et al. (2016)

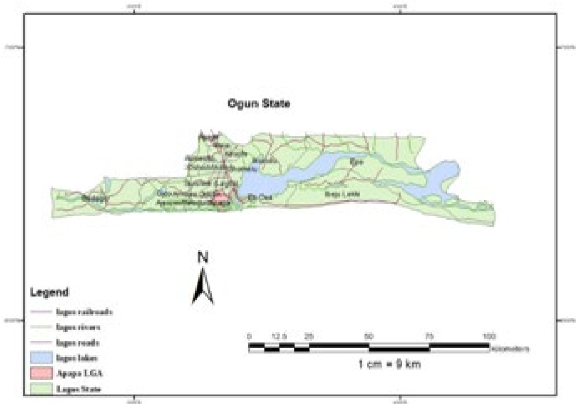

Figure 3.2: Map of Lagos State showing Apapa Local Government Area
Source: Mapbox (2023)

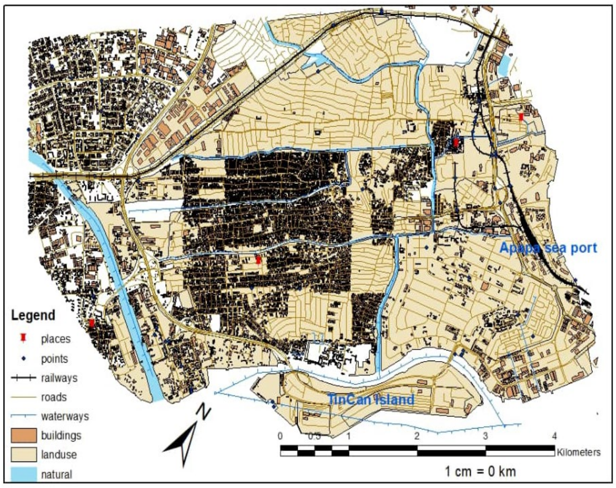

Figure 3.3: Map showing the study area, (Apapa and Tin Can Ports, Lagos)
Source: Mapbox (2023)

5.3 Types and Sources of Data Collection

Primary data were sourced from water sample at Lagos seaports and the findings were compared with water quality standard that was obtained as secondary data from literature review with a view to assessing the impact of shipping pollution on water quality in the Lagos seaports environment, Nigeria.

5.4 Sampling Techniques

A litre of sterilized container of water samplewas collected from each of the Apapa and Tin Can Island seaports for physiochemical analysis. The variables tested were nitrate at 0.5 ml of samples, and pipetted into test tubes 1 ml of 5% salicylic acid solution to each test tube and mixed. After 30 minutes, 10 ml of 4M NoaH solution was added for one hour for colour development. Phosphate at12 g ammonium molybdate in 250 ml distilled water dissolved and 0.2908 g of antimony potassium tartrate weighed and dissolved in 100 ml distilled water. The two reagents mixed thoroughly, made up to 1000 ml of 2.5M H_2S0_4 and finally made up to 2 litres, stored in Pyrex glass in dark room compartment. Sulphate at25 ml of water samples pipetted into 50 ml standard flasks followed by 20 ml of distilled water, 2 ml gelatine $BaCl_2$ solution and made up to 50 ml mark for solutions to come up in 30 minutes. The absorbance of the standard solution and samples read from spectrophotometer at 420 nm. Chloride at50 ml of water sample pipetted into 250 ml conical flask. 1 ml of potassium chromate indicator was titrated with silver nitrate solution until a permanent brick red precipitate persisted. A clean dropper of water sample was used to drop water on pH paper and the observed change in the colour of the pH paper was compared with the colour shades on the standard pH chart

5.5 Methods of Data Collection.

Experimental design was used to assess the impact of shipping pollution on water quality in the Lagos seaports environment, Nigeria and the findings were compared with water quality standard.

5.6 Methods of Data Analysis

Physiochemical analysis, mean analysis, deviation and literature review were adopted to assess the impact of shipping pollution on water quality in the Lagos seaports environment, Nigeria.

VI. RESULTS AND DISCUSSION

Table 1: pH values for TIN CAN ISLAND and APAPA were within the acceptable range, indicating that the water samples met the pH standards according to (NSDWQ, 2007). Observed mean TDS value (5577.50 mg/L) exceeded the acceptable limit of 500 mg/L for water quality standards observed in TINCAN ISLAND and APAPA. Observed mean Chloride value (106160.84 mg/L) significantly above the acceptable limit of 250 mg/L in TIN CAN ISLAND and

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APAPA. These deviations indicate that TDS and Chloride levels in the water samples in TIN CAN ISLAND and APAPA were significantly above the recommended limits, suggesting potential water quality issues with regard to these parameters.

Elevated TDS levels can affect water quality and the health of aquatic organisms. It can affect the osmoregulation in fish and other aquatic species, potentially leading to stress or harm. High TDS levels can affect the taste, odour and overall palatability of water, making it less desirable for consumption. In case of TIN CAN ISLAND and APAPA, TDS samples levels significantly exceeded the recommended limit, indicating a potential concern for water quality and ecosystems health.High chloride levels in TIN CAN ISLAND and APAPA samples can have adverse effects on the environment and human health. Elevated chloride concentrations can be toxic to freshwater organisms, particularly sensitive species like amphibians and invertebrates. Excessive chloride in water can contribute to the corrosion of infrastructure and affect the quality of drinking water. The levels recorded in APAPA and TIN CAN ISLAND far exceeded the recommended limit.

Parameters such as pH, conductivity, temperature, alkalinity and hardness, the results were within the acceptable range according to water quality standards. pH values in TIN CAN ISLAND and APAPA samples were within the recommended range, indicating neutrality to alkaline conditions. Conductivity values reflect the overall salinity or ion concentration in the water. It was within the acceptable limits. Temperature, alkalinity and hardness values were within the acceptable range. The findings suggest that some parameters met the water quality standards. There were concerns regarding TDS and chloride levels in TIN CAN ISLAND and APAPA. These elevated levels can have detrimental effects on ecosystem health, water quality and potentially human health.

Table 1: Laboratory results of pH, Conductivity, Temperature, Alkalinity, TDS, Chloride and Hardness

Sample	pH	Conductivity Nscm	Temperature ^{O}C	Alkalinity mg/L	TDS mg/L	Chloride mg/L	Hardness mg/L
TINCAN	7.10	6304.00	25.50	160.00	3050.00	881.91	1184.40
ISLAND	7.10	6311.00	25.50	163.00	3055.00	889.42	1184.40
APAPA	7.77	16630.00	25.60	200.00	8105.00	211439.77	3360.00
	7.77	16700.00	25.60	200.00	8110.00	220183.62	3360.09

Source: Water Sample from TINCAN ISLAND and APAPA Seaports (2023)

TINCAN ISLAND
pH: 7.10
TDS: 3050.00 mg/L
Chloride: 881.91 mg/L

APAPA
pH: 7.77
TDS: 8105.00 mg/L
Chloride: 211439.77 mg/L

The observed mean for pH, TDS and Chloride:
pH observed mean
(pH TINCAN ISLAND + pH APAPA) / 2
= (7.10 + 7.77) / 2
= 7.435

TDS observed mean
(TDS TINCAN ISLAND + TDS APAPA) / 2
= (3050.00 + 8105.00) / 2
= 5577.50 mg/L

Chloride observed mean
(Chloride TINCAN ISLAND + Chloride APAPA) / 2
= (881.91 + 211439.77) / 2
= 106160.84 mg/L

The deviations from the acceptable limits for pH, TDS and Chloride:
pH Limit (acceptable)
= 7.5
Deviation for pH TINCAN ISLAND: Within acceptable range (7.10)
Deviation for pH APAPA: Within acceptable range (7.17)
TDS Limit (acceptable)
= 500 mg/L
Deviation for TDS TINCAN ISLAND: 3050.00 - 500 = 2550.00 mg/L
Deviation for TDS APAPA: 8105.00 - 500 = 7605.00 mg/L
Chloride Limit (acceptable)
= 250 mg/L
Deviation for Chloride TINCAN ISLAND: 881.91 - 250 = 631.91 mg/L
Deviation for Chloride APAPA: 211439.77 - 250 = 211189.77 mg/L

Table 2: Nitrate levels were significantly above the acceptable limit in both locations. Nitrate pollution can lead to adverse health effects, particularly in infants. Nitrate contamination in water can primarily occur due to agricultural runoff, wastewater discharges and industrial activities. Elevated nitrate levels pose a risk to human health, especially for infants and pregnant women. High nitrate concentrations can lead to methemoglobinemia, also known as "blue baby syndrome." Moreover, excessive nitrate in water bodies can contribute to eutrophication, leading to algal blooms, oxygen depletion and disruption of aquatic ecosystems.High levels of nitrate in water bodies can have significant implications for both human health and the marine environment. In addition to the risk of methemoglobinemia, excessive nitrate concentrations can also lead to the growth of harmful algal blooms. These blooms can deplete oxygen levels in the water, leading to hypoxia and the death of aquatic organisms. Increase nutrient from high nitrate levels can disturb the balance of the ecosystem, favouring the growth of certain species over others and disrupt the natural food chain.

High sulphate concentrations can cause a laxative effect in humans.Tin Can Island was within the acceptable limit for sulphate (400 mg/L), Apapa exceeded this limit with a value of 800 mg/L. High sulphate concentrations can have adverse effects on the taste and odour of water. It can also contribute to the corrosion of pipelines and increase the salinity, which negatively affects freshwater organisms. Excessive sulphate levels in water can cause gastrointestinal issues and be particularly problematic for individuals with sulphate sensitivity. Sulphate contamination, particularly in Apapa raises concerns about the overall water quality. Apart from affecting the taste and odour of water, high sulphate concentrations can contribute to the corrosion of infrastructure and pipelines, leading to potential leaks and contamination. Increased salinity resulting from high sulphate levels can have adverse effects on freshwater organisms, particularly those adapted to lower salinity environments. This can disrupt the aquatic ecosystem's stability and biodiversity

Sodium levels exceeded the limit in both locations. High levels of sodium in drinking water can be harmful, especially to individuals on low-sodium diets.Tin Can Island and Apapa exceeded the recommended limit of 100 mg/L for sodium content. High levels of sodium in drinking water can have negative impacts on individuals with hypertension or cardiovascular diseases. Consuming water with elevated sodium concentrations may lead to increase blood pressure, putting people with these conditions at greater risk.Excessive sodium in drinking water as observed in both locations can pose health risks, especially for individuals with specific medical conditions. High sodium intake can contribute to increase blood pressure, which in turn can elevate the risk of heart disease and stroke. It is important for individuals with hypertension or cardiovascular issues to monitor their sodium intake and consider alternative sources of water that have lower sodium content.

Since there were no maximum limits for phosphate, carbonate, calcium, magnesium and potassiumby NSDWQ (2007), it is essential to monitor them for any potential health or environmental concerns. Excessive levels of these substances in water can contribute to the eutrophication process, alter water pH and potentially disrupt the balance of the ecosystem by providing abundant nutrients to aquatic organisms.Their presence at elevated levels in water can have impacts on ecosystems. These substances can contribute to nutrient loading, promote the growth of algae and aquatic plants and potentially disrupt the balance of the ecosystems. High levels of calcium and magnesium for example can result in hard water, which can create scale build up in pipes and reduce the efficiency of water treatment processes.

In summary, the data suggests potential concerns regarding the water quality, ecosystem, health and marine environment in Tin Can Island and Apapa ports due to elevated levels of nitrate, sulphate, sodium and other substances.

Table.2: Laboratory Results of Nitrate, Sulphate, Phosphate, and Carbonate.

Sample	Nitrate mg/L	Sulphate mg/L	Phosphate mg/L	Carbonate mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L
TIN CAN ISLAND	392.25	480.00	ND	24.00	1024.08	150.20	107.00	78.08
	391.35	475.80		24.00	1030.10	149.30	105.00	80.14
APAPA	800.00	2266.60	ND	32.00	3023.00	336.67	311.00	80.90
	800.00	2271.30		32.00	3030.00	340.09	311.00	88.20

Source: Water Sample from TIN CAN ISLAND and APAPA SEAPORTS (2023)

Observed Mean Calculation:
For Tin Can Island and Apapa, we calculate the mean as follows:

TIN CAN ISLAND
Nitrate: (392.25 + 391.35) / 2 = 391.80 mg/l
Sulphate: 391.35 mg/l

Sodium: 105.00 mg/l
APAPA
Nitrate: 800.00 mg/l
Sulphate: 800.00 mg/l
Sodium: 311.00 mg/l
Deviations from Acceptable Limits:
Nitrate:
TIN CAN ISLAND: 391.80 - 50 = 341.80 mg/l over the limit
APAPA: 800.00 - 50 = 750.00 mg/l over the limit
Sulphate:
TIN CAN ISLAND: 391.35 - 400 = -8.65 mg/l within the limit
APAPA: 800.00 - 400 = 400.00 mg/l over the limit
Sodium:
TIN CAN ISLAND: 105.00 - 100 = 5.00 mg/l over the limit
APAPA: 311.00 - 100 = 211.00 mg/l over the limit

Table 3**:** The water sample from TIN CAN ISLAND had higher levels of lead, nickel, cadmium and copper than the acceptable limits, indicating potential contamination issues.The water sample from APAPA also exceeded the limits for lead, nickel, cadmium and copper. The presence of elevated levels of lead, nickel, cadmium and copper in water samples from Tin Can Island and Apapa indicates poor water quality in these areas. These metals can have detrimental effects on aquatic life and human health. Exceeding the maximum limits suggest that the water is contaminated and unsuitable for consumption or use.High concentrations of metals like lead, nickel, cadmium and copper can have adverse effects on the surrounding ecosystems. Aquatic organisms such as fish, invertebrates and plant life can be highly sensitive to these metals. They can accumulate in the tissues of organisms, causing chronic exposure and bioaccumulation in the food chain. It can disrupt the balance of the ecosystems and lead to reduced biodiversity.
The presence of excessive lead, nickel, cadmium and copper in the water samples raises concerns for human health. Drinking water contaminated with these metals can lead to various health issues. Lead exposure, especially in children can impair cognitive development and cause neurological disorders. Nickel, cadmium and copper can also have toxic effects on different body systems and organs, including the kidneys, liver and respiratory system. Long-term exposure to these metals may increase the risk of chronic illnesses.Discharging water with high metal concentrations into marine ecosystems can harm marine life including fish, shellfish and other organisms. These metals can bio-accumulate in marine organisms, leading to toxicity and potentially entering the human food chain through seafood consumption.

TABLE 3: Laboratory Results of Lead, Iron, Zinc, Nickel, Cadmium and Copper

Sample	Pb mg/L	Fe mg/L	Zn mg/L	Ni mg/L	Cd mg/L	Cu mg/L
TIN CAN ISLAND	0.04 0.04	3.09 3.04	7.14 7.20	0.00 0.00	0.01 0.02	0.02 0.02
APAPA	0.02 0.03	1.00 0.91	12.88 13.04	0.01 0.00	0.00 0.01	0.04 0.03

Source: Water Sample from TIN CAN ISLAND and APAPA SEAPORTS (2023)

The observed mean and deviations from the acceptable limits for each metal in the
water sample of TINCAN ISLAND and APAPA:
TINCAN ISLAND
Observed Mean:
Lead (Pb): (0.04 + 0.02) / 2 = 0.03 mg/L
Iron (Fe): (0.04 + 0.03) / 2 = 0.035 mg/L
Zinc (Zn): (3.09 + 1.00) / 2 = 2.045 mg/L
Nickel (Ni): (3.04 + 0.91) / 2 = 1.975 mg/L
Cadmium (Cd): (7.14 + 12.88) / 2 = 10.01 mg/L
Copper (Cu): (0.00 + 0.01) / 2 = 0.005 mg/L
Deviations from Acceptable Limits:
Pb: Deviation = 0.03 - 0.01 = 0.02 mg/L above limit
Fe: Deviation = 0.035 - 0.3 = 0.265 mg/L below limit
Zn: Deviation = 2.045 - 5 = 2.955 mg/L below limit
Ni: Deviation = 1.975 - 0.07 = 1.905 mg/L above limit
Cd: Deviation = 10.01 - 0.003 = 10.007 mg/L above limit
Cu: Deviation = 0.005 - 1 = 0.995 mg/L below limit
APAPA
Observed Mean:
Pb: 0.02 mg/L
Fe: 0.03 mg/L
Zn: 0.955 mg/L
Ni: 1.97 mg/L
Cd: 12.96 mg/L
Cu: 0.02 mg/L
Deviations from Acceptable Limits:
Pb: Deviation = 0.02 - 0.01 = 0.01 mg/L above limit
Fe: Deviation = 0.03 - 0.3 = 0.27 mg/L below limit
Zn: Deviation = 0.955 - 5 = 4.045 mg/L below limit
Ni: Deviation = 1.97 - 0.07 = 1.9 mg/L above limit
Cd: Deviation = 12.96 - 0.003 = 12.957 mg/L above limit

Cu: Deviation = 0.02 - 1 = 0.98 mg/L below limit

VII. SUMMARY OF THE FINDINGS

Assessing the impact of shipping pollution oil on water quality at Lagos seaports, physiochemical parameters were used to analyse water sample collected at Lagos seaports. The findings indicates that TDS, chloride, nitrate, sulphate, sodium, lead, nickel, cadmium and copper were higher and at variance with water quality standard in the Lagos seaports environment. This implies poor water quality in the Lagos seaports environment, Nigeria.

VIII. CONCLUSION

Industrial waste and run off water from close proximity may contribute significantly to variance in water quality standard at Lagos seaports environment. There is need for the monitoring agencies to carry out assessment of environmental impact on Lagos seaports environment, Nigeria.

IX. RECOMMENDATIONS

Regular monitoring and evaluation of waste management practices and their impact on water quality, ecosystems and public health in the Lagos seaports are essential by monitoring agencies. Data collection and analysis can provide valuable insights into the effectiveness of implemented measures and identify areas for improvement. Monitoring can help track changes in waste generation patterns, identify pollution hotspots and assess the success of interventions over time.

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