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Industrial effluents as major source of water pollution in Nigeria: An overview

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Abstract

Water pollution crises from introduction of foreign materials capable of deteriorating water into a water body, hence positing negative effect on aquatic lies and human health. Industrial effluents account for several point sources of water pollution. While developed nations adopt stringent water quality requirement to control river pollution from point and non-point sources, the situation is different in most developing countries like Nigeria. waste water treatment in Nigeria is not given the necessary priority it deserves and therefore, industrial waste are discharged into receiving water bodies without treatment and the consequences of which include among others, river pollution, loss of aquatic life uptake of polluted water by plants, diseases burden and shorter life expectancy in developing countries. The present review intends to investigates the level of water pollution caused by level of water pollution caused by industrial effluents from tanneries textiles, palmoil mill, brewere and soft drink in Nigeria with a view to provide useful information to the researchers on current research status authorities concern on the management, control and investigation of pollution cases, water quality surveillance and forecasting water quality.

Keywords

Industrial Effluents Pollution, Water Quality

1. Introduction

Nigeria is the most populous country in Africa with a population of over 160 million people, the country is endowed with generous resources of water bodies the span of water bodies with country is estimated at 900km^2. This water provides resources for fishery, transportation, irrigation, recreation and domestic use (Ekige *et al,* 2010). Different regulations put in place to protect the marine environment and other water bodies in Nigeria have not been effective in controlling the indiscriminate dumping of effluent into open water bodies. These dumping of effluents ranges from chlorides, phosphate, oil and grease, nitrates heavy metals among others a(Ekiye et al, 2010). The level of these effluents have been found to be in concentration above acceptable and permissible level (Olayinka and Alo 2004; Esoka and Umaru, 2006; Emiola *et al* 2010).

Industries are the major sources of pollution and various level of pollutant can be discharge in to the environment either directly or indirectly (Glyn and Gary, 1996). However, discharged effluents from industries have been other chemicals equally present are poisonous to human and toxic to aquatic life.

(Kupechella and Hyland, 1989; WHO, 2002). Effluents from industries were found to alter the physical, chemical and biological nature of receiving water bodies (Kanu *et al,* 2011).

Yusuf and Sonibare (2004), reported that effluent from Kaduna textile industries contains oil and grease, ammonia, sulphide and colour which are considered pollution sources; and colour which are potential pollution sources; they concluded that air quality of the area covered by the entire Kaduna river basin could be negatively affected by both the gaseous emissions and particulates which could be released from the effluents. However, deterioration of water quality

due to industrial effluent and municipal sewage discharge has been documented in literatures. The contermination of Cauvery River in India by heavy metals (lead (Pb), Chromium (Cr), Zinc (Zn), was reported and it was attributed to agricultural, industrial and anthropogenic activities around the river (Begum et al, 2009). High level of mercury (Hg) was found in amphibians, invertebrates and reptiles which revealed a strong influence from industrial effluent (Hsua et al, 2006). The characteristic qualities of five textile industries effluent in Kaduna (Nigeria) was analysed and high level of chemical oxygen demand (COD), Total supended solids (TSS), ammonia (NH_3), Biological oxygen demand (BOD) and sulphide (S^{2-}) that exceeded the federal environmental protection agency (FEPA) limit by several fold was reported (Yusuf nd Sonibare, 2004). The characteristics of selected effluents from industries in Ikeja, Lagos (Nigeria), were analysed and it was reported that the concentration of effluent discharge is on the limit (Sangadoyin. 1995). High levels of blood lead was reported due to exposure to the environemental pollutant which can get into the human body through various sources (Orisikwe, 2009).

However, characteristics of pollutants in effluent from five tannery industries in Kano metropolis in Kano state (Nigeria) were analysed and it was reported that effluent significantly chromium concentration varied between 1.02±0.13 to 1.56 ±0.06 mgL^{-1} which are above the limit set by world health organization (WHO) and FEPA of $1.0mgL^{-1}$. Hafawa enterprise Tannery unique leather finishing had significantly high lead concentrations, while great Northern Tannary limited were found to be a potential source of iron contamination (Akan *et al,* 2007). Another study conducted by Akan *et al,* 2009, analysed effluent samples from tanneries and textiles industries from Kano industrial areas of Chalawa, Bompai and Sharada industril are and reported that the physicochemical parameters (BOD, COD, DO) anions, trace elements and heavy metals were higher than the limit set by WHO for the discharge of tanneries an textile effluents into river they concluded that based on the high levels of the above parameters/effluents, regular monitory of pollutant in the tannery and textile effluents are necessary to ensure proper discharge of these effluents into receiving rivers (Salanta, Chalawa and Bompai). A study on water quality of Ogun River (Nigeria) in chihc industrial effluents from Lagos and Abaekuta are discharged was conducted and it was reported that the level of turbidity, oil and grease, faecal coliform and iron were very high in l the sampling siles (Jaji *et al,* 2007).

Although finding related to industrial pollution water resources have been disturbing, the category of pollution that has received much altention in Nigeria is sewage pollution of portable drinking water (Ekiye et al, 2010). This has been managed with the weight of such bodies as UNICEP established in 1952 an water aid which began work in Nigeria in 1995 to assist with the vast water and sanitation needs found and has since been assisting the water and satitation units (WASU) of Local Government Councils to deliver water ans sanitation services to the poor. However, about 60 percent of the Nigerian populace both rural and some urban dwellers still source for domestic water and sometimes drinking water from ponds, streams and shallow wells justifying the concern for increases in he level of pollutants in bothe surface and ground water whose sources could be traced o industrial effluents and domestic sewage, thus making water pollution monitoring more vital (Adelegan, 2004).

Presently, very little if any has been done on an integrated level concerning industrial pollution abatement in Nigerian waters (Egbu, 2004; Olayanka and Alo, 2004; Essoka and Umaru, 2006; Eyiye *et al*, 2010). The Federal Government of Nigeria from tannneriies, textiles, palm oil milks, brewery and softdrinks industry researchers on current research status and only gave attention to environmental abuse after the discovery of an Italian ship dumping toxic waste in Nigeria in may 1998, giving rise to the establishment of the "Federal Environmental Protection Agency "(FEPA) later that year. The establishment of FEPA was also followed by the publication of "National guidelines and standards for Environmental Polltion" which focused mainly on industrial pollution. This body was rename in September, 1999 and 15 presently Federal Ministry of environment. The present review intends to investigate the level of water pollution caused by industrial effluents: Nigeria with a view to provide useful information to the authorities concern on the management, control and investigation of pollution cases, water quality surveillance and forecasting water quality.

2. Water Bodies as Sink for Industrial Effluent

Industrial and technological expansion waste generation expansion among others have rendered many water resources un whole some and hazardous to man and other living resources, thus, water pollution is now a significant global problem (Anetor *et al,* 2003).

Industrial effluents are a main source of direct and often continuous input of pollutants into aquatic ecosystems with long term implications on ecosystem functioning including changes in food availability and an extreme threat to the self-regulating capacity of the biosphete. These industrial discharge or wastes include heavy metals pesticides, polychlorinated biphenyls (PCB_b), dioxins, polyaromatic hydrocarbons (PAH_S), petrochemicals, phenolic compounds and microorganisms (Fakayode, 2005). These wastes are usually discharged into water bodies and the cumulative hazardous effects it has on the environment have received much attention. Some heavy metals contained in these effluents have found to be carcinogenic while other chemical equally present are poisonous depending on the dose and duration of exposure. Undoubtedly, waste waters from industries and residential areas discharged into another environment without suitable treatment could disturb the ecological balance of such an environment (Botkin and Kelly, 1998).

In Nigeria, cities like Kaduna, Lagos, Kano and Aba depend very much on its river for water supplies. However, the rush by African countries to industrialize has resulted in discharge of partially treated or raw wastes into the surrounding bodies of water since the development of treatment facilities cannot keep pace with the rate at which the wastes are generated by the industries (Nwachuku *et al,* 1989).

The industrial discharge, therefore contribute a larger portion of the flow of the flow of the river during the dry season, with the result that the water quality of the river is further deteriorated. Uses, for which the river is employed involving body contact, expose serious hazards to users due to the bacterial situation. Many bodies of water in Nigeria experience seasonal fluctuation, leading to a higher concentration of pollutants during the dry season when effluents are least diluted (Kanu *et al,* 2006).

3. Tannery Industrial Effluents as Source of Water Pollution

The direct discharge of effluents from tanneries into bodies of water has become a growing environmental problem. Most of these wastewaters are extremely complex mixtures containing inorganic and organic compounds (Fu *et al,* 1994). The tannery operation consists of converting the raw hide or skin into leather, which can be used in the manufacture of a wide range of products. Consequently, the tanning industry is a potential-intensive industry. Chemical impurities mostly comparise of the following dissolved substance:- inorganic salt cations such as $Fe^{2+}, Zn^{2+}, Cu^{2+}, Ca^{2+}, Na^{+}$ e.t.c., anion such as $SO_4^{2-}, NO_3^{-}, PO_4^{3+}$; organic parameters such as dissolved oxygen (DO), total dissolved solids (TSS) Bosnic et al, 2000).

However, Tannery waste-water for example has a Biochemical oxygen demand (BOD) of 2500 – 3000mg/L which means that 1cubic metre of tannery effluent pollutes a river in the tannery industries; the production of 1to of hides per day requires a water consumption of $50m^3$. This quantity of water is equal to the daily water consumption of 250 urban people with consumption of 200 IPcd (Kaul et al, 2005). Akan *et al* (2009) analysed the levels of effluent samples from tanneries in Kano industrial area of Chalawa, Bompai and Sharada and reported that all the tanneries are the major sources of high chromium, sulphate, nitrate and dissolved oxygen. This indicates the source of termination of River Chalawa which is the major sink of these effluents.

Another study conducted by Danazumi and Biche (2010) reveals that untreated waste –water from Chalawa Sharada industries which are being discharged in to Chalawa river is the major factor responsible for needed since the river is used for various purpose including irrigation fishing and domestic water supply.

Onwuka *et al* (2004), studies eighty eight (88) samples of the groundwater near industrial effluent discharges in Enugu (Nigeria) in order to evaluate its portability. The parameters of interest are common waste – derivable chemical constituents such as nitrate (NO_3^-) chloride (Cl^-) and sulphate (SO_4^{2-}), and indicator micro organism, like Escherichia coli. The study showed that about twenty two percent (22%) of the samples had concentrations of NO_3^- higher than the WHO permissible level (45mg/L) bacteriological quality of the ground water showed evidence of sewage and industrial effluent contaminations the identification of E. coli in the water indicates faecal contamination. Improvement in the management of both domestic and industrial wastes will improve the quality of both surface and groundwater, hence reduction or rather elimination of water pollution.

Textile industrial effluent as source of water pollution

Textile industry can be classified into three categories viz, cotton, water consumption depending upon the raw material used. The water consumption depending upon the processing operations employed during the conversion of fibre to textile fabric textile industries are major sources of these effluents due to the nature of their operations, which require water that results in high waste water (Gloreishi and Haghighi 2003).

Textile industries has various departments, each of which carries out different operation and produces one type of specific waste water. The wastewater contains acids used in desizing, dyeing bases like caustic soda used in scouring and mercerization. It also contains inorganic chlorite compounds and other oxidants, e.g hypochlorite of sodium, hydrogen peroxide and peracetic acid for bleaching and other applications. Chemical compounds are also present, e.g dyestuff, bleaching agents, starch and related synthetic polymers used for sizing and thickening, surface active chemical are used as wetting and dispersing agents and enzymes for finishing. Salt of heavy metals are also present, e.g of copper and zinc, and iron (ii) chloride used as printing ingredients. All these wastes passed into an effluent tank and then drained into a drainage systems that connects to receiving water bodies and hence the source of water pollution (Ohioma et al, 2009).

However, Sekhar *et al* (2003) traced heavy metal contamination of an area to industrial effluent, Yusuf and Sonibare (2004) reported that the negative impacts from Kaduna textile mills effluents could be felt as far as all the regions covered by the Kaduna River basin, the main receptor of these effluents. This justifies tht industrial effluents are the major sources of water pollution.

4. Palmoil Mill Effluent as a Source of Water Pollution

Palm oil mill effluent is an important source of inland water pollution when released into local river or lakes. In Nigeria palm oil is processed locally and industrially through the oil palm belt stretching from cross river o Lagos State. Beside the main product i.e the crude liquid wastes, which may have a significant impact on the environment. Palm oil

mill efflume (POME) is one of the major sources of pollutant produced during oil palm processing (Kanu et al 2011).

The palm oil mill effluent (POME) is generated from three major sources, namely sterilize condensate, hydrocyclone waste and separator sludge. On an average 0.9 – 1.5m^3 of POME is generated for each ton of crude palm oil produced (Davis and Reilly, 1980). POME is rich in organic carbon with a biochemical oxygen demand (BOD) higher than 20g/L and nitrogen content around 0.2g/L as ammonia nitrogen and 0.5g/L total nitrogen (Ma, 2000).

The characteristic Problems associated with palm oil mill effluents are pH, dark colour, high level of biochemical oxygen deman (BOD), chemical oxygen demand (COD) and suspended solids (SS).High value of COD indicates the recalcitrance of chemicals that have escaped biodegradation. When these chemical are present in water bodies are used by both plant an animals may lead to bioaccumulation in both plant and animals systems. However, majority of sink for POME are rivers and streams and thus serves as a source of water pollution (Kanu *et al,* 2011).

5. Soap and Detergent Industrial Effluent as Sources of Water Pollution

Alkyl sulphates (AS) are anionic sources of water pollution used in household and personal deansing applications. As at a concentration above 106µg/L aquatic animals (Belanger *et al,* 2004). However, industrial effluents from soap manufacturing industries are known to contain complex chemicals most of which are very toxic and capable of destroying the microbial habitats in a serious adverse way. For example, characterization of the composite wastewater from both soap and food processing plants indicated that the waste was highly contaminated with organic compounds as indicated by Chemicaloxygen demand and Biochemical oxygen demand values as reported by El-gohary *et al,* (1987).

In a study to assess the seasonal variation in bacterial heavy metal biosorption in a receiving river as effected by industrial effluents, Kano *et al,* (2006), observed an overall seasonal variation of heavy metals such as lead, zinc and manganese in the rainy season as compared to other metals for dry seasons. Moreover, effluent from the soap manufacturing plant contained significant concentration of oil and grease amounting to 563mgL^{-1}. The inefficiencies of waste treatment processes involve do not treat properly the waste being generated and thus the discharged effluents remains a source of water pollution (Yusuf and Sonibare 2004).

6. Brewery and Soft Drink Effluents as Source of Water Pollution

Waste water from Brewery industry Originates from liquors pressed from grains and yeast recovery and have the characteristic odour of fermented malt and slightly acidic (Kanu *et al,* 2006).

Brewery effluent are high in carbohydrate; nitrogen and the cleaning and washing reagents have been proved water pollutants (Kanu *et al,* 2011). However, Ekhaise and Ayansi (2005), reported high counts of bacterial population in Ikpoba River in Bein city Nigeria receiving a brewery industrial effluent. Similar result were reported by Kanu *et at,* 2006) of the effect of brewery discharge into Eziama River, Aba, Nigeria. Therefore the above justices that brewery effluent are sources of water pollution.

On the other hand, Ibekwe et al (2004), analyzed the waste water in the accumulation pond and final discharge point of Nigerian Bottling company PLC in owerri, Nigeria to determine their baderiological and physic-chemical characteristics. Species of organisms isolated included staphylococcus, Bacillus, Lactobacillus, and streptococcus. Others include klebsiella, Escherichia, proteus and serratia. However, species of lactobacillus and proteus were isolated from the final discharge point only. Therefore the presence of the above microorganisms implies that effluent from soft drink processing companies are sources watr pollution.

7. Conclusion and Recommendation

In Nigeria, most of the portable water used domestic, agricultural and industrial purposes is channeled from rivers and ground water.The quality of these water bodies can not be guaranted due to constant disposal of industrial effluents into the water bodies.

Presently, very little if any has been done on an integrated level concerning industrial pollution abatement in Nigerian waters. There is also, little or no institutional memory in Nigeria on the influence of industrial waste on human health, thus, a detailed campaign should be put in place, elucidating the mechanism of water pollution especially with regard to these toxic industrial effluents.

To provide a holistic approach toward water pollution abatement, prevention at the source is the best alternative. Having identified these major water pollution sources in this review, government should as a matter of urgency, adopt legal, administrative and technical measures to eliminate the undesirable effect of industrial effluents in Nigerian water bodies imposition of direct charges on industrial effluents by the regulating agency, as well as continuous monitoring and surveillance is imperative in order to ensure the protection of Nigerian water resources from further degradation s a result of pollution.

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