**Bulletin of Environment, Pharmacology and Life Sciences**
Bull. Env. Pharmacol. Life Sci., Vol 3 [10] September 2014: 78-81

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804


**ORIGINAL ARTICLE**

# Physico-Chemical Characteristics of Pharmaceutical Effluents from Sango Industrial Area, Nigeria

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**ABSTRACT**
*Pharmaceutical effluents are waste water generated during the process of drug manufacturing by pharmaceutical industries. When these effluents are discharged directly into the environment without proper handling and treatments, they possess the potential to cause adverse effects on human health and the environment. This study investigated the physico-chemical parameters of effluents released by three different pharmaceutical industries in Sango Industrial Area of Ogun State. In all, 25 parameters were studied. These includes pH, Colour, Conductivity, Salinity, Turbidity, Appearance, Odour, Chloride, COD, BOD,TSS, TDS, Nitrates, Phosphates, Sulphates, DO, Alkalinity, Barium, Cadmium, Copper, Iron, Manganese, Nickel, Lead, Zinc. Results showed Nickel to be absent in the effluents but other results showed that the majority of other parameters tested have values that are beyond the standard values of WHO, FEPA and USEPA with TSS having outrageous results of 70, 30 and 42 for the effluents A, B and C respectively . This calls for an abrupt use of modern treatments plants to reduce the toxicity that results from discharge of pollutants in the effluents which when discharged, finds their way into the water bodies around and pose threat to man and animals that depends on water for survival.*
***KEYWORDS:*** *Pharmaceutical Effluents, Pollutants, Treatment Plants, Environment, Disease, Pharmaceutical.*

Received 02.05.2014 Revised 09.07.2014 Accepted 21.08. 2014

## INTRODUCTION

Over the last three decades there has been increasing global concern over the public health impacts attributed to environmental pollution, in particular, the global burden of disease. The World Health Organization estimates that about a quarter of the diseases facing mankind today occur due to prolonged exposure to environmental pollution[1]. Most of these environment-related diseases are however, not easily detected and may be acquired during childhood and manifested later in adulthood. The discharge of industrial effluent into water bodies is one of the main causes of environmental pollution and degradation in many cities, especially in developing countries. Many of these industries lack liquid and solid waste regulations and proper disposal facilities, including for harmful waste. Such waste may be infectious, toxic or radioactive[2].

Pharmaceutical effluents are wastes generated during the process of drug manufacturing by pharmaceutical Industries. When these effluents are discharged directly into the environment without proper handling and treatment, they affect both human health and the environment. Their risks to human health and environment cannot be overemphasized. Increase in demand of pharmaceuticals in Nigeria has led to the consequential increase in pharmaceutical manufacturing companies and therefore, increased in the amount of wastes generated which most times contain recalcitrant substances that are either cytotoxic or genotoxic and sometimes both[3,4].

Therefore, this research is aimed at studying the physico-chemical characteristics of effluents of three industries located Sango Industrial Area. The pollution level of each effluent is compared with the guidelines as prescribed by WHO, FEPA and USEPA.

## EXPERIMENTAL

### Sample Collection

Effluents from three Pharmaceutical industries located in Sango Industrial Area of Ogun State, (Nigeria), were collected directly from their discharged points, and were denoted as A, B and C. Sampling was done during the period of high production. The effluents released from these industries flows into the water bodies around the environment such as the canals and rivers. The effluents were studied for physical, chemical, biological parameters.

## Analytical Procedures

All chemicals and reagents were of analytical grade and were obtained from BDH Chemicals Ltd, UK. PH, Appearance, Colour and Odour of the effluents were measured in the field itself. Dissolved oxygen was also fixed in the field itself. Electrical conductivity and TDS were determined by Elico model Conductivity TDS analyzer. Turbidity, Total Suspended Solids (TSS), Biological Oxygen Demand, Chemical Oxygen Demand, Chlorides, Nitrate, Sulphate, and phosphates were determined as per standard procedures3. Copper, Manganese, Iron, Zinc, Lead, Cadmium, Nickel and Barium were determined using PERKIN ELMER (A. Analyst 200; Germany) consisting of a hollow cathode lamp, slit width of 0.7 nm and an air-acetylene flame.

## RESULT AND DISCUSSION

Below is the table showing the physicochemical characteristics of three different pharmaceutical industry effluents obtained from their discharge points into the environment.

**Table 2: Mean values of physicochemical parameters of three pharmaceutical industrial effluents**

| Physicochemical Parameter | Effluent A | Effluent B | Effluent C | FEPA[a] | USEPA[b] | WHO[c] |
|---|---|---|---|---|---|---|
| **pH** | 7.2 | 4.7 | 7.1 | 6.0-9.0 | 6.5-8.5 | 6-9.5 |
| **Colour** | Purple | Colourless | Yellow | NS | NS | NS |
| **Conductivity** | 199.0 | 299.0 | 413.0 | NS | NS | NS |
| **Salinity** | 0.02 | 0.03 | 0.03 | NS | NS | NS |
| **Turbidity** | 120.0 | 40.0 | 50.0 | NS | NS | 5 |
| **Appearance** | Not clear | Not clear | Not clear | NS | NS | NS |
| **Odour** | Objectionable | Objectionable | Objectionable | NS | NS | NS |
| **Chloride** | 10.0 | 18.0 | 14.0 | 600 | 250 | 250 |
| **COD** | 80.0 | 90.0 | 110.0 | NS | NS | NS |
| **BOD** | 22.0 | 40.0 | 60.0 | 50 | NS | NS |
| **TSS** | 70.0 | 30.0 | 42.0 | 30 | NS | NS |
| **TDS** | 134.0 | 200.0 | 277.0 | 2000 | 500 | <1200 |
| **Nitrates** | 1.52 | 2.46 | 3.31 | 20 | 10 | 50 |
| **Phosphates** | 0.08 | 0.12 | 0.16 | 5 | NS | NS |
| **Sulphates** | 7.0 | 10.0 | 14.0 | 500 | 250 | 500 |
| **DO** | 3.8 | 3.2 | 3.0 | NS | NS | NS |
| **Alkalinity** | 30.0 | 40.0 | 30.0 | NS | NS | NS |
| **Barium** | 0.04 | 0.06 | 0.06 | NS | NS | NS |
| **Cadmium** | 0.02 | 0.05 | 0.04 | <1 | 0.002 | 0.003 |
| **Copper** | 0.15 | 0.23 | 0.28 | <1 | 0.009 | NS |
| **Iron** | 0.20 | 0.25 | 0.34 | 20 | 0.3 | NS |
| **Manganese** | 0.07 | 0.12 | 0.21 | 5 | 0.05 | NS |
| **Nickel** | ND | ND | ND | <1 | 0.005 | 0.02 |
| **Lead** | 0.01 | 0.03 | 0.04 | <1 | 0.003 | 0.01 |
| **Zinc** | 1.75 | 2.29 | 2.62 | <1 | 0.12 | 0.01 |

*Values are means of 3 replicates. All values are in mg/L except conductivity ($^{o}/_{oo}$), pH and turbidity have no unit; BOD: Biochemical oxygen demand; DO: Dissolved oxygen; TDS: Total dissolved oxygen; TSS: Total suspended solids; ND: Not detected; NS: Not stated; [a]Federal Environmental Protection Agency (1991). Permissible limits for effluents discharged into surface water; [b]United states Environmental Protection Agency (1999). National recommended water quality criteria-correction; [w]orld Health Organization (2002).Guidelines for drinking water recommendation.

The chemical and physical properties of different waste water from three pharmaceutical industries A, B and C at their discharged point were presented in Table 2. The characteristics of the effluents involve considerable number of pollutants of dissolved matter, suspended matter and high turbidity values.

While the pH of effluents from industries A and C were slightly neutral (7.2 and 7.1 respectively), the PH of effluents from industry B was acidic (4.7). The acidic nature of the industry B effluent is capable of stemming the pH of the receiving water bodies thereby, destabilizing fundamental properties such as

alkalinity, metal solubility and hardness of water. Wang *et al* supports the fact that metabolic activities of aquatic organisms are also dependent on the pH values[7].

The effluents characterized by high mean values of turbidity: 120, 40 and 50 for effluents A, B and C respectively. These turbidity values were above the maximum permissible limits specified by WHO.

The concentrations of the Nitrates, Phosphates and Sulphates in the three effluents were all below the WHO standard, even though the 3rd effluent (C) has the highest value for these ions. This may be due to the fact that the raw materials used in drug production in these industries have very low concentrations in Nitrates, Phosphates and Sulphates.

The mean values of total suspended solids (TSS) for industrial effluents A, B and C were 70, 30 and 42 respectively which showed that the values for effluent A and C exceeded the specified limits set by FEPA for discharge into surface water. The biochemical oxygen demand (BOD) value of effluent C (60) was highest followed by effluent B (40) while effluent A has the lowest [22].

The low dissolved oxygen (DO) values from all the three effluents compared to FMEnv (1992) standards indicate that these industries produced many organic substances with high oxygen-demanding wastes[8,9].

The relatively high level of alkalinity (30, 40 and 30) for Effluent A, B and C respectively could be as a result of low DO. Phosphate salts found in the pharmaceutical effluents could be attributed to detergents used for washing in the factory and this could serve as a source of hardness of the effluents [10].

Of all the heavy metals, Nickel was the only metal that was not detected in any of the effluents. The concentrations of Cadmium, copper, iron, manganese, lead below the WHO standard while zinc was the only metal with concentrations higher than the WHO standard.

The average levels of most of the parameters of all the three pharmaceutical industrial effluents at their point of discharge (as sown in table 2 above) were higher than the discharge specifications set by the regulatory bodies[1,3,5]. Since these values were out of range required by standards, it therefore suggested that these wastewaters were not treated before discharge.

Effluents are often suspected to contained different compound that are dangerous to the environment and its inhabitants with so many suspected to have the potential to disrupt the endocrine system. The most widely suspected endocrine disrupting chemicals are both natural and synthetic hormones, steroids, pesticides, herbicides, fungicides, plasticizers, metals, and other industrial chemicals [11].

## CONCLUSION

The results obtained in this research shows that most of the parameters are not within the standard specifications. Such effluent should not be discharged in to the nearby water body or soil without treatment. They are unfit for irrigation. The high level pollution of the industrial effluents cause's environmental problems which will affect plant, animal and human life. Modern treatment plants are hereby recommended for all industries.

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**Citation of This Article**

Olaitan O J, Sulola E O, Kasim L S, Daodu J O. Physico-Chemical Characteristics of Pharmaceutical Effluents from Sango Industrial Area, Nigeria. Bull. Env. Pharmacol. Life Sci., Vol 3 [10] September 2014: 78-81