



Comparison of Pond Water Qualities as it affects the Growth of Fishes in Ede, Osun State, Nigeria

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Abstract: The physicochemical characteristics of water samples collected from selected ponds in Osun-State were conducted using standard analytical techniques. This study examined the physicochemical parameters of fish pond water to determine the effect of pond description on fish water after disposal. The results obtained from concrete pond and metallic pond were as follows; BOD $36.45 \pm 0.02 - 720.25 \pm 0.05$ mg/L, and TDS $18.45 \pm 0.01 - 34.05 \pm 0.01$ mg/L, pH $6.55 \pm 0.02 - 7.55 \pm 0.05$ UpH, turbidity $49.45 \pm 0.02 - 135.45 \pm 0.05$ NTU, and hardness $19.50 \pm 0.12 - 22.50 \pm 1.45$ mg/L. The results varied from one pond to another depending on the residence time of the samples and the nature of the pond characteristics on fish pond. All properties were within the established limit for effluent disposal except Biochemical oxygen demand (BOD) and Total dissolved solids (TDS).

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1. Introduction

Fish Ponds are wetlands located in and around human habitations, as they are generally semi natural ecosystems constructed by man in landscape suitable for water stagnation. It may be a fabricated or natural water body. The Earthen pond culture system is most common artificial method of fish production. Some of the problems associated with artificial fish production with pond include uncontrolled increase in human population, development of township at large, poor pollution control, seasonal changes in water level, enrichment due to nutrients and organic matter on the other, leading to the cultural eutrophication (Davenport, 1993). In most developing countries of world, fishes are cultivated in ponds (lentic water) but unfortunately, most of the culturists are not so aware of importance of water quality management in fish and fish production. Proper awareness, adequate training and enlightenment about water quality management practices will broaden the knowledge of culturist and enhance maximum fish yield in their ponds to a greater extent through applying low input cost and getting high output of fish yield (Davenport, 2003). Hence, as part of measure to ensure adequate check on quality of fish pond water, the present attempt is having been made to determine aseasonal variation in physicochemical properties of water samples from fish ponds. Fish water is one of the most overlooked aspect of pond management until it affects fish production. Water quality generally means the

component of water which must be present for optimum growth of aquatic organisms (Ehiagbonare and Ogundiran, 2010).

Water quality is made up of physical, chemical and biological factors which influence the use of water for fish culture purposes. These factors include dissolved oxygen, pH, hardness, turbidity, alkalinity, ammonia and temperature. Other parameters such as biological oxygen demand and chemical oxygen demand indicate the pollution level of a given water body (Ehiagbonare and Ogundiran, 2010). Fish productivity depends on the physicochemical characteristics of the water body as reported by Ehiagbonare (2010). In recent years, the inland, fishpond waters and the terrestrial life in the Niger Delta region of Nigeria, which Bayelsa State is part of, have been subjected to alteration ecologically. This is partly due to the human activities, population growth, oil exploitation and exploration, which resulted in the pollution of the environment. The components of the pollution contribute to greater oxygen demand and nutrient loading of the water bodies, promoting toxic algal blooms and leading to destabilized aquatic ecosystem (Morrison et al., 2001). The distribution and production of fish and other aquatic animals are determined and affected by quality and suitability of available water in their environment for normal life processes (Sikoki and Veen, 2004). The water needed for basic life activities should meet certain physicochemical parameters as required by regulatory authorities for normal activities. A sharp drop or increases in this limit have severe adverse

effects on their body functions (Kiran, 2010) and this may stunt their growth and hinder production process. So, good water quality is essential for survival and growth of fish. The purpose of the recent research is to investigate the physicochemical properties of water quality parameters on fish pond as may affect healthy fish production.

2. Material and Methods

2.1 Study area and Sampling stations

This study was carried out in ponds in Federal Polytechnic, Ede, Osun- State, Nigeria and Owode layout, off Abeere road. Federal Polytechnic Ede (FPE) lies between latitudes 7° 43' 59.99" North and longitude 4° 25' 59.99" East. Owode layout lies between longitude 4° 29' 31" East and latitude 7° 42' 49" North. Operations such as integrated fish pond production having both concrete and metallic fish ponds stocked with tilapia fish. The climatic condition of this area is characterised by dry season (November - April) and wet season (May - October). Fish pond water samples were collected February, 2022.

2.2 Collection of Fresh fish pond water samples

Prior to sample collection, all the sampling bottles (5 lits) were thoroughly washed, dried and rinsed with the same water to be collected in the fish ponds. The fish pond description and the residence time of the pond water are shown in Table 1.

Table 1: Pond description and residence time of pond water at different fish pond.

| S/N | Sample Code | Sample state | Fish-pond Description |
|-----|-------------|--------------|-----------------------|
| 1 | A | Osun | Concrete |
| 2 | B | Osun | Metallic |

2.3 Water Quality Test on Fish pond water

The quality parameters determined include: BOD (Biochemical Oxygen Demand); Hardness; TDS (Total Dissolved Solids); pH and Turbidity:

- i. **Biological Oxygen Demand (BOD):** Fish pond water samples collected were aerated for five days at 30°C in a BOD bottle with a volume of 350 ml and 110 ml volume of the samples was used. Distilled water was used as water solution for dilution and as a blank which were aerated for five days using clean supply of compressed air (Olukunle and Oyewumi 2017).
- ii. **Total Dissolved Solid (TDS):** The TDS test was carried out to determine the concentration of the dissolved mineral salt and the ionic effect in fish pond water samples. The conductivity was determined using

conductivity meter (Labtech model 648). Pond water samples of 20 ml was measured and dispensed into the labeled beakers. The meter was switched on and its probe rinsed with de-ionized water, and the probe was inserted into the fish pond water samples, and the read button was pressed on the meter to take the readings. The unit is $\mu\text{s/cm}$ (micro Siemens per cm) and TDS ions such as potassium, sodium, chloride, carbonate, sulfate, calcium, and magnesium that contribute to the dissolved solids in water were determined using Equation (1) as given by Olukunle and Oyewumi, (2017); Ogbeibu *et al.*, (2006).

$$\text{TDS} = 0.5 \times \text{Conductivity}$$

- iii. **pH:** This was carried out to determine the hydrogen ion concentration in the fish pond water sample collected. The pH was determined using a pH meter (Suntex model sp-701), which was first calibrated with buffer 4 and 7 (using 1M NaOH and 1M HCL). The probe of the pH meter was rinsed with distilled water. Therefore, the samples of 40 ml of pond water were measured in a labeled beakers, then the probe was inserted into the sample collected. The reading was taken when the pH meter displayed a stable value for pH level of water. The probe was rinsed with distilled water and cleaned with tissue paper after each insertion in the various samples (Olukunle and Oyewumi 2017).
- iv. **Turbidity:** This was carried out to measure the degree to which water loses its transparency due to the presence of suspended solid particles. The turbidity was determined using a turbidometer (Nach model 2100N). The turbidometer was turned on to initialize. The cuvette of the meter was rinsed with distilled water, and 10 ml of distilled water was dispensed into the cuvette then placed in the meter to calibrate it and later poured off. After the meter had been calibrated, 10mL of pond water samples was dispensed in the cuvette and placed in the turbidometer (Nach model 2100N) at a wavelength of 810 nm. Readings were taken and recorded in units known as Formation Turbidity Unit (FTU) (Olukunle and Oyewumi 2017; Ogbeibu *et al.*, 2006).
- v. **Hardness:** This was carried out to estimate the hardness in the fish pond water samples. The hardness was determined using complexometric titration method which was established by forming a colored complex with the metal ion being titrated during the reaction called Ethylene diamine tetra acetic

acid (EDTA) which replaces the indicator to form a more stable complex with metal and when the reaction is completed the change for the color is observed. The end corresponds to be disappearance of the last trace of red to leave to pure blue show a periodic table level of hardness of water. The amount of hardness is expressed in milligrams per litre (mg/L) (Olukunle and Oyewumi 2017).

2.4 Statistical Analysis

All data was in triplicates, the mean and standard deviation values were reported. Pearson's correlation was used to determine the relationship between the physiochemical parameters of fish pond water.

3. Results

The physicochemical parameters of the fish pond water samples are presented in Table 2. The results showed that the turbidity of the samples was between 57.95 ± 0.06 - 315.45 ± 0.05 NTU for concrete pond and 49.95 ± 0.05 - 315.95 ± 0.05 NTU. In addition to that high turbid waters will affects the environment due to poor housekeeping with the fish pond area (Masaba et al., 2019; Olukunle and Oyewumi 2017). It is also observed that the clean environment will required less turbid in water requirements as reported by Mgbemena et al. (2021) and Maule et al. (2007).

Table 2: Physicochemical parameters on fish pond water.

| Parameters | Concrete Pond | | | | Metallic pond | | | | WHO/FAO |
|------------|---------------|--------------|--------------|--------------------|---------------|-------------|-------------|---------------|------------------|
| | Sample A1 | Sample A2 | Sample A3 | Average | Sample A1 | Sample A2 | Sample A3 | Average | |
| Turbidity | 57.95±0.06 | 135.45±0.05 | 97.55±0.02 | 96.98±0.06 | 135.95±0.05 | 49.95±0.02 | 79.05±0.01 | 88.31 | 5 - 25 |
| pH | 6.85±0.01 | 6.65±0.02 | 7.55±0.05 | 7.02±0.04 | 6.55±0.02 | 6.85±0.02 | 7.05±0.06 | 6.82 | 6.5 - 8.5 |
| BOD | 36.45±0.02 | 720.25±0.03 | 71.5±0.04 | 276.07±0.05 | 165.65±0.02 | 286.75±0.01 | 328.45±0.03 | 260.28 | 10 |
| TDS | 19.55±0.05 | 21.65±0.01 | 34.05±0.03 | 25.08±0.04 | 24.05±0.05 | 22.45±0.02 | 18.45±0.01 | 21.65 | 500 [*] |
| Hardness | 19.50 ± 0.12 | 20.12 ± 0.20 | 22.45 ± 0.23 | 20.69±0.23 | 20.55 ± 1.34 | 22.50± 1.45 | 21.66 ± 3.0 | 21.57 | - |

* - FEPA Standard (1991)

The pH of the samples analysis was between 6.65 ± 0.02 - 7.05 ± 0.05 mg/L for concrete pond and 6.55 ± 0.02 - 7.55 ± 0.05 mg/L for metallic pond which gave highly acidic in nature as reported by Mgbemena *et al.*, (2021). More so, the least pH values were observed in samples from matalic ponds. The fish water pond is not likely to harm the environment (Ilechukwu and Okonkwo 2012). Therefore, the results showed that, the pH values variations may likely result to the initial pH of the water before the research work (Omitoyin *et al.*, 2005; Olukunle and Oyewumi 2017).

The total dissolved solids (TDS) in the fish water analysis for both ponds were between 19.55 ± 0.03 - 34.05 ± 0.03 mg/L for metallic pond and 18.45 ± 0.03 - 24.05 ± 0.05 for concrete pond. However, the highest number of total solid were obtained in metallic pond which gave a variable in growth performance as reported by Omitoyin *et al.*, (2005); Bhatnagar and Devi (2013). The total solids are within limit for the effluent discharge into the environment as reported by Agbaire *et al.*, (2015) and Naylor *et al.*,

(2000).

Tables 2 and 3 shows that the BOD values were between 36.45 ± 0.02 – 720.25 ± 0.03 mg/L for concrete pond and 165.65 ± 0.02 – 328.45 ± 0.03 mg/L for metallic pond. However, metallic pond has the highest concretration microbial activities consume within the environment (Mgbemena *et al.*, 2021; Maule *et al.*, 2007).

The values of water hardness for the samples were between 19.50 ± 0.12 – 22.45 ± 0.23 mg/L for concrete pond and 20.55 ± 1.34 – 22.50 ± 1.45 mg/L for metallic pond. Therefore, no particular trend was observed in both samples of pond water as reported by Mgbemena *et al.*, (2021). More so, the hardness of the pond water may have been that of the water before introduction into the pond and this confirms that aquaculture activities may have negligible effects on hardness of pond water. The water hardness of the samples was within the recommended values for effluent discharge into the environment (Naylor *et al.*, 2000; Olukunle and Oyewumi 2017).

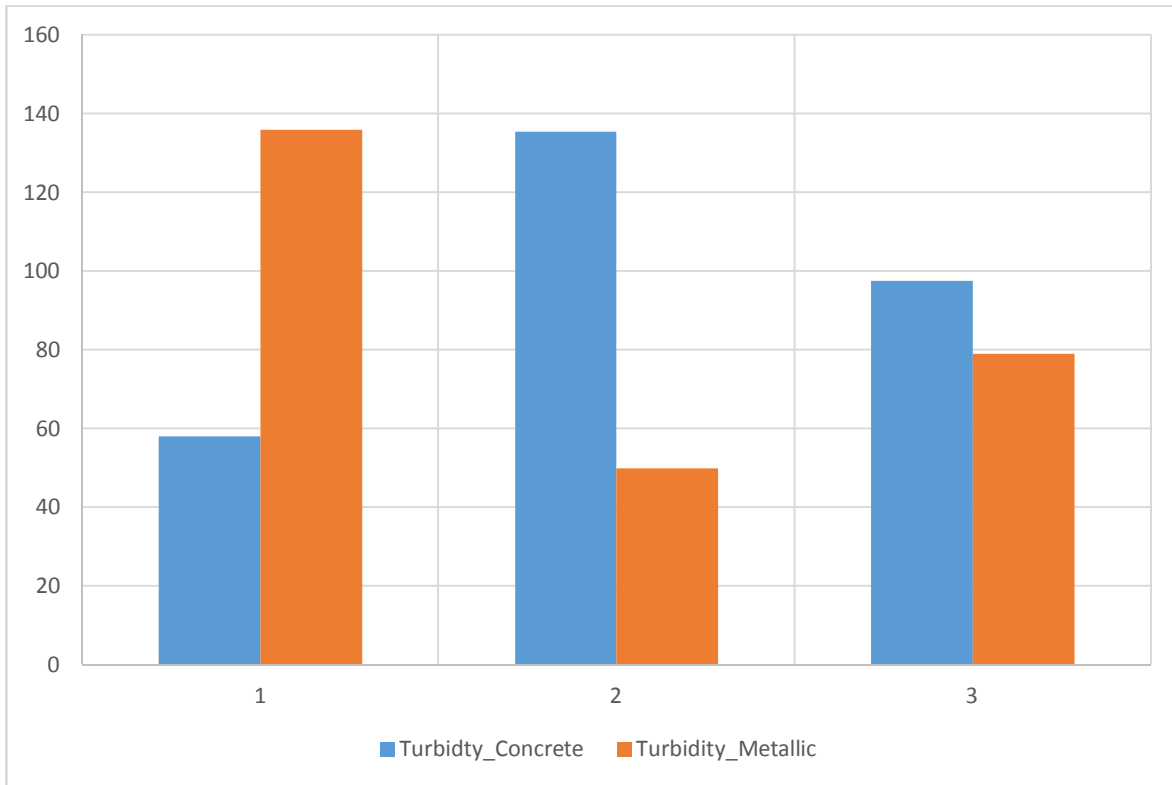


Figure 1: Turbidity Value of Pond water as affected by materials of construction

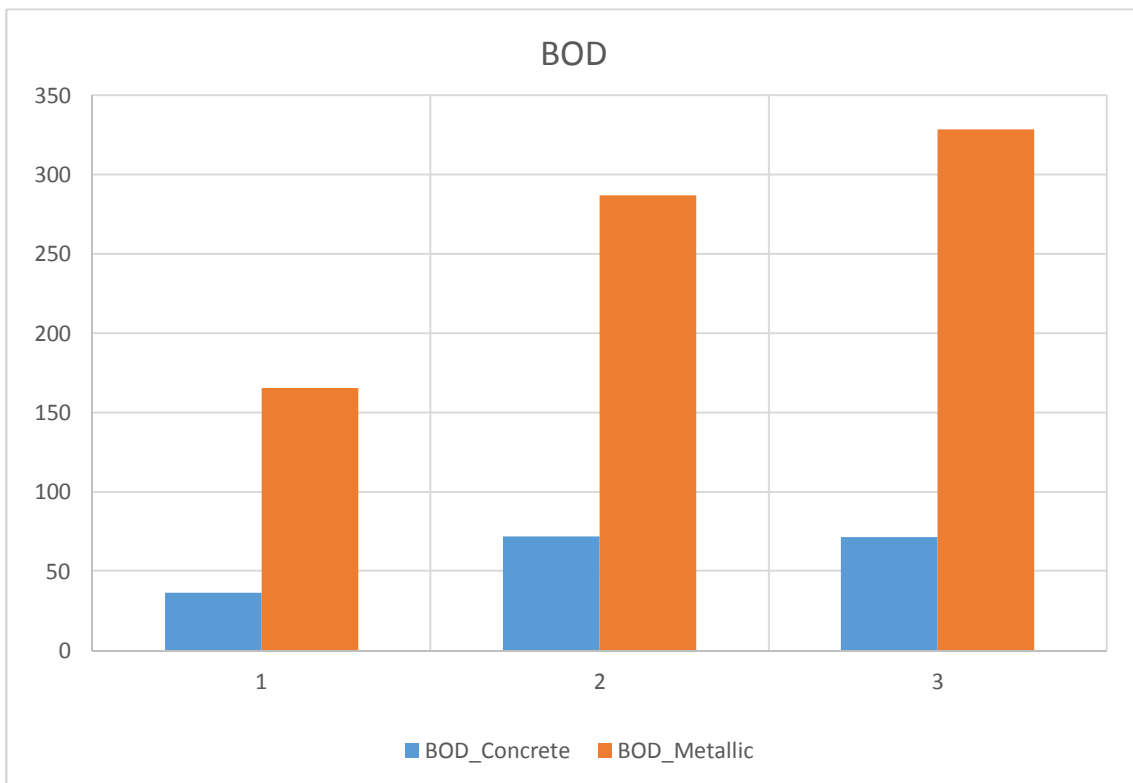


Figure 2: BOD of Pond water as affected by materials of construction

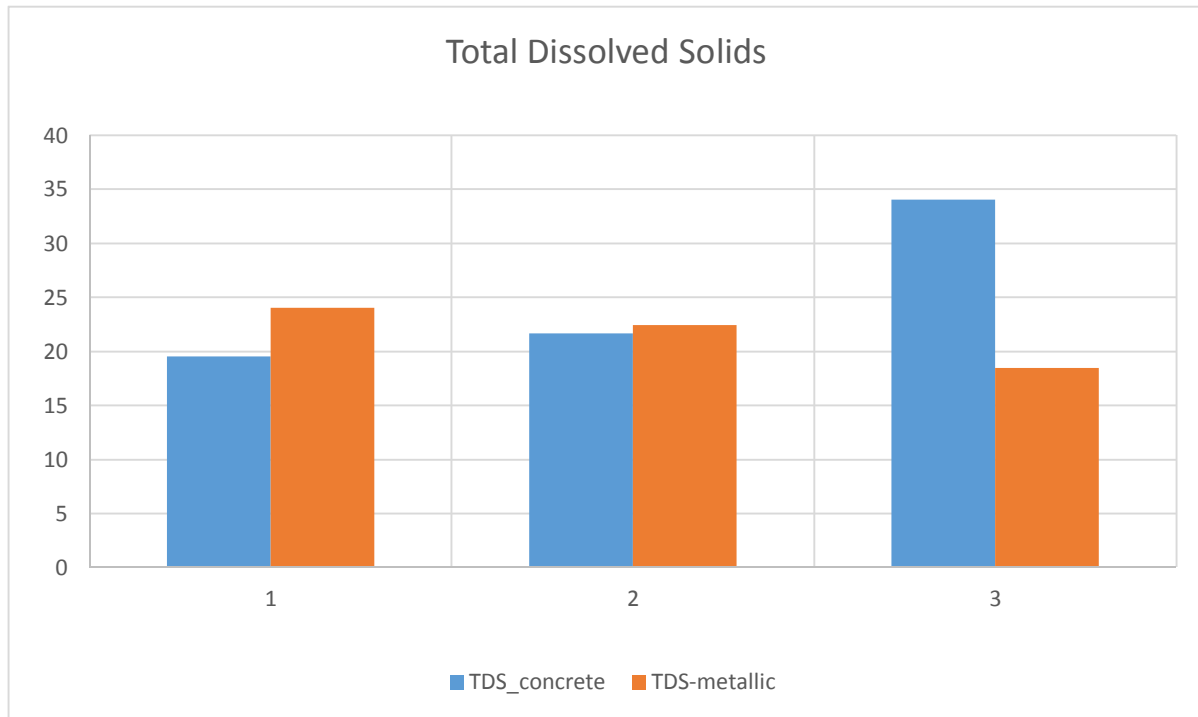


Figure 3: Total Dissolved Solids value of Pond water as affected by materials of construction

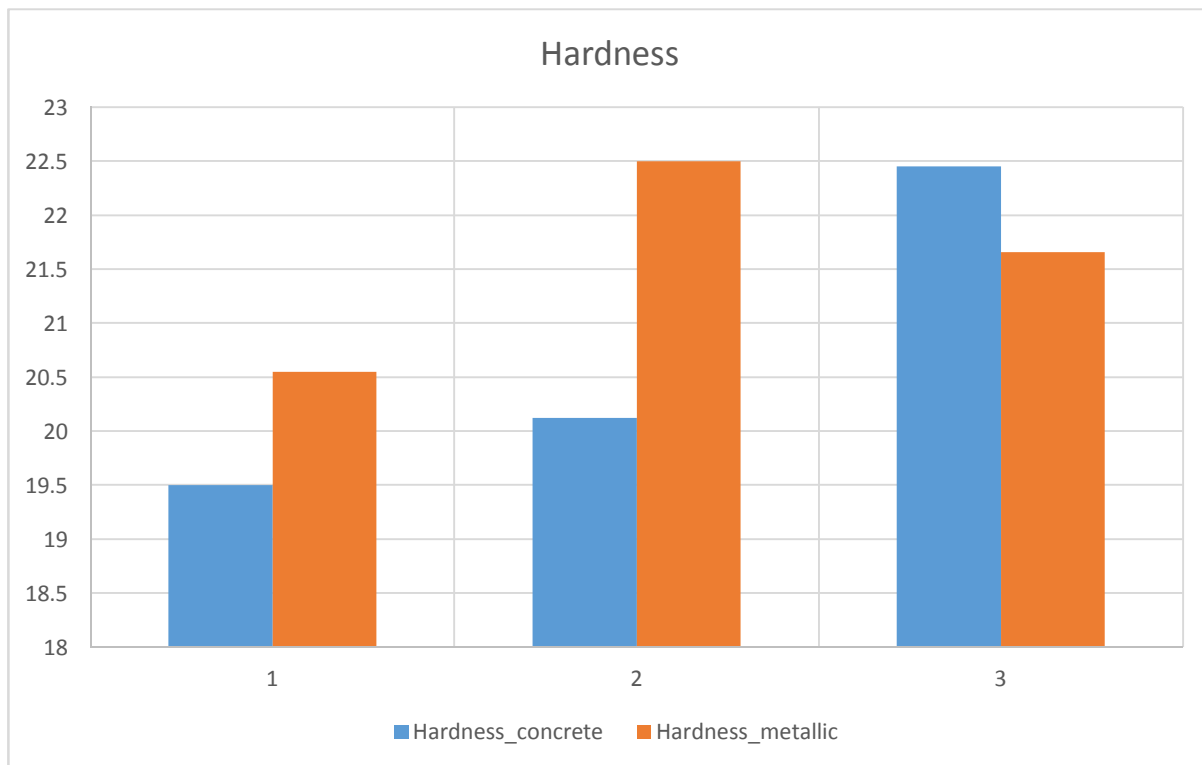


Figure 4: Hardness value of Pond water as affected by materials of construction

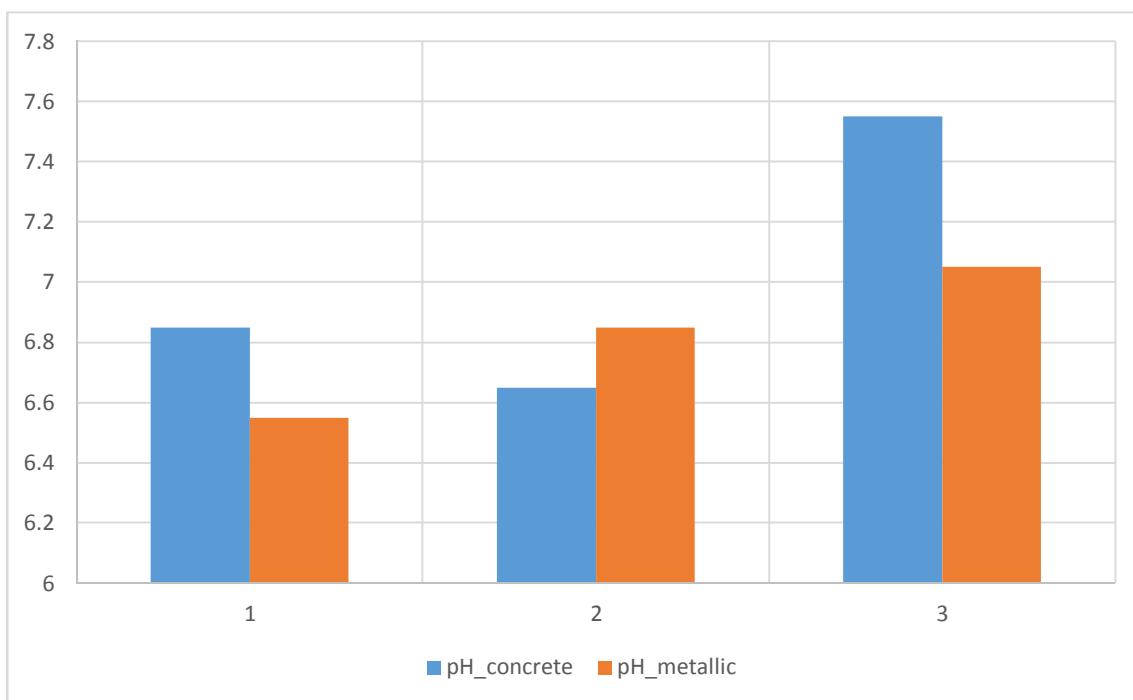


Figure 5: pH value of Pond water as affected by materials of construction

4.0 Conclusion

The study revealed that all physicochemical parameters determined in the fish pond water were all within permissible limits for release into the environment except biochemical oxygen demand (BOD) and total dissolved solid (TDS). The Government and concern agencies and organizations should create awareness of affordable methods of fish pond purification and conservation would be discovered. Further research should be carried out on minerals element's by using different method of pond description

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