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A Comparative Analysis of Physio-chemical Characteristics from Polluted Water Samples

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Abstract:
The physio-chemical parameters of polluted water samples collected from different locations were studied. They were analyzed by using the standard methods. The Salinity value was used to identify different Mangrove species specific to their locations.
Keywords: Water samples, Mangroves species.

Introduction:
Water is said to be a precious natural resource. Thus, this resource of nature should be handled carefully and cautiously. Poor conditions of water bodies are not only the indicator of environmental degradation; but also it is also a threat to the ecosystem. According to the environmental and Economical aspects, water quality plays a vital role[1]. Heavy metals are said to be hazardous because they tend to bioaccumulate. Heavy metals can enter a water supply through industrial and consumer waste, sewage waste etc, releasing their toxic pollutants into various water bodies. Being dangerous on the grounds not only do they tend to bioaccumulate but also biomagnify as they enter the food chain. Heavy metals can enter a water supply through modern and buyer squander, delivering their harmful contaminants into different water bodies. The impact of the presence of heavy metals can bring about diminished or disturbed mental health and focal capacity, lower levels and harm to blood organization, lungs, kidney, liver and other imperative organs[2]. An expected 38,354 million liters each day (MLD) of sewage is generated in numerous urban communities of India, of which the sewage treatment limit is supposed to be just 11786 MLD[3].The productive use of wastewater has seemed to increase in the developing countries. Since there is no alternative mode of irrigation many small-scale farmer's use wastewater for high value crops. Sewage is collected through a large network of pipes, which is then transported to the centralized treatment plants and where it is being treated. The main purpose or the aim of this exercise is to reuse treated wastewater[4]. The projection and prediction for the year 2050 projections for India reports that around 1447 cubic kilometers of water will be required out of which 74% is identified for irrigation purpose, 7% drinking water, 4% industrial use, 9% energy generation 6% for other uses[4]. For water recovery and reuse distinctive treatment advancements, for example, incorporated interaction plan, layer treatment, wetlands, bioremediation, modern wastewater treatment, sterilization are used[5]. In India, the local schools of Madhya Pradesh have constructed Grey water treatment and reuse systems; post which the treated water is being used for Toilet flushing, irrigating food crops[6]. The current research work deals with the important study of physiochemical parameters such as Alkalinity, Acidity, pH, BOD, COD, Chlorinity, Salinity, Sulphates, Phosphate-Phosphorus, Copper, Zinc of waste water which was collected from Powai

Lake. The quality of the water was assessed for different parameters on three occasions; i.e. before the Ganpati Visarjan, on the day of Visarjan and after the Ganpati Visarjan. It was observed that some of the parameters showed significant increase during the time of immersion period and a sudden decline post immersion period[7]. The shores of Powai Lake which are now beautiful and fixed with elegant lodging edifices are kicking the bucket. Sewage had decreased the Dissolved Oxygen (DO) to its lowest value starting around 1961. The level has been dropped to a minimum of 1.7mg/L. According to CPCB the permissible limit of Dissolved Oxygen (DO) level for propagation of wildlife and fisheries is 4 mg/L. Biological Oxygen Demand (BOD) reading more than 3 mg/L is unfit for the humans and if unconditionally raised above 6 mg/L is unsuitable for survival of fish species mentioned to CPCB guidelines. Mangroves are woody plants which form the prevailing vegetation in flowing, saline wetlands along tropical and subtropical coasts. The salinity of the Mangroves is dependent on the number of ions, compartmentation, osmoregulation, selective transport and uptake of ions to the shoot and capacity to accommodate the salt influx[8].Mangrove species were accessed for their ecological fitness in two different habitats as well as growing in saline and fresh water conditions. Assessments were carried out by physiological and biochemical parameters measured from the fully exposed mature leaves under saline and non-saline conditions. *Bruguiera gymnorrhiza, Excoecaria agallocha, Phoenix paludosa* which grows in Sundarbans are found in abundance while the rest *Heritiera fomes, Xylocarpus granatum* are scanty[9].Mangroves are defined based on five unique characteristics such as complete fidelity to the intertidal zone, taxonomic isolation from terrestrial relatives, community composition that commonly forms pure stands, morphological specialization, physiological adaptations[10].Mangroves are one of the major contributors to the global carbon cycle which are known to produce large amounts of litter in the form of falling leaves, branches and other debris. Besides Mangrove Habitats contribute to complex food webs and energy transfer.[11]. Traditionally and economically the Mangroves have been used in firewood and charcoal. They are also used for various purposes such as dwelling, furniture, boats, fishing gear, tannins for dyeing and leather production. Extracts and chemicals from Mangroves have been used in folkloric medicine, as insecticides, pesticides, since ancient times and these practices are known to continue to this day[12]. Four main reasons for rehabilitating Mangroves are identified to be conservation, landscaping, sustainable production and coastal protection. Mangroves rehabilitate practical aspects such as the causes of site degradation, site selection, source of seedlings, planting, monitoring and maintenance. Biodiversity, Biotechnology, Ecological modeling, Mapping, Human ecology, and Databases are some of the fields known to have impacts on restoration of the mangrove ecosystem.[13].

Materials and Method

The study was conducted by sample collection and chemical analysis.

Sample collection

Water samples were collected from two locations.

Location1: Charni Road (SPOT1):

The water sample was collected on 9th January, 2020 at 2:00pm. During low tide conditions by maintaining the distance of 2 meters between the two samples. The samples were collected in plastic bottles.

Location 2: Powai Lake (SPOT2):

The water sample was collected on 26th January, 2020 at 2:00pm. During low tide conditions by keeping the distance of 1 meter each between the two samples. Similar to SPOT 1 the samples were collected in plastic bottles.

Figure 1. Samples collected from Charni Road

Figure 2. Samples collected from Powai lake

Total Alkalinity: 10ml of water sample was taken in a conical flask and 4-5 drops of phenolphthalein indicator were added. At the end point if the solution turns colorless, the alkalinity due to phenolphthalein is absent. Whereas if we continue the titration by using a methyl orange indicator the end point from colorless to pink is achieved. If the solution turns pink after adding phenolphthalein while titration against 0.5N HCL till color change is achieved from pink to colorless.

For reverse titration, now 2-3 drops of methyl orange can be added and continue with the same titrant to obtain the end point from yellow to pink. If the solution turns pink immediately after the addition of methyl orange consider methyl orange alkalinity as zero. Total alkalinity was calculated by observing total burette reading. Methyl orange indicator can be used directly only when water samples show absence of phenolphthalein alkalinity.

Total Acidity: 10 ml of water sample was taken in a conical flask and 2-3 drops of methyl orange indicator were added. If the solution turns yellow, methyl orange acidity is absent. If we continue titration using phenolphthalein the end point achieved is yellow to pink. 4. If the solution turns pink after adding methyl orange titrate against 0.5N NaOH till color changes from pink to yellow. For reverse titration, now add 2-3 drops of phenolphthalein and continue with the same titrant to obtain the end point from yellow to pink. If the solution turns pink immediately after the addition of phenolphthalein indicator, consider phenolphthalein acidity is zero. Calculate total acidity by observing total burette reading. Phenolphthalein indicator can be used directly only when a water sample shows absence of methyl orange acidity.

Chlorinity & Salinity:

Formula for Salinity:

Salinity: chlorinity×1.805 + 0.003 (temp correction factor)

Take out 10 ml of water sample in a conical flask. Add a few drops of K2Cro4 indicator titrate against 0.02N AgNO3 till a buff-colored precipitate is obtained.

Biological Oxygen Demand (BOD):

The Standard Value for:

Waste water: 110- 400 mg/L

Raw sewage: >100 mg/L

Tap water 0.5 mg/L.

Fill the B.O.D bottle to the brim with a water sample. Add 1ml of “Winkler’s A “& 1 ml of “Winkler’s B”. Place the inverted glass stopper bottle & keep for 15 minutes. Add Conc H_2So_4 to dissolve the precipitate. Take out 50ml of the treated water sample in a conical flask and titrate against $Na_2S_2O_3$. When it turns pale yellow add 2-3 drops of starch indicator & continue titration till the solution becomes colorless.

Determination of pH:

The ionization of water results in the formation of hydrogen ions and hydroxyl ions. Change in the concentration of one brings about the simultaneous changing in the concentration of the other there by altering the condition of the water. So, a number scale termed pH scale is used to determine the pH of a medium. The pH meter is set on a flat surface. The electrode of the pH meter is dipped in a buffer solution with a known pH to calibrate it. After calibrating the pH meter, the electrode is washed by dipping into distilled water to get rid of any adhered buffer. The electrode is gently wiped with a tissue paper. The electrode is then dipped in the sample solution and its reading is noted. 6. The electrode is washed again by dipping in distilled water and the pH of the sample is measured two more times.

Chemical Oxygen Demand (COD):

Method: Titrimetry.

In flask 1 (Blank)- Take out 10 ml of distilled water. In flask 2 (sample)- Take out 10 ml of water sample. Add 5ml H_2SO_4 & 10 ml of N/80 $KMnO_4$ to each flask. Mix the contents well by gentle rotation and plug it with cotton. Place these flasks in a hot water bath at 70 for 15mins.Cool and add 1 gms of KI crystals in each flask and gently rotate the content till it dissolves. Plug it with cotton and keep it in the dark for 10 mins. Titrate the contents against N/80 sodium thiosulphate solution using starch as indicator. Note the burette reading for blank as well as sample flask. Calculate COD by using the difference between the two burette readings.

Sulphates:

Method: Turbidometry

Prepare a series of dilutions of standard sulphate solutions as shown in the observation table. Also prepare a tube containing 5ml of water sample. To each of the test tubes add 1ml of the buffer solution and 1ml of 1% $BaCl_2$ solution. Shake the contents of the tubes vigorously and immediately read the absorbance on the colorimeter at 540 nm. Plot a graph by taking concentration of sulphates on X-axis and OD on Y-axis and determine the amount of sulphate in terms of mg/ltr.

Phosphate-Phosphorus:

Prepare a series of dilutions of standard phosphate solutions as shown in the observation table. Also prepare a tube containing 5ml of water sample. Add acid molybdate reagent and 0.2ml of ascorbic acid solution to each tube. Mix the contents of the tubes well on a vortex mixer. Keep the tubes standing for 10 minutes. Read the optical density on a colorimeter at 625or 640nm.Plot a standard graph and determine the PO_4- of the water sample.

Copper:

Method: Colorimetry.

Prepare a series of dilutions of standard working copper solution as shown in the observation table.To each tube add 1ml of Na citrate solution, 0.2ml of liquor ammonia and 0.5 ml of carbamate reagent. Mix the contents of each tube and keep standing for 10 mins. Read the optical density on a colorimeter at 440 nm. Plot a standard graph of OD against concentration of copper.

Lead:

Method: Colorimetry

Prepare series of dilutions of standard working lead solution as shown in the observation table.To each tube add 2ml of NaOH Solution and 0.5ml of Na_2S solution. Mix the contents of each tube and keep standing for 10 mins. Read the optical density on a colorimeter at 440 nm. Plot a standard graph of OD against conc of Lead.

Observations and Conclusions:

Parameters	Charni road water samples			Powai lake water samples		
	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3

Alkalinity	0.375	0.375	0.375	0.125	0.125	0.125
Acidity	0.125	0.125	0.125	0.125	0.125	0.125
Chlorinity	35.5	35.5	35.5	28.4	28.4	28.4
Salinity	64.08	64.08	64.08	30.20	30.20	30.20
pH	6.0	6.0	6.0	6.0	6.0	6.0
BOD (mg/L)	3.6	6	6.8	2.8	5.2	5.6
COD (mg/L)	18	49	35	16	14	35
Sulphates (mg/L)	80	92	88	92	88	82
PhosphateS (PO_4-P/L)	32	28	30	60	102	88
Copper(µg/L)	80	88	88	24	20	24
Lead(mg/L)	78	68	72	8	6	12

Table 1. Comparative Study of Physio-chemical Parameters of Polluted water samples

Parameters	**Distilled water samples**		
	Sample 1	**Sample 2**	**Sample 3**
Alkalinity	-	-	-
Acidity	-	-	-
Chlorinity	28.4	28.4	28.4
Salinity	30.20	30.20	30.20
pH	7.0	7.0	7.0
BOD (mg/L)	1.2	2	-
COD (mg/L)	2	2	-
Sulphates (mg/L)	2	2	-
Phosphates (PO_4-P/L)	2	2	-
Copper (µg/L)	2	2	-
Lead (mg/L)	2	2	-

Table2. Readings of Distilled water (where used as a blank)

Species Codes	**Species name**	**Low Salinity Zone**	**Medium Salinity Zone**	**High Salinity Zone**	**Present and Referred**
11	*Bruguiera*	0	33.33	0	Yes
13	*Exoecaria*	47.7	53.33	33.33	Yes

Table 3. Mangrove species which matches the Salinity content

Tests conducted:

Figure 3. Total alkalinity and Acidity test

Figure 4. Chlorinity and Salinity test

Figure 5. Biological Oxygen Demand test

Figure 6. Chemical oxygen demand test

Figure 7. Sulphate content

Figure 8. Phosphate- phosphorus content

Figure 9. Copper content

Figure 10. Lead content

Conclusions:

Since Distilled water comes in neutral range Alkalinity & Acidity tests are not applicable and can be considered as blanks. With the help of observations for Salinity values obtained from Powai Lake we recommend that the mangrove species which grow over in dominance are *Bruguiera & Exoecaria* respectively. [For drinking water (tap water) Standard as per IS 10500 – there is no standard for BOD & COD mentioned but ideally it should be NEGLIGIBLE/ZERO].

Results and Discussion:

Total Alkalinity:

Alkalinity of water is its qualitative capacity to react with a strong acid to a designed pH. As a result of dissolution or hydrolysis of solutes, hydroxyl ions present in the sample react with the added acid thus, alkalinity depends upon the end point, pH and indicator used. Total alkalinity is defined as the value obtained by titration using phenolphthalein in and methyl orange indicator (pH at the end point is approximately 0.3 & 3.9 respectively. There is not much difference(mg) between the total alkalinity of both the locations.

Total Acidity:

Acidity of water is the quantitative capacity to react with a strong base to a designated pH. As a result of dissolution or hydrolysis of solutes, hydrogen ions present in the sample react with the added alkali. Thus acidity depends upon the end point, pH and indicator used. Total acidity is defined as the value obtained by titration using methyl orange and phenolphthalein indicator (pH at the end point of titration is approximately 3.7 and 8.3 respectively). No difference in the total acidity is seen since the values obtained for both are the same.

Chlorinity & Salinity:

Chlorinity is defined in terms of weight in grams of $AgNO_3$ precipitated by 1kg of sea water. In a neutral or slightly alkaline solution AgNO3 reacts with CL ions to form a white precipitate of AgCL. Excess of $AgNO_3$ reacts with K_2CrO_4 indicator to form a buff-colored precipitate of $AgCrO_4$. The milli equivalent of $AgNO_3$ utilized in the titration can thus be co-related to the chlorinity of the water sample, to find out salinity the following Knudsen's relationship can be used. When it comes to the Chlorinity & Salinity the readings are differing & their results too. Charni road has more content for chlorinity & salinity as compared to Powai Lake.

Biological Oxygen Demand (BOD):

Oxidation of organic material has a profound effect on aquatic life and aesthetic quality of water. Aquatic organisms use oxygen to break down Carbon based material for assimilation into new cell mass and energy. This is commonly measured as Biological Oxygen Demand. BOD is defined as the amount of dissolved oxygen required by organisms by decomposing organic matter in aerobic conditions. The BOD of both the locations showed variations in their Day 1 & Day 5 readings. By taking the average of the readings we claim that Charni Road has more amount of biological oxygen demand.

Determination of pH:

The ionization of water results in the formation of hydrogen ions and hydroxyl ions. Change in the concentration of one brings about the simultaneous changing in the concentration of the other there by altering the condition of the water. So, a number scale termed pH scale is used to determine the pH of a medium. The pH of both locations claims to be 6 which falls in acidic range

Chemical Oxygen Demand (COD):

The organic carbon in the water sample can be oxidized using a strong oxidizer such as $KMnO_4$ agent. In the presence of H_2SO_4, $KMnO_4$ produces nascent oxygen which reacts with the organic matter in the water sample. The excess of oxygen oxidizes iodide added to the water to form active iodine which is then titrated against sodium thiosulphate. Thus, the amount of oxidizing agent consumed during oxidation can be related to the amount of oxygen required for the chemical oxidation. The difference in the amount of thiosulphate required to deactivate iodine liberated in the blank and sample can be related to the COD of the water sample.The COD of both the locations showed variations in their readings. By taking the average of the readings we claim that Charni Road has more amount of Chemical oxygen demand.

Sulphates content:

In the presence of acetic acid, soluble sulphates from the water sample can be precipitated to form Barium sulphate. Since $BaSO_4$ forms a uniform suspension in the water, it makes the water turbid. The turbidity can be measured on the colorimeter. The absorbance can then be related to that of standard BaSO4 suspension to estimate the amount of sulphates in the water sample. As observed in the table, there was not much difference in the Sulphate content seen.

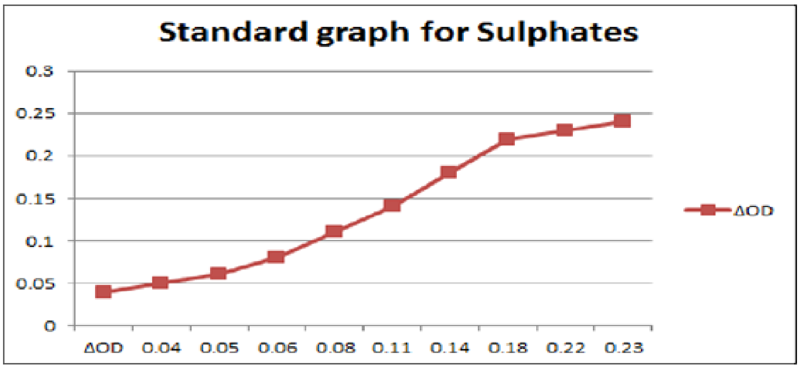

Figure 11. Standard graph for Sulphate

Phosphate-Phosphorus content:

In the acidic medium molybdate ions react with phosphate ions to form golden yellow phosphomolybdate complex. This complex in the presence of a reducing agent like the ascorbic acid is reduced to a blue colored complex the intensity of which is proportional to PO_4-P content. As observed in the table Charni road showed more phosphate- phosphorus content.

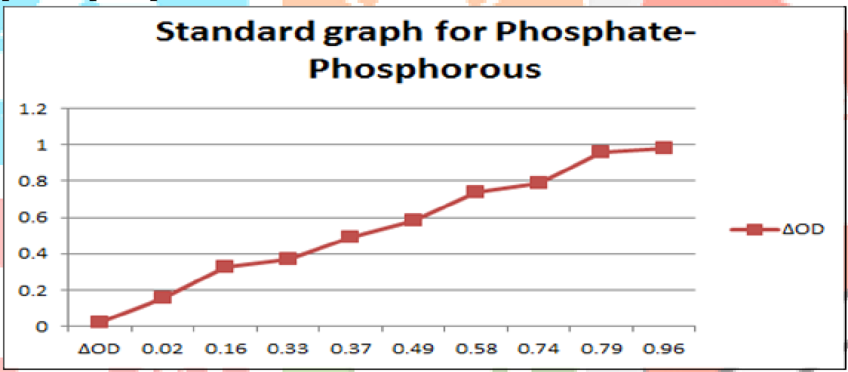

Figure 12. Standard graph for Phosphate-phosphorus

Copper content:

In the alkaline medium copper displaces Sodium in the solution of sodium diethyldithiocarbamate to produce a colloidal yellow brown copper diethyldithiocarbamate. Addition of citrate removes the interferences of other metal ions. As observed in the table, Charni road showed more copper content.

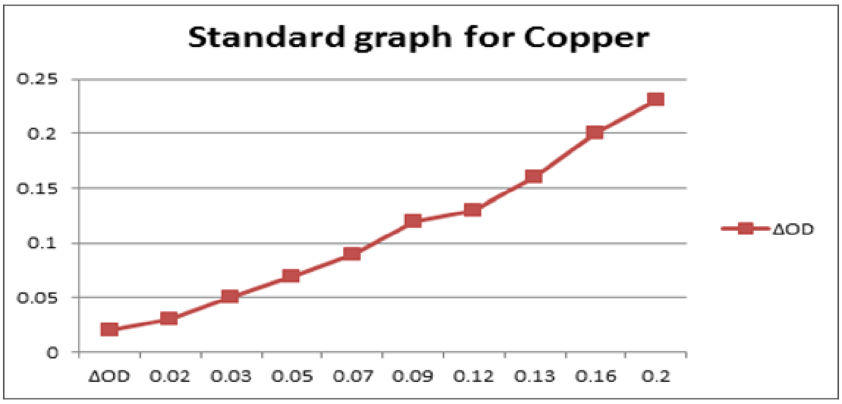

Figure 10. Standard graph for Copper

Lead content:

In the alkaline medium lead reacts with sulphide to form brown color precipitate of lead sulphide. This remains as a fine suspension. The intensity of this color on a colorimeter at 440 nm is proportionate to the amount of lead present in the water sample. As observed in the table, Charni Road showed more amount Lead content.

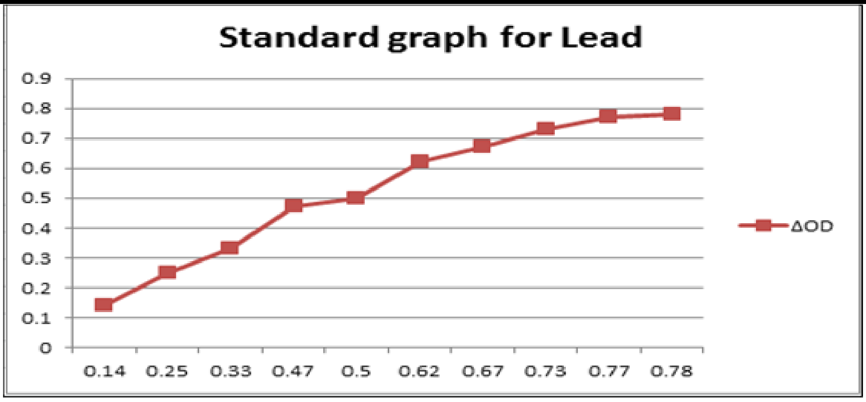

Figure 11. Standard graph for Lead

Conclusion:

Since the research project was based on the comparative studies of both the locations, we conclude that Charni Road water sample showed more variation in water quality characteristics in comparison to the water sample collected from Powai Lake. Distilled was used as blank whereas Tap water was an added experimental sample other than the water samples collected from the two locations. These portrayed very little variation in the characteristics of water quality even when compared to Powai Lake, where the lake water showed more variation but less in comparison to Charni Road water sample.

Acknowledgments:

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