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Analysis of Physico-Chemical Parameters of Sacred Nuggikeri Lake Dharwad (Karnataka), India and Removal of TDS from Water using Natural Adsorbents

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Abstract - *Nuggikeri Lake (Dharwad) 15°24'55"N 75°0'20"E is one of the holy places of visit in Dharwad city with Nuggikeri Hanumappa temple at its vicinity. Regular visit of the pilgrims, the runoff from the agricultural fields and use of lake for domestic purposes adds considerable quantity of pollutants to the lake. Results of the study indicated that the quality of water is below the environmentally safe standards for healthy aquatic systems. Natural Adsorbents are one of the most effective media for removal of contaminants from water and improve the water quality. Therefore, in our study we have used adsorbents like Neem (Azadirachta indica) leaves powder, Activated carbon obtained from Coconut Shell Flour (CSF) which proved to be effective in removal of TDS from the water. The present study dealt with assessment of the physico-chemical parameters of Nuggikeri Lake, Dharwad (Karnataka) India and to analyze the efficiency of Adsorbents i.e. Neem (Azadirachta indica) leaves powder and Activated carbon (Coconut shell Flour (CSF)) with respect to TDS. The efficiency of each adsorbent is conducted over batch study, which includes the effect of various doses, contact time, the effect of initial concentration at normal pH and room temperature.*

Keywords: **physico-chemical parameters, Adsorbent, Activated Carbon, Neem Leaves, Coconut shell, Chloride, TDS, Hardness**.

1. Introduction

Lakes are important resources for aquatic wildlife and human needs, and any alteration of their physico chemical parameters will have wide-ranging ecological and societal implications. Dynamic interactions among biological, chemical and physical processes are frequently either quantitatively or qualitatively distinct from those on land or in air because the boundaries between water and land as well as water and air are distinct. These are an example for Lentic ecosystem. However, unlike rivers and ocean, limited mobility of material occurs in lakes. The sediments received by the lakes through inlets from catchment area erosion get progressively settled to the bottom of the lake. In lentic ecosystem, there is a rapid interaction of sediment and water which increases the biological activities in the lakes [1]. Lakes are dynamic lentic ecosystems which are significant inland water resources for meeting the increasing water demand. However, all these functions depend on the quality of water, which is based on a well-balanced environment in terms of its physical, chemical and biological variables [2]. Mud, silt and human activities like washing and bathing mainly change the water chemistry [3]. In addition to this, water quality of lakes is also impacted by dumping of religious offerings into the lakes [4].Apart from this, lakes have significant economic values including supplying water for irrigation, power generation, providing food via fish and aquatic products and stabilizing the health and biodiversity of important life support ecosystem [5]. Therefore, there is a need for serious characterization of water physico-chemically before its use. In this paper, we have considered the Nuggikeri Lake of Dharwad (Karnataka) India for physico-chemical characterization of water. It acts as a natural water hole for the fodder animals and the villagers. It receives water from surface run-off. The major part of the lake catchment is rich in vegetation of Eichhornia crassipies, Hydrilla, Water lilies, Blue-Green algal blooms. The water quality of Nuggikeri Lake was assessed in terms of physico-chemical parameters during summer season.

Adsorption has emerged as promising technique for removal of contaminants from water. The processes can occur at an interface between any two phases, such as, liquid- liquid, gas-liquid, or liquid-solid interfaces [6]. The adsorption process has not been used extensively in waste water treatment, but demands for a better quality of treated waste water effluent, including toxicity reduction, have led to an intensive examination and use of the process of adsorption on activated carbon. Activated carbon is a solid, porous, black carbonaceous material. It is distinguished from elemental carbon by the absence of

both impurities and an oxidized surface. It can be prepared from a large number of sources such as coconut, wood, peat, coal, tar, sawdust, and cellulose residues. Therefore, we have used adsorbent i.e. Activated carbon; Neem leaves powder [7] and Coconut shell Flour (CSF) [8] for our study. The main aim of our study is to find the removal efficiency of Adsorbents with respect to TDS.

1.1. MATERIALS & METHODS

1.1.1. Analysis of physico-chemical parameters

The surface water samples from Nuggikeri Lake were collected fortnightly from two sampling stations during 08.00 am to 10.00 am. Samples were collected in glass containers of one liter capacity. The sampling of surface water was done by simply dipping the container slowly in water without disturbing the surface and avoiding development of any air bubble in the near vicinity of collection spot as well as in the container. [11]

1.1.2. Removal of TDS from water using Natural Adsorbents.

Study was done using two different Adsorbents in the form of finely powdered Activated carbon such as Neem(Azadirachta indica) leaves powder and Coconut shell Flour.[7][8][9]. Activated carbon using Neem Leaves and Coconut shell Flour in our Institute laboratory.

A. Preparation of Neem (Azadirachta indica) Leaves Powder Adsorbent

Neem leaves were collected from nearby area and they were washed several times with clean water and then with deionized water to remove the dirt, and other impurities and then leaves were dried under sunlight for 7 days. After that leaves were crushed fine. About 20 grams of this material treated with 10ml concentrated HNO_3 & the charred material was kept overnight. Then material was ten washed repeatedly with deionized water & heated in a muffle furnace for 3 hours at 100^0C. Then final adsorbent is ready.[12]

B. Preparation of Coconut shell Flour (CSF) Adsorbent

Coconut Shells were collected and they were washed several times with clean water and then with deionized water to remove the dirt, and other impurities and then leaves were dried under sunlight for 7 days. The dried shells were grinded to fine powder and heated in a a muffle furnace for 4 hours at 200^0C. Then final adsorbent is ready.

2. EXPERIMENTAL WORK

2.1: Analysis of physico-chemical parameters

The sampling of surface water was done by simply dipping the container slowly in water without disturbing the surface and avoiding development of any air bubble in the near vicinity of collection spot as well as in the container. Water temperature, Air temperature and pH were recorded at sampling station. Collected water samples were brought immediately to the laboratory for the estimation of various physicochemical parameters like, Conductivity, Total dissolved solids (TDS), Dissolved oxygen (DO), Total Alkalinity, Total hardness, Ca^{++}, Mg^{++}. Physicochemical parameters were analyzed as per standard methods [11].

Table 1: Physicochemical parameters of surface water of Nuggikeri Lake

Parameters	Unit	Value /Reading
pH		7.8
Temperature	° C	27.2°C
Conductivity	µs/cm	940
Turbidity	NTU	1.8
Alkalinity	mg/L	17.3

TDS	mg/L	730.
Calcium	mg/L	63.9
Magnesium	mg/L	15.4
Total hardness	mg/L	195.3
Potassium	mg/L	58.1
Chloride	mg/L	198
Sulphate	mg/L	85.6
Nitrates	mg/L	0.9
DO	mg/L	6.9
BOD	mg/L	4.8

2.2: Removal of TDS from water using Natural Adsorbents.

Experimentation was done using various concentration of Coconut Shell flour (CSF) adsorbent ranging from 0.5 g/l to 2.0 g/l. The adsorbents were added to the test sample with a batch size of 1000 ml and agitated vigorously in test Jar apparatus at 150 rpm at different time intervals of 15 , 30 and 60 minutes at neutral pH (i.e.7) and room temperature25±5 ^{0}C. The neutral pH(7) which was adjusted by using 0.1N HCl & 0.02NaOH as acid/basic solution. The same procedure is repeated for Neem (Azadirachta indica) leaves powder adsorbent. The mixture is filtered using Whatman filter paper No.41. The filtrate is tested for Total Dissolved Salts (TDS) as per the standard technique.

Table 2: Analysis results of Nuggikeri Lake of Dharwad (Karnataka State) India

Sl No.	Name of the adsorbent	Conditions of study		Treated Water Sample
		Dose (g/l)	Time(min)	TDS(mg/l)
		0.0	0	721 (Stock Sample)
		0.5	15	700.9
		0.5	30	677.1
		0.5	60	656.0
		1.0	15	630.1
		1.0	30	597.3
1.	**Coconut Shell flour (CSF)**	1.0	60	533.5
		1.5	15	618.4
		1.5	30	593.2
		1.5	60	519.4
		2.0	15	618.1
		2.0	30	588.4
		2.0	60	**502.3**
		0.5	15	688.9
		0.5	30	659.1
		0.5	60	578.0
	Neem(*Azadirachta indica*) leaves powder	1.0	15	643.1
2.		1.0	30	627.3
	NLP	1.0	60	541.5
		1.5	15	628.4
		1.5	30	613.2
		1.5	60	543.4

		2.0	15	623.3
		2.0	30	606.2
		2.0	60	**531.6**

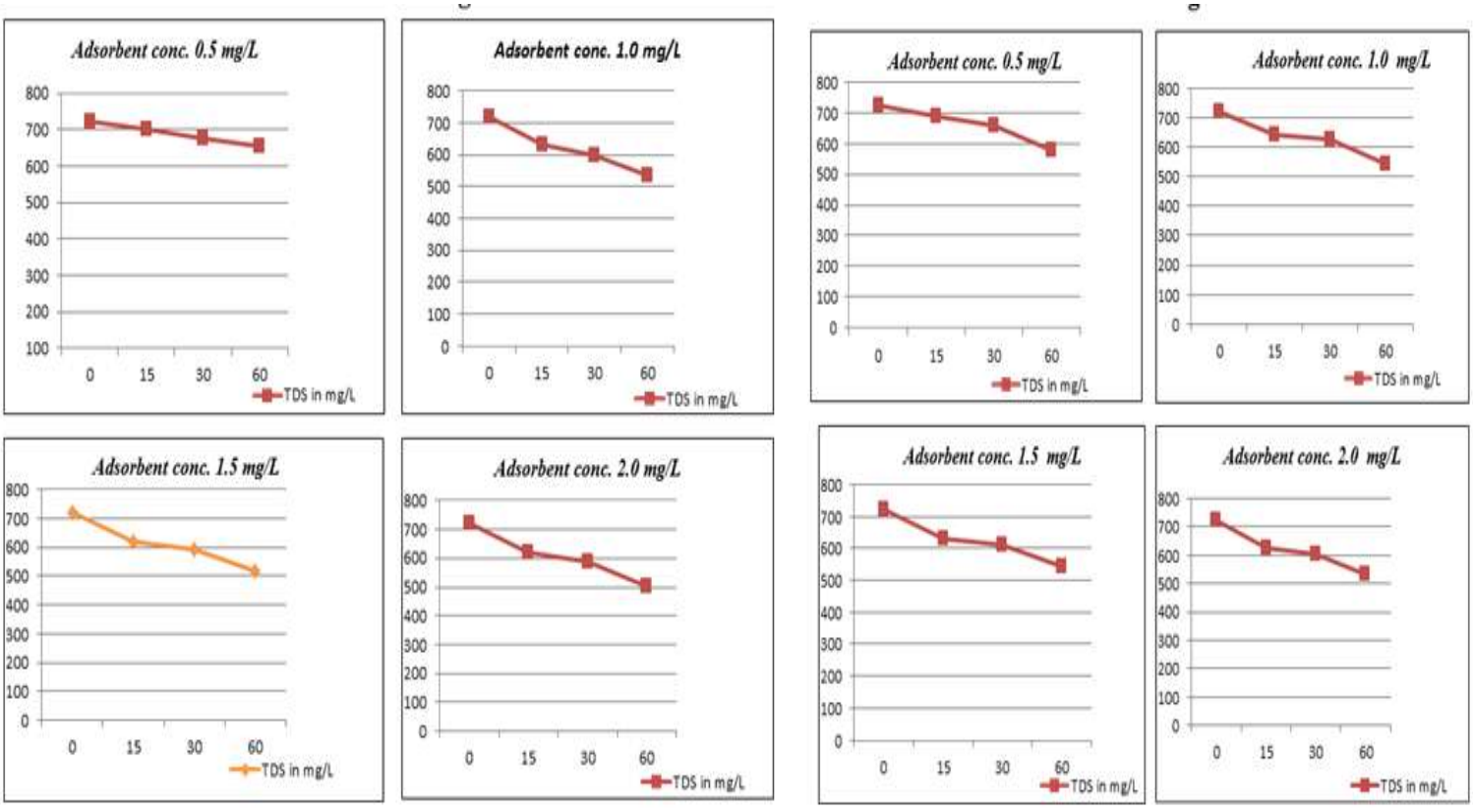
2.3. RESULTS AND DISCUSSION

The physicochemical parameters of the Nuggikeri Lake have been given in the Table 1. The physicochemical features of Nuggikeri Lake water were influenced due to the discharge of effluents from domestic waste and agriculture discharges. The water quality of lake is also impacted by dumping of religious offerings into the lake. The atmosphere temperature was recorded between 27 ^{o}C to 28^{o}C. (Note the water temperature observed during tests in the laboratory was 27.2 ^{o}C). The temperature is one of the important factors in aquatic environment since it regulates physicochemical as well as biological activities [13].

Effect of Concentration of Adsorbent and Time on removal of TDS

To study the effect of different Concentration of adsorbents and contact time with for the maximum removal of TDS (Total Dissolved Solids) from water samples collected from two sampling stations of Nuggikeri Lake were carried out. In the experimental work, the sample results are compared with the original sample (Referred as Stock Sample) of initial TDS of Nuggikeri Lake water to check the efficiency of respective adsorbents in removal of TDS.

It is clear from the results analysis of different test samples that time and adsorbent concentrations play an important role for the removal TDS from the water.



3. CONCLUSIONS

Step I: Water Quality Index of Nuggikeri Lake was calculated from various physicochemical parameters in order to evaluate the suitability of water for various purposes. The index values clearly showed that the status of Nuggikeri Lake is contaminated and not totally safe for drinking purpose. It requires proper monitoring of water quality in order to detect major changes in physicochemical parameters. And environment management plans to control the release of effluents.

Step II: As per experimental work carried out in the institute laboratory with Activated carbon; Neem leaves powder and Coconut shell flour (CSF) at neutral pH and room temperature following conclusions were drawn:

Decrease in TDS (Total Dissolved Solids) is observed as 502.3 mg/L (69.66 %) from 721 mg/L and 531.6 mg/L (73.73 %) using from 721 mg/L for raw water using Coconut shell flour adsorbent and Neem Leaves powder adsorbent at an optimum dose of 2 g/L and contact time 60 respectively. Results reveal a 30.34 % removal of TDS using Coconut shell flour (CSF) to that of 25.94% removal of TDS using Neem Leaves Powder with concentration of 2 g/L and contact time 60 minutes respectively.

No major change in decrease of TDS was observed with change in concentration of Neem Leaves adsorbent from 1.5 g/l to 2.0g/l where as considerable decrease in TDS was observed when concentration of CSF increased from 1.5 to 2.0 g/l which indicates that best results can be obtained when the dosage of CSF is increased.

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