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# Physico-Chemical Properties of Sri Sanishwaran Temple Pond Water, Tirunallar

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**ABSTRACT**

Tirunallar Saniswaran Temple dedicated to Lord Darbaranyeswaran, a form of Lord Shiva. Temple management imposes restrictions over misuse of these holy ponds. The devotees use the holy water for washing their limbs before entering the temple. Sometimes they make a holy dip into the water; people believe that it can wash all their sins away. Thousands of devotees visit the temple. So, the present investigation deals with the physiochemical properties of Sri Saneeshwaran temple pond water. Analysis of water samples revealed that the physico chemical properties such as $p^H$, Electrical conductivity, Total hardness (mg/l), Ca hardness (mg/l), Mg hardness (mg/l), BOD (mg/l), Total Dissolved solids (mg/l), Suspended solids (mg/l), Chlorides (mg/l), Sulphate (mg/l), Sodium (mg/l), Potassium (mg/l), Dissolved Oxygen (mg/l) and Oil & grease (mg/l)., is varied significantly. Similarly the bacterial load is higher in after mass bathing than in before mass bathing.

***Keywords*:** Water analysis; Saneshwaran temple; Devotees; Physico-chemical properties

## 1. INTRODUCTION

Temple Tanks are traditional rectangular rainwater storage structures built very near to the temples in India for use by the community. Usually there are residences all around the temples and the temple tanks. Though in olden times, the water in the temple tank was used for drinking purpose also, now it is used for bathing and washing. These tanks helped in recharging the shallow open wells located in households around the tank. In the recent past, initiatives have been taken to divert rainwater from nearby storm water drains for rainwater harvesting and groundwater recharge. The impact of this system on the groundwater quality is yet to be established.

In recent times temple tanks have fallen into disrepair. Houses have been built around the tanks, which contaminated and tarred, thus preventing ground water from seeping in. Today sewages flow into the temple tanks; as the devotees and public wash their clothes and body with detergents and soap for cleaning or for any other cleansing utilization. Some aquifers have lowered levels and the limited ground water intrusion has resulted in many temple tanks going dry. Over exploitation of ground water has also resulted in saline water entering many of the tanks, in costal region. (Sharma Sundar, 2007). In India, traditionally settlements are located in and around temples. The temple complex includes a tank, which is as an important site for cultural actions, and the temples and tanks are inseparable. Temple tanks occupy a prime position in the day to day living of the people.

Thirunallar is a small town in Karaikal, India, in the Union Territory of Pondicherry (better known in the Tamil Lanuguage as Puducheri), and can be reached by road from the down of Karaikal which lies in the Neighbouring state of Tamil Nadu. Thirunallar is most noted for the shirne of Lord Shani (Saturn), Tirunallar Saniswaran Temple dedicated to Lord Darbaranyeswaran, a form of Lord Shiva. Temple management imposes restrictions over misuse of these holy ponds. Therefore they remain comparatively clean. Temple devotees use the holy water for washing their limbs before entering the temple. Sometimes they make a holy dip into the water; people believe that it can wash all their sins away (Anithakumari and Aziz, 1989, Maya *et al.*, 2000 and Sulabha and Prakasam, 2006). In Thirunallar, every Saturday many devotees are visited the temple and make an oil bath in the temple pond. Similarly, every year the *Sani* is transfered to one *rasi* to another, namely *sanipeyarchi*. At this time some lakhs of peoples are visiting the temple and make oil bath.

After taking mass bath, the water may be polluted or contaminated because by adding on dusts, oil, detergents etc. Many studies have been under taken to the water quality of temple ponds (Subbamma and Ramasarma, 1993; Behura., *et al* 1993; Pandy and Verma 1993; Arun prasath., 1996; Ravichandran *et al*., 2009). So, an attempt was made on the Physic-chemical and bacteriological quality of temple pond water (Before and after mass bathing) at Thirunallar.

## 2. MATERIALS AND METHODS

The present investigation was carried to find out the water quality of Saneeswaran temple pond before and after mass bathing and this research work comprise the physico chemical properties and bacteriological study of water samples.

## 2. 1. Materials

The water samples were collected in clean polythene and sterilized plastic bottles of 2 litre capacity during 8.00 am to 10.00 am. The samples were brought to the laboratory immediately and kept at 4 °C. The physico - chemical characteristics of the samples were analyzed using standard methods as suggested in APHA (2005).

## 2. 2. Methods

### Physico - chemical analyses of water samples

### pH

The pH of the water sample was measured by using pH meter in the field itself.

### Electrical conductivity

The electrical conductivity of the water sample was measured by using a self - contained conductivity meter at 25 °C.

### Total hardness

Take 50 ml of sample in a conical flask. In case of a sample with high hardness a smaller aliquot may also be taken. Add 1 ml of buffer to this. If the sample is having higher amounts of heavy metals, add 1 ml of $Na_2S$ solution. Add approximately 100 mg of Eriochrome Black T indicator; the solution will turn wine - red. Titrate the contents with EDTA solution, the colour changes to blue at end point.

$$\text{Hardness (mg/1)} = \frac{\text{ml EDTA used x 1000}}{\text{ml sample}}$$

### Calcium Hardness

50 ml of sample was taken in a conical flask. 5 ml of triethanolamine and pinch of calcium indicator was added. 100 ml of distilled water and 10 ml of KOH were added. It was titrated against EDTA solution. End point is the appearance of pink colour form greenish pink.

$$\text{Calcium hardness (mg /1)} = \frac{\text{Titration value x 1.6 x 1000}}{\text{Volume of sample}}$$

### Magnesium Hardness

50 ml of water sample was taken in 1000 ml conical flask. 20 ml of ammonium chloride buffer was added. 3 drops of Eriochrome blue - T indicator was added to this solution. It was titrated against EDTA solution. The end point is blue from wine red.

$$\text{Magnesium hardness (mg /L)} = \frac{\text{Titration value x 0.96 x 1000}}{\text{Volume of sample}}$$

**Biological Oxygen Demand (BOD)**

Biological oxygen demand of the water sample was determined by incubating BOD bottles containing the samples kept at 20 °C for five days. The samples were diluted with distilled water and 1 ml of phosphate buffer, magnesium sulphate, calcium chloride and ferric chloride were added to aerate distilled water and the pH was determined. The dissolved oxygen content of one set was estimated immediately following the Winkler's method of estimation of dissolved oxygen. Another set was incubated for 5 days in BOD incubator and the incubated samples were used for the estimation for dissolved oxygen.

BOD (mg/1) = Dissolved oxygen before Incubation – Dissolved oxygen after Incubation x dilution factor

**Total dissolved solids**

Total dissolved solids indicate mainly the various kinds of minerals present in water. Total dissolved solids do not contain any gas and colloids. These can be determined as the residue left after evaporation of the filtered sample. 50 ml of filtered water sample was taken in an evaporating dish and it was evaporated the clear filtrate in the evaporating dish on a water bath. After evaporation, heat it at 103 °C for 1 hour in an oven. Cool in a desiccators and take the final weight and the total solids were calculated.

**Suspended solids**

Suspended solids were estimated by filtering 100 ml of well mixed water sample through Whatmann No.4 filter paper. The residue obtained was dried to a constant weight at 103 °C.

Suspended solids (mg/l) = Total solids – Total dissolved solids.

**Chloride**

A known volume of water sample was taken and pH was adjusted to neutral by adding $H_2SO_4$. 1 ml of $K_2Cr_2O_4$ indicator solution was added. The samples were mixed thoroughly and it was titrated with $AgNO_3$ solution to form pinkish yellow colour. The chloride content was estimated by using the formula.

$$\text{Chloride mg /1} = \frac{\text{(A-B) X N X 3540}}{\text{ml sample}}$$

A - (ml $AgNO_3$ solution for sample)
B - ml $AgNO_3$ for blank
N - Normally of $AgNO_3$

**Sulphate**

Hundred ml of water sample was taken in a glass beaker. 10 ml of concentrated HCl was added and boiled for 5 minutes. It was cooled over night. The liquid was discharged and the precipitate was filtered through Whatmann No. 42. The sulphate was dried, cooled, weighed and calculated.

$$\text{Sulphate (mg/l)} = \frac{\text{Wt of PP} + \text{S} \times 106 \times 96}{\text{Volume of sample} \times 223} \times 1000$$

**Sodium**

Digested sample of the water was subjected to determined the sodium content using flame photometer with filter. The sodium content was determined from the calibration curve. Standard sodium chloride solution was prepared and fed into the flame photometer to draw a standard curve and analyzed sodium value.

Sodium can be determined by dividing the percentage of the sodium concentration to the cationic concentration.

$$\text{Per cent sodium} = \frac{\text{100 x sodium content mg/1}}{\text{Na + Ca + Mg + K content in mg /L}}$$

**Potassium**

Digested sample of the water was subjected to determine the potassium content using flame photometer at 769 nm. The potassium content was determined from the calibration curve. Standard potassium chloride solution was prepared and fed into the flame photometer to draw a standard curve and analyzed potassium value.

**Oil (Partition - gravimetric method)**

Collect about 1 liter of water sample and 5 ml HCl is add to it (Because pH of the water sample is 2 or lower) 30 ml Trichloro trifluoroethane is added to the water sample and transfer this content in a separating funnel preferably shake vigorously for 2 minutes. Let layer separate out, drain solvent layer through a funnel containing solvent moistened filter paper into a clean evacuated distillation flask. It a clear solvent layer cannot be obtained, add 1g $Na_2SO_4$ if necessary. Distill solvent from distilling flask in a water bath of 70 °C for 15 min and draw air through it with an applied vacuum for final 1 minute after the solvent has evaporated. If the residue contains visible water add 2 ml acetone and evaporates on a water bath. The content is cool in desiccators for 30 min and weighs it.

**Most probable Number (Halvorson and Ziegler, 1933)**

One ml of water sample was taken by using beral pipette in a sterilized test tube containing medium. Shake the newly inoculated test tube for at least 10 seconds until the contents are thoroughly mixed. Take one ml of water from the well-mixed test tube to a sanitized test tube containing 10 ml of same media using a beral pipette. After the second test

tube has been inoculated and shake well. This process is continued up to the completed (10 times). Once the dilution series has been inoculated let the test tubes incubate until growth is observed. Once growth is observed, then the amount of organisms contained in the original sample may be estimated.

## 3. RESULTS AND DISCUSSION

Tamil Nadu is a rain - fed state. It depends mainly on water stored in lakes, ponds and under the ground. To conserve water kings and rulers of the state with their long - term vision, created ponds and lakes. Temples were constructed with ponds, either inside or alongside. These temple ponds served the purpose of storage as well as recharge of ground water. The temple tanks have which were used for providing water. The paucity of water in the state required all homes to be built facing the tank, necessarily a square or a rectangular so that the water would run - off the slopping roofs in to the tank. There is several archeological evidence of the construction of tanks in ancient and historical India. Nearly every south Indian village has a temple and a tank. The water of the tank was used for drinking purpose, washing hands and feet before going into the temple and sometimes for irrigating temple lands. Its limited use meant that it maintained ground water levels thus ensuring sufficient water in the domestic wells through the hot summer months. Sacred tanks helped to maintain water level. (Maya *et al,* 2002).

In this study the maximum pH value of Sanesswaran Temple pond water (8.75) was recorded at after mass bathing than in before mass bathing (6.75). Both the values are within the permissible limit prescribed by World health organization. But the water sample collected before mass bathing is acidic and after mass bathing is alkaline in nature. The changes of pH values indicate the alkaline nature of water might be due to high temperature that reduces the solubility of $CO_2$ in water (Mahananda, *et al,* 2010). This result is supported by the findings of Tidame and Sinde (2012); Agarkar and Garode (2000, 2001), Sachidanandamorthy and Yajurvedi (2004; 2006) and Lashari *et al.,* (2009).

Water temperature directly as well as indirectly influences many abiotic and biotic components of aquatic ecosystem. It also reflects to the dynamics of the living organisms such as metabolic and physiological behaviour of aquatic ecosystem. In the present study temperature was found ranging between 28.85 to 30.35 °C of which maximum value (30.35 °C) was noticed in after mass bathing than in before mass bathing (28.85 °C). Many researchers observed similar trends while working on different temple ponds. (Sharma sundar, 2007; Ganesan, 2008; Ravichandran *et al.,* 2009 and Tidame & Sinde 2012). Water temperature is very important parameter because it influences the biota in a water body.

Electrical conductivity is another key factor that determines the quality of water. It is a measure of purity of water. Electrical conductivity is a numerical expression ability of an aqueous solution to carry electric current. This ability depends on the presence of ions, their total concentration, mobility, valence, relative concentrations and temperature of measurement. The EC value in the present study ranged between 0.38 to 0.65 mm hos being maximum value was recorded (0.65 mm hos) after mass bathing and minimum value was recorded (0.38 mm hos) before mass bathing. The fluctuations in EC are due to fluctuation in total dissolved solids and salinity (Pandey & Verma., 1993).

Hardness is due to concentration of alkaline earth metals. Calcium and Magnesium are the most abundant elements in natural surface and ground water and exist mainly as carbonates, bicarbonates and carbon dioxide constituted major source of inorganic carbon to producers in an aquatic ecosystem. They also act as buffers regulating the pH of the medium. Total hardness values ranged from 119.62 to 132.50 mg /l, of which higher value (132.50 mg/l) was found after mass bathing while the lower value was found (119.62 mg/l) before mass bathing. This may be due to the presence of high content of calcium and magnesium in addition to sulphate and nitrates. (Angadi *et al*, 2005).

Biolgical Oxygen Demand (BOD) varied significantly before and after mass bathing. The higher BOD value was recorded after mass bathing than before mass bathing. BOD Values ranged from 2.31 to 3.35 mg/l. This may be due to human activities in and around the pond, and also biodegradable materials are mixed the water (Ravichandran *et al.*, 2009). Mahananda *et al* (2010) and Tidame and Shinde (2012) are also inconformity with the results of present study.

Solids refer to suspended and dissolved matter in water. They are very useful parameters describing the Chemical constituents of the water and can be considered as general of edaphically relation that contributes to productivity within the water body. Total dissolved solids of water samples varied from 88.50 to 99.0 mg/l of which higher value (99.0 mg/l) was reported after mass bathing while the lower value (88.50 mg/l) before mass bathing. Higher concentration of TDS enriches the nutrient status of water body which leads to eutrophication of the aquatic ecosystem. In water total dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, organic matter, salt and other particles (Mahananda *et al.*, 2010). Many studies have been under taken to the assessment of total solids in various pond water samples (Shinde *et al.*, 2011; Mahananda *et al*., 2010; Sulabha and Prakasam, 2006).

Total suspended solids showed high significant positive relationship with turbidity, electrical conductivity, total solid and total dissolved solids. It showed high significant negative relationship with transparency (Shinde *et al*., 2011). The maximum value of total suspended solids was recorded after mass bathing when compared with before mass bathing. High unsuspended solid may be aesthetically unsatisfactory for bathing. The total suspended solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium magnesium, sodium, potassium, manganese, organic matter, salt and other particles. The effect of presence of total suspended solids is the turbidity due to silt and organic matter. (Mahananda *et al.*, 2010). Similar trend was also noted in the earlier reports of Sulabha and prakasam (2006). Saxena and Chauhan (2007) and Umamaheshwari, (2010).

Chloride anion is generally present in natural waters. The chloride concentration is higher in organic wastes and its higher level in natural water is definite indication of pollution from domestic sewage. The ecological significance of chloride lies in its potential to regulate salinity of water and exert consequent osmotic stress on biotic communities. In this investigation the chloride values were higher in the samples collected after mass bathing while the lower value was recorded in the samples collected before mass bathing. The higher content of chloride in ponds may be due addition of human faces and sewage inflow. Chloride increases with the increasing degree of eutrophication (Subbamma and Ramasarma 1993). Chloride was one of the major anion found in water and are generally combined with calcium, magnessium or sodium. High chloride content indicates the accumulation of the polluting substances in these tankes (Ravichandran *et al*., 2009).

Sulphate concentration in the present study varied from 18.70 to 20.10 mg/l of which higher (20.10 mg/l) was observed as the water samples collected after mass bathing while the lower (18.70 mg/l) was observed in before mass bathing.

The higher sodium content of water samples was recorded after mass bathing while the lower content was recorded before mass bathing. In surface water the sodium concentration may be less than 1 mg/l or exceed 300 mg/l depending upon the geographical area. In the present study sodium content varies 6.42 (Before mass bathing) to 7.88 (After mass bathing).

Potassium is a naturally occurring element. Its concentration however, is quite a lower than that of sodium. Potassium concentration in the present study varied form 3.40 to 4.12 mg/l of which higher value (4.12 mg/l) was observed in after mass bathing while the lower value (3.40 mg/l) was recorded before mass bathing. Potassium remains mostly in solution with out undergoing precipitation (Lashari *et al.*, 2009, Mahananda *et al* 2010).

Dissolved oxygen is one of the most important parameter of the water quality, directly affecting survival and distributing flora and fauna in an ecosystem. In the present study higher dissolved oxygen content was recorded after mass bathing while the lower values recorded before mass bathing.

Oil and grease concentration of the water samples varied significantly of which higher Oil and grease concentration was observed after mass bathing while the lower content was recorded before mass bathing. Both the values are within the prescribed limit.

Bacteria are ideal sensors for the indication of microbial pollution of surface water bodies because of their fast response to changing environmental conditions. Faecal coliforms, *E. Coli* and intestinal enterococci (faecal streptococci) are good indicators for the assessment of faecal pollution Higher bacterial load was registered after mass bathing while the lower value was observed at before mass bathing. The fairly high values of total coliform and faecal coliform are indicative of increasing pollution of the ponds by adding organic materials. Therefore a potential health risk exists due to presence of microbial pathogens in water. (Sulbha and Prakasam, 2006). Similar results are also reported in earlier studies of Ravichandran *et al*., (2009), (Mahananda *et al.*, (2010) and Umamaheshwari (2010).

**Table 1.** Physico-Chemical Properties of Sri Saneeswaran Temple Pond Tirunallar.

| S. No. | Water Characteristics | Before mass bathing | After mass bathing | ISI Standard* |
|---|---|---|---|---|
| 1. | pH | 6.75 | 8.75 | 8.50 |
| 2. | Temperature (°C) | 28.85 | 30.35 | 25 to 27 |
| 3. | Electrical Conductivity (µmhos/cm) | 0.38 | 0.65 | 0.55 |
| 4. | Total hardness (mg/l) | 119.62 | 132.50 | 3.00 |
| 5. | Ca hardness (mg/l) | 20.21 | 22.15 | 80.00 |
| 6. | Mg hardness (mg/l) | 15.42 | 18.10 | 30.00 |
| 7. | BOD (mg/l) | 2.31 | 3.85 | 3.0 |

| | | | | |
|---|---|---|---|---|
| 8. | Total Dissolved solids (mg/l) | 885 | 990 | 500 |
| 9. | Suspended solids (mg/l) | 65.0 | 92.8 | 100 |
| 10. | Chlorides (mg/l) | 92.0 | 98.5 | 250 |
| 11. | Sulphate (mg/l) | 18.70 | 20.10 | 150 |
| 12. | Sodium (mg/l) | 6.42 | 7.88 | - |
| 13. | Potassium (mg/l) | 3.40 | 4.12 | - |
| 14. | Dissolved Oxygen (mg/l) | 3.67 | 4.88 | 5.0 |
| 15. | Oil & grease (mg/l) | 0.08 | 0.35 | 0.5 to 1.0 |
| 16. | Feacal Coli form (MPN/100ml) | 75 | 400 | 100/100 ml |

* Source ISI water quality standards.

## 4. CONCLUSION

Temple management imposes restrictions over misuse of these holy ponds, therefore they remain comparatively clean. Temple devotees use the holy water for washing their limbs, sometimes they make a holy dip into the water and people believe that it can wash all their sins away. Similarly many people visit every Saturday in Thirunallar and take oil bath in the temple pond. The water samples for analysis collected exactly Friday 8.00 am for before mass bathing and Sunday 8.00 am for after mass bathing. The analysis reveals that water quality parameters are higher after mass bathing than before bathing. Similarly the faecal coliform also varied significantly. So the temple management should take care and clean the temple pond water immediately after mass bathing to avoid the infectious diseases spreading through the water.

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