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# A Study of the Physico-chemical Analysis of Ground Water and Surface Water due to the Impact of Dyeing Industry Effluents in and around Nallur

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## ABSTRACT

In this investigation, an attempt has been made to evaluate the impact of dyeing industry effluents and sewage water in Noyyal River in and around Nallur at Tiruppur, Tamilnadu, India. In the study area, it has been observed that the people utilized the surface water and groundwater on the banks of the river for domestic and agriculture purposes. There were 2000 residents living on the river bank at Nallur and the Noyyal River was receiving the dyeing industry effluents and sewage from the houses, affecting the surface water badly. During the rainy session, the surging rainwater was mixing with the effluents and reached the river and the groundwater. Hence the groundwater on both sides of the river was polluted by the percolation of the effluent. Water quality analysis of surface water, water in bore wells and open wells has revealed that the water cannot be used for domestic and agricultural purposes. Once an aquifer is polluted by percolation of contaminated water, it is very difficult for reclamation. It has been observed that TDS, hardness and high concentration of chloride has made the water saline and that the dye content was very high, compared to BIS Standards; the groundwater had a high concentration of Ca, Mg, Na and phosphate.

**Keywords:** BIS Standards; Dyeing industry; Ground water; Surface water.

## 1. INTRODUCTION

### 1.1. Water

Drinking water and other household water sources must be of high quality, free of chemical pollution and microbes. Due to over-exploitation of resources and poor waste disposal techniques, the fast development of metropolitan areas has harmed groundwater quality (Rajankar *et al.* 2009). It is a binary compound that occurs at room temperature as a clear colorless, odorless, tasteless liquid; freezes into ice below zero degree centigrade and boils above hundred degrees centigrade and is widely used as a solvent.

Dyeing ore output in India increased from 3 million tonnes in 1950-51 to 75 million tonnes in 1997-98, while steel output increased from 1.04 million tonnes in 1950-51 to 25.1 million tonnes in 1997-98 (Agarwal Ranjana, 2009). The Government of India announced 20 polluting enterprises in Press Notice No. 9 (1984 series) dated June 21, 1984. The dyeing and steel industries are also on the list (Babyshakila and Usha, 2009). As a result, it became necessary to delve deeper into the features of the steel industry's environmental impact assessment. Soil performs a variety of functions that are helpful to humans and other living beings. It functions as a filter, storage buffer and transformation mechanism, protecting the global ecosystem from the negative impacts of environmental contaminants (De, 2000).

Metals are absorbed by plants from the soil, water and air; the uptake is determined not only by the metal's overall amount, but also by its accessibility to roots and transmission through the soil root system (Panda and Kar, 1998). In addition to agricultural and industrial activities, the overall quantity of metal in soil is impacted by the intrinsic impact of steel industry waste on the physico-chemical property of soil natural resources of certain places (Rowell, 1994). Metals in an ionic form in the soil solution are readily accessible, but those bonded to rock material are not.

Co, Mn, and Ni are more accessible when the pH is lower, but Mo and Si are more accessible when the pH is higher. Metal absorption has been seen in a variety of plant species (Shaxson, 1996). Some plants, such as *Astritalics sp.* (Se), *Crotaitalics cobalaticola* (Co), *Phaseolus vulgaris* roots (Zn), *Chlorella vulgaris* algae (Au) and *Sebertia acuminata* (Ni), are known to have a specific propensity for collecting specific metals. The world's greatest Ni deposits are found in *Sebertia acuminata*, Caledonia (Torkashvand Mohammadi,

2010). On a dry weight basis, its leaves and latex can contain up to 10 g and 250 g of Ni compounds per kg. When compared to other plants, aquatic plants acquire hundreds of times more Ag (Van Breemen, 1993).

Environmental contamination caused by industrial wastewater has become a source of worry in India on several levels (Chauhan *et al.* 2000). Pollution of the air, land and water by industrial effluent has been linked to a variety of illnesses and may be the cause of today's reduced life expectancy (WHO, 2002; WHO, 2003). Metallic cations are present in modest levels in industrial sewage effluents. Various approaches were used to measure the mobility of hazardous metals in industrial wastewater (Kazi *et al.* 2005). Toxic compounds entering water bodies are dissolved, suspended in water, or deposited on the bed. As a result, water contamination occurs and the water quality deteriorates, posing a threat to aquatic ecosystems. The consequences of long-term irrigation of such effluents on soil quality are devastating (Olaniya *et al.*; Brar *et al.* 1997). Pollutants can also infiltrate into the groundwater and impact the deposits.

### 1.2 Textile Industry

The textile industry is one of the few basic industries that have always been a necessary component of human life. One may classify it as a more glamorous industry, but it provides with the basic requirement of clothing. There are numerous kinds of fibers and other raw materials, which are used to produce a cloth. Dyeing is an essential process in most of the textile industries.

### 1.3 Stages of Textile Manufacturing

The initial stage of textile manufacturing involves the production of the raw material either by farmers who raise cotton, sheep, silkworms or flax or by chemists who produce fiber from various basic substances by chemical processes. The fiber is spun into yarn, which is then converted into fabric in a weaving or knitting mill. After dyeing and finishing, the woven material is ready for delivery either directly to the manufacturer of textile products where they are finally stitched into wearable clothes.

## 2. SCOPE AND OBJECTIVES OF THE STUDY

A number of industries like the dyeing industry and sewage from the residential area are discharged from the houses located around the Noyyal River and also from the other canals discharges, without any treatment. The volume of the effluent is increasing day-by-day. The absence of the treatment plant to treat the industrial wastewater and the sewage water will lead to the spoilage of the environment. In the near future, people may not be able to get good quality drinking water from the surface water and the groundwater in and around the Noyyal River Bed. The environmental damage caused by water pollution due to the discharge of dyeing industry effluents and sewage water in the Noyyal River has not been studied so far.

### 2.1. Objectives

1. To analyze the physico-chemical parameters of the surface water in Noyyal River at Nallur, Tiruppur, Tamilnadu, India.
2. To analyze the physico-chemical parameters of the groundwater present in the open wells and bore wells on the river bank.
3. To recommend a suitable remedial measure for the treatment of polluted ground water using R.O. system.

**Table 1. Physico-chemical parameters of ground water samples**

| S. No. | Parameter | Method of Analysis |
|---|---|---|
| 1 | Turbidity | Neplo turbidity meter |
| 2 | TDS | Conductivity method |
| 3 | Electrical conductivity | Conductivity meter |
| 4 | pH | pH Meter |
| 5 | Total hardness | EDTA Titrimetric method |
| 6 | Calcium | EDTA Titrimetric method |
| 7 | Magnesium | Calculation from Total Hardness |
| 8 | Dyeing | Spectrophotometer |
| 9 | Ammonia | Nessler’s Method |
| 10 | Nitrite | Spectrophotometer |
| 11 | Nitrate | Spectrophotometer |
| 12 | Chloride | Silver nitrate |
| 13 | Fluoride | Colorimetric meter |
| 14 | Sulphate | Turbidity method |
| 15 | Phosphate | Spectrophotometer |

## 3. MATERIALS AND METHODS

The River Noyyal passes through the village at Nallur from east to west, dividing the village between the north to south being connected through the bridge and causeways. The dyeing industries are located on the northern side of the Noyyal River with a distance 5 km. Water samples from the river for a stretch of about two-kilometer length along the northern and southern banks of the river were collected for analysis. The river receives a large volume of untreated dyeing industry effluent

through the three-meter broad canals from the west upstream. River water samples were collected at two different places along the route. Groundwater samples were also collected from the bore wells with a distance of about 400 to 500 m away from the river bank.

## 4. RESULTS AND DISCUSSION

Water quality studies were undertaken from samples of water at Noyyal River; the purpose was to analyze how far these samples measure up to the standards expected to fulfill safe drinking water. There are standards set by various national bodies like the U.S.P.H. (United Stated Public Health Standards) and B.I.S. (Bureau of Indian Standards) and also international bodies like WHO (Table 1).

### 4.1 Water Quality

The results of various water samples for the various physico-chemical analysis from different sites in the study area are presented in Table 2.

**Table 2. Physico-chemical characteristics of ground water samples**

| Parameters | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | Permissible limit |
|---|---|---|---|---|---|---|---|---|---|---|
| pH | 7.5 | 7.4 | 7.6 | 7.8 | 7.4 | 7.2 | 7.4 | 7.5 | 7.4 | 7.0 - 8.5 |
| Turbidity, NT | 8 | 9 | 8 | 7 | 6 | 6 | 7 | 8 | 6 | 1 |
| Total Hardness | 2400 | 2000 | 1780 | 1900 | 1800 | 1780 | 1710 | 1600 | 1560 | 200 |
| Calcium, Ca | 430 | 405 | 397 | 390 | 360 | 340 | 316 | 380 | 290 | 75 |
| Magnesium, Mg | 270 | 240 | 250 | 270 | 210 | 200 | 200 | 160 | 150 | 30 |
| Nitrite, $NO_2$ | 0.18 | 0.17 | 0.16 | 0.14 | 0.13 | 0.11 | 0.14 | 0.13 | 0.12 | - |
| Nitrate, $NO_3$ | 0.18 | 0.11 | 0.10 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.3 | 45 |
| Chloride, Cl | 3900 | 3600 | 3400 | 3200 | 3000 | 2800 | 2700 | 2060 | 2400 | 200 |
| Fluoride, F | 1.2 | 1.1 | 0.9 | 0.8 | 0.7 | 0.7 | 0.5 | 0.3 | 0.2 | 1.0 |
| Sulphate, $SO_4$ | 210 | 201 | 206 | 194 | 186 | 201 | 182 | 120 | 118 | 200 |

Results are expressed in mg/l

## 5. CONCLUSION

An attempt has been made to evaluate the impact of dyeing industry effluents and sewage water in Noyyal River in and around Nallur at Tiruppur, Tamilnadu, India. It has been observed that the people utilized the surface water and groundwater on the banks of the river for domestic and agriculture purposes. The surface water in the Noyyal River is affected badly due to the continuous discharge of the dyeing Industry effluent and the sewages. During the rainy session, the surging rainwater mixes with the effluents and reaches the river and the groundwater. Hence the groundwater on both sides of the river is polluted by the percolation of the effluent.

Water quality analysis of surface water, water in bore wells and open wells has revealed that the water cannot be used for domestic and agricultural purposes. It has been observed that TDS, hardness and high concentration of chloride has made the water saline and that the dye content was very high, compared to BIS standards; the groundwater had a high concentration of Ca, Mg, Na and phosphate. It was observed that neither the river water nor the groundwater is potable. Alarmingly significant content of Ca, Mg, F and phosphate were observed both in the river and in the groundwater, beyond the limits of BIS standards; the possibilities of blue baby syndrome and stomach cancer diseases are to be seriously considered. It has been suggested to take steps to remove these ions by suitable methods like reverse osmosis.

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## CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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