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Assessment of Water Contamination due to Dyeing and Bleaching Effluents on Noyyal River Basin, Tamil Nadu – A Review

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Abstract: The origin of Noyyal River is the Vellingiri hills which is located in the Coimbatore district, Tamil Nadu, India. The townships of Coimbatore, Tirupur and Erode were surrounded by the Noyyal River, its canals, tanks, and rivulets. Mainly, Tirupur area is facing plights due to the huge concentration of industrial wastes discharged by the cloth dyeing industries**.** This river has 23 check dams and most of them are situated around Kooduthurai and Tirupur. Tirupur area has surrounded by many numbers of dyeing and textile units in the upstream. These units are ejected their effluents into the river which contains lot of chemical and toxic substances. Based on the recent water quality analysis the irrigation wells along the river and in the downstream villages have been contaminated and the ecosystem has been harmfully affected by the seepage and percolation of water stored in the Orathapalayam dam. Ultimately it also create problems to the agriculture, livestock and rearing. Hence the treatment is major concerned before discharging the effluents. For the treatment process, it is necessary to carry out various parameter analyses which determine the quality of water. This article deals with various parametric analyses such as pH, total dissolved solids, calcium, magnesium, nitrates, nitrites, BOD, COD, DO , heavy metals and the effects of various pollutants involved in Noyyal River basin.
Keywords: Noyyal River, Tirupur, Water quality.

Introduction

The Noyyal River's basin is extended upto 180 km and 25 km broad and occupied a total area of 3,500 km². The basin is surrounded by 1,800 km² area of cultivated land. The population compactness of the rural areas is 120 people per km² and for the cities 1000 people per km².

Due to untreated effluent discharged in the river, the groundwater has been contaminated. Hence it is no longer suited for irrigation.

Since water pollution is a major environmental hazard, experts started their research works in the earliest of 1980's to reduce its ill effects. Specifically, the Tirupur area has been polluted due to dyeing industries hence researchers investigated numerous analyses for concerning water quality of Noyyal River basin. Ramasamy and Rajagopal, 1993 examined the groundwater quality in Tirupur[1]. Based on the analysis, they shaped the results that the quality of the groundwater in Tirupur was started decreasing due to the dyeing industries. On the other hand, the water quality of effluents from dyeing and bleaching industry in Tirupur has been analyzed by Senthilnathan and Azerz[2],1999. They suggested that the industrialist have the responsibility to

discharge the effluents with careful treatments[2].Sundar and Saseedharan, 2006 investigated the groundwater quality in Noyyal River basin. The result demonstrated that due to industrialization the groundwater quality was spoiled in and around Noyyal River basin[3]. Geetha et al., 2008 also performed study on the possessions of textile and dying effluents on Noyyal River basin in Tirupur[4].

The fast rate of industrialization is affecting in and around of Coimbatore city by dyeing effluents. Now a day, researchers are focusing more attention on water quality analysis in those areas[5]. The hydro-geochemistry analysis for groundwater of Noyyal river basin has been examined to characterize the groundwater[6]. Usharani et al., 2010 has also analyzed the physic-chemical and bacteriological characteristics of Noyyal River and its groundwater quality. The land use and land cover detections have been integrated by Santhosh Baboo and Renuka Devi, 2010[8] using Remote sensing and GIS for Coimbatore district.

Bolstad and Swant, 1997 had assessed the collective impacts of land use in the southern Appalachian watershed, based on quality of water[9]. The same kind of work has been undergone by Chang et al., 2008[10]. In addition, landscape characteristics and surface water quality relationship have derived by them. Cyrill Wilson and Qiban weng, 2010 had also assessed the former problem and the relationship between the water quality and urban land cover modifies in the lake Calumet area, Greater Chicago[11]. In Turkey, Buyukcekmece watershed pollution profile was assessed by Gokce Tezenli Guyer and Esra Genc Illhan, 2010[12]. Evaluation and estimation of the groundwater resources and potential of Pathri Rao watershed, Haridwar district, Uttarkhand was studied by Singhal et al., 2010[13].

In the view of water quality analysis, the experts are performing their research work using various advance technologies. Choi et al., 2003 evaluated the long term hydrological impact for watershed urbanization using GIS and simulation model for watershed management[14]. In Himachal Pradesh for the lesser Himalayas, Walia et al. 2010 prepared a map which shows characterization of watershed and soil resource for Moolbari watershed, Shimla district[15]. Land cover or land use parameters had assessed for marphometric analysis using remote sensing and GIS approach[16].

Parameters Estimation In Noyyal River

pH

pH is an important parameter to check the quality of water sample. Various human activities as well as some natural processes[17] are responsible to change the pH of water sample from 7.64 to 8.62. Selvarani and Elangovan, 2009 examined that pH level of Noyyal River water samples, it was found to be in the range between 7.25 and 9.09 which indicate that the river samples was alkaline in nature[6]. Geetha et al., 2008 suggested that pH values of sample in the area varied from 6.96 to 8.5 which is similar to the findings of selvarani and Elangovan,2009 indicates alkaline nature of the ground water[4]. Senthilnathan and Azerz, 1999 observed lowest pH value at Chinnakarai area and highest at Kassipalayam and Mudalipalayam area[2].

Total Dissolved Solids

Total Dissolved Solids is one of an important parameter in water quality analysis. If it exceeds the permissible limits, unsafe for human beings as creates kidney and heart diseases[18]. And also the laxative and constipation effects are produced due to the presence of more solids in water[19]. Senthilnathan and Azerz,1999 discussed that textile dyeing and bleaching industries effluent containing high TDS (Table 1) level (8000 ppm) and low TDS level (1510ppm) released at chinnakari and mudhalaipalam respectively[2]. Noyyal River TDS study was investigated by selvarani and Elangovan, 2009 and they demonstrated that samples of 58% are less than the permissible limit which 16% of the samples had desirable limit and remaining 42% was undesirable in Annur, Avinasi, Sulur, Palladam, Pongalur, Perundurai, Chennimalai, Tirupur, K.Paramathy and some parts of Karur block[6].

Electrical Conductivity

In Tirupur region Electrical Conductivity of groundwater has been tested by Arumugam and Elangovan[20], 2009 and results show that samples of 37% are available within the allowable limit and samples of 45% are impermissible, but these are slightly deprived in quality and only 18% of the sample locations can be classified as dangerous according to the World Health Organisation (WHO) standard[20]. Medium value of electrical conductivity 10 to 25µS/cm was present at the water sampling sites namely Vallipalayam,

Kulatthupalayam, Kovilur, Sivagiripudur, Uttukkuli and Pallarpalayam. Electrical Conductivity in range of 1 to 10 µS/cm found in the sampling sites of Somanur, Rayapuram and Tirupur New BS[4]. Very high value of electrical conductivity (27-66.7µS/cm) found at the sampling sites of Peelamedu, Mangalam, Avinashi, Orathupalayam, Karuvapalayam, Tirupur-RS, Padiyur, Marur, Kodumanalpudur, Maravanpalayam, Kodumanal ,Palayakottai, Kuppichipalayam, Chinnamuthur, Velayutahmpalayam, Pudur and Attupalayam.

Chlorides

Chlorine is an important parameter in water sample analysis. The acceptable limit for chloride content is 200ppm. Soil porosity and permeability play a vital role in strengthening the chlorides concentration[21]. Due to the bleaching and dying process in the dyeing units, chloride is found in excess concentration near Noyyal River course and lakes[20]. Selvarani and Elangovan, 2009 has studied that the chloride ion concentration ranges from 26 to 1656ppm in Noyyal River basin and the result shows that chloride is in excess concentration for 20% of the samples. Chloride concentration within the permissible limit was available at SS Kulam, Annur, Sultanpet, Avinasi, Sulur, Chennimalai, Tirupur, and K.Paramathy[6]. Geetha et al., 2008 observed that chloride concentration varied from 153 ppm to 3012 ppm[4]. Samples obtained from Kodumanalputhur and Orathupalayam was found to contain 3012 and 2265 ppm chloride concentration respectively[4]. Senthilnathan and Azerz, 1999 found high value of chloride content (3545ppm) at mangalam and low value (886ppm) at Mudhalaipalayam[2].

Phosphate

Phosphate is the important parameter to analyze ground water sample which should be permissible in the range from 0.31 and 3.94 ppm. But it pollutes the ground water when the concentration is more than 2 ppm. Senthilnathan and Azerz, 1999 observed acceptable phosphate level in Noyyal River basin except Ksaipalayam[2].

Nitrite And Nitrate

Nitrogen is originally fixed from the atmosphere and then mineralized in to ammonium by bacteria present in soil. The nitrate ion concentration changes from 6 to 520 ppm with an average value of 79 mg/l. Nitrite was identified to be the etiologic agent of methaemoglobinaemia[22]. In groundwater, nitrogen concentration was obtained from the biosphere[23]. Selvarani and Elangovan, 2009 found that the River basin of Noyyal was contained 98% of the samples are in the acceptable limit[6]. Nitrate level was found to be low near Noyyal River basin and maximum obtained value was 0.02ppm[2].

Alkalinity

Geetha et al., 2008 observed alkalinity values, varied from 165 to 675ppm in Noyyal River basin[4]. The result explained that ground water alkalinity of the samples in Kodumanal, Orathupalayam and Kodumanalpudur are further than 600 ppm[4]. Senthilnathan and Azerz, 1999 found high alkalinity value in the range varied from 250 to 650 ppm because of strong acids and bases present in effluent[2]. Arumugam and Elangovan, 2009 has studied 62 samples, out of which 27 samples contained more alkalinity value than the maximum allowable limit of 500 ppm which is due to untreated effluent discharge from dyeing and bleaching industries[20]. According to Selvarani and Elangovan, 2009 report, 85% of the samples arrive under pleasing and acceptable limit. Alkaline water samples, higher than the permissible limit in some places of Tirupur district like Pongalur, Madukarai, Perundurai, Tirupur, Chennimalai, and some parts of Avinasi, K.Paramathy and Karur were observed[6].

Hardness

Sawyer et al., 2003 explained empirical formula for the calculation of total hardness in water sample[24,25] . The most permissible limit for total hardness is 80–100 ppm[26]. In Noyyal River basin, the total hardness was found minimum in Mudalipalayam (390 mg/L) and maximum in Mangalam (4700 ppm)[2.] Total hardness was studied in Noyyal River basin by Geetha et al., 2009. The result demonstrated that only one sample was available within the tolerance limit and 60% of samples exceeded maximum permissible limit. Based on their findings, the hardness of Kodumanalpudur and Kulathupalayam areas are exceed the permissible limit[4].

Calcium

Geetha et al., 2008 studied calcium level in Noyyal River and its concentration of calcium ranged between 20 to 290 ppm in the area[4]. Based on their finding, the level of calcium was lying in the acceptable limit, except the two samples obtained at Uttukuli and Kodumanalpudur[4]. According to Senthilnathan and Azerz, 1999 observation, highest value(1900 ppm) present at Mangalam and lowest value(250ppm) available at Mudhalaipalayam[2].

Magnesium

The presence of magnesium is minimum than calcium content and also the enrichment mineral the process of magnesium dissolution is a slower than calcium[27]. Geetha et al., 2008 studied magnesium concentration in their study location which is varied from 15 to 282 ppm[4] . The report explained that samples of water obtained from Kalatthupalayam, Kodumanalpudur and Karuvapalayam were found to contain 241, 282 and 180 ppm[4]. Senthilnathan and Azerz, 1999 studied magnesium level in Noyyal River basin[2] it was found Magnesium level was higher value of 1900mg/l at Mangalam and minimum value of 250mg/l at Mudalipalayam[2].

Potassium

Geetha et al., 2008 observed potassium analysis in Noyyal River basin[4]. The result demonstrated that potassium concentration ranged between 5 to 311 ppm through an average 38 ppm in ground water and anomalous potassium range is identified in Vallipalayam[4.] Similarly, Potassium concentration in Noyyal River basin was studied by Senthilnathan and Azerz, 1999. Maximum concentration of 80ppm potassium was identified in Veerapandi and minimum of 10ppm in Mudalipalayam area[2].

DO, BOD and COD

If the ground water consists more concentration of BOD and COD, it determines high percolation of surface waster pollution[28]. BOD and COD values were monitored in Noyyal River basin by Senthilnathan and Azerz, 1999. The value of BOD is varied with the maximum of 140ppm in Veerapandi and minimum of 80ppm in Chinnakarai and value of COD is varied with the maximum of 928ppm in Chinnakarai and minimum of 220ppm in Andipalayam area[2].

Sulphates

Selvarani and Elangovan, 2009 observed that more number of the samples drop under the restrained condition[6]. Arumugam and Elangovan, 2009 reported that sulfate concentration in groundwater is in the permissible limit for all the sample[20]. Geetha et al., 2008 studied sulfate level in Noyyal River basin. Their findings are similar with Arumugam and Elangovan, 2009 report and it was found that sulphate concentration was very high than the tolerance limit[4].

Sodium

Sodium concentration (>50 ppm) make the water unsuitable for domestic use. Sodium study in Noyyal River was done by Geetha et al., In Marur, Kodumanalpudur, Kodumanal and Palayakottai, sodium level was found to be maximum[4]. Selvarani and Elangovan, 2009 observed that the samples of 86% drop under tremendous class, while the rest of the samples drop in first-class[6].

Heavy Metals

Heavy metals such as copper, zinc, cadmium and chromium study was investigated by Senthilnathan and Azerz, 1999 in Noyyal River basin[2]. According to their report, copper concentration level was maximum and cadmium concentration was found to be minimum[2]. 99% of the water samples in Noyyal River have less than1 ppm iron concentration which falls under good quality. This is suitable for industrial, irrigation and drinking purposes[6]. Geetha et al., 2008 studied Cyanide level in their study area and it was not identified in river basin[4].

Conclusion

The review provides an overview on the contamination of Noyyal River water basin due to bleaching and dyeing effluents assessed by various water parameters which would alter the water quality. The results have well been corroborated with WHO standards for all the water parameters that help us to realize the serious water quality deterioration. Various studies confirmed that the underground water quality of the Noyyal River's basin was contaminated due to dyeing and bleaching effluents. From those analyses, to maintain the water quality researchers suggested that the effluent treatment is must before discharge. So, periodic (pre monsoon, post monsoon and summer) assessment of water quality based on water parameter analysis is mandatory. This will help to preserve future sustainability in water quality.

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