*Available online at http://www.journalcra.com*

*International Journal of Current Research*
*Vol. 7, Issue, 02, pp.12332-12336, February, 2015*

**INTERNATIONAL JOURNAL OF CURRENT RESEARCH**

**ISSN: 0975-833X**

## RESEARCH ARTICLE

# PERFORMANCE ASSESSMENT OF CETPs POST ZERO LIQUID DISCHARGE IMPLEMENTATION IN TIRUPPUR, TAMILNADU

***Abhilash, P. R. and Govindaraju, M.**

Department of Environmental Biotechnology, Bio-Spatial Technology Lab, Bharathidasan University, Tiruchirappalli 620 024, India

**ARTICLE INFO**

***Article History:***
Received 20th November, 2014
Received in revised form
05th December, 2014
Accepted 07th January, 2015
Published online 26th February, 2015

***Key words:***

TDS,
Effluent,
CETP,
Waste water Treatment,
BOD, COD,
Zero Liquid Discharge (ZLD).

**ABSTRACT**

Modern industrialisation has resulted in wide spread use of water for the industrial chemical processes and thus resulting not only in depletion of natural resources but also the large scale environmental pollution by the discharge of the untreated or partially treated waste water to land and water bodies. The present study covers the waste water pollution resulted by several CETPs located in an around Tiruppur area which discharges to the river Noyyal. Over a period of years with the increase in the production, quantity of waste water getting generated and discharged got increased which eventually depletes both the Noyyal river as well as the surrounding ground water quality. Some of the chemicals such as Sodium chloride used in textile bleaching process without proper treatment and recovery reaches to the water bodies and land resulting in high level of Total dissolved solids in the entire area. This ultimately affect the availability of good drinking water and resulting in dependency of tanker water for drinking water which is brought from places which are around 30 km away from Tiruppur city. In late nineties, the industrial units in Tirupur area have started putting up effluent treatment plants, either individually or collectively depending on their convenience and location in order to prevent water pollution as well as to revive and restore the health of the already damaged environment. Apart from the individual ETPs, 7 CETPs with physicochemical treatment facilities were commissioned during 1998-99 to treat about 40450 KLD of effluent and let-out the treated effluent into drainage canals which join Noyyal river. Due to inadequate treatment facilities, these CETPs as well as the individual ones failed to meet the quality criteria especially the total dissolved solids level of less than 2100 mg/l prescribed for treated effluent (Central Pollution Control Board Standard, 2000). Hence, they were directed to incorporate Zero Liquid Discharge (ZLD) system during the year 31st July 2007 so as to ensure recovery & reuse of water and salt as well as minimize sludge generation.



## INTRODUCTION

The concept of common Effluent Treatment Plants (CETPs) was originated in mid eighties to treat the waste water generated by cluster of small scale industries, since such units were not in a position to have individual treatment facilities due to the shortage of land, huge capital investment and high repair and maintenance cost. Hence CETPs were perceived to be a feasible solution for abatement of industrial waste water pollution. The ministry of Environment and Forest (MoEF), Government of India has initiated technical and financial support schemes in 1991 for promotion and start up of common treatment facilities in order to treat and dispose of waste water and hazardous solid wastes generated by industrial units . The outcome of this saw several CETPs commissioned across the country over the years and many more are in the pipeline.

***Corresponding author: Abhilash, P.R.***
*Bio-Spatial Technology Lab, Department of Environmental Biotechnology, Bharathidasan University, Tiruchirappalli 620 024, India.*

The idea of CETP was adopted as a measure to attain end - of - pipe treatment of combined waste water at lesser unit cost than it could be achieved by individual industries and to facilitate the discharge, monitoring and enforcement of environmental regulatory agencies.

### Study area

Tiruppur is a city in the south Indian state of Tamil Nadu. It is a mid-sized industrial town located in the upper hydrological basin of the Cauvery River. The basin suffers from water scarcity due to erratic seasonal rainfall, limited reservoir capacity and a high demand on the already limited resource. It has a geographical area of 27.19 $Km^2$ divided into 60 corporation wards located at $11^{O}10'N$, $77^{O}18'E$. The town has witnessed huge surge in the industrialization during the last two decades or so which resulted in the establishment of around 6250 industrial units in the area. Out of this, there are around 1500 knitting units and 4750 other units which are into various activities of textile processing such as dyeing, bleaching, fabric

painting, garment making, embroidery etc. As a consequence, the skilled and unskilled workforces also migrated in to the city from other regions. The population of the city stood at 444,352 as per the 2011 census (**Census Report, 2011**). Due to its famed hosiery and knit wear products, Tiruppur is often referred to as 'T Shirt city' internationally. It is also the major knit wear hub of India accounting about 45% of the total knit wear exports from the country. Tiruppur's textile mills exported over Rs 17,800 crore worth of products in 2013-14, of which 65 per cent went to Europe (The Economic Times, July 4 2014, Chennai). Knitwear is one of the major sources for employment in Tiruppur. Around four lakh people are dependent on this industry. But in the recent years besides external factors like economic slowdown, the industry is also facing pollution related issues which resulted in to closure of several units not meeting the required standards.

A natural drainage canal, namely 'Noyyal River', is passing through the town virtually dividing it into two halves and carrying sewage and industrial wastewater. The Noyyal River being seasonal river has peak flow only during monsoon plays reluctant host the rest of the year to untreated sewage and industrial effluents from Coimbatore and Tiruppur, the two main cities in its basin. The river gets polluted when it passes through Tiruppur, due to discharges of 96.1 million litres per day (MLD) of colored effluent with high total dissolved solids (TDS) in the range of 6000 to 7000 mg/L, by the textile bleaching and dyeing units in Tiruppur (**TNPCB Report ,2009**). The Tirupur's textile industry uses bleaching liquids, soda ash, caustic soda, sulphuric acid, hydrochloric acid, sodium peroxide, and various dyes and chemicals for its dyeing and bleaching processes. Many other harmful substances include a number of dyes, many based on benzidine structures or heavy metals, both known to be toxic. Most of these chemicals are not retained in the finished hosiery goods, but are discharged as wastewater.

The wastewater is acidic, smells terrible and contains dissolved solids, which increase the biological and chemical oxygen demand in water. With no freshwater available for dilution, the groundwater from Coimbatore and Tiruppur is no longer suited for irrigation. In recent years, the name of the town got a hammering from environmentalist and farmers for all wrong reasons due to the adverse impact generated by the discharge of wastewater. These textile processing units produce daily about 100 million liters of effluent having high load of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Color and Total Dissolved Solids (TDS) and discharge it into the surrounding environment. Due to its small scale nature, majority of these industries could not establish effluent treatment system and those having their own treatment plant also do not treat the wastes effectively to required quality.

The partially treated or wholly untreated wastewater finds its way into the Noyyal river system resulting in stagnation of the same in the river bed throughout the year and percolation into the ground water. As a result, the ground water is highly polluted to such an extent that it is found unfit for any purpose including domestic, industrial and agricultural activities. With the non-availability of safe water, the public in general and farming community in particular started campaign against industrial pollution and sought judicial intervention to incorporate 'Zero Liquid Discharge' technologies in the effluent treatment plants.

## MATERIALS AND METHODS

The inlet and outlet water samples were collected from all the 7 CETPs which were operational during 2007 and 2013. Waste water monitoring was conducted during July month for 2007. The Zero Liquid discharge system was implemented for these CETPs during 2009. Monitoring was performed again during 2013 on July month to assess the improvements in the treatment system. Inlet and outlet CETP water samples were collected in 2.5 liter new plastic containers and later analyzed in laboratory. The samples were analyzed for Chemical parameters as per the standards methods of APHA, 2005.

## RESULTS AND DISCUSSION

The Various Chemical parameters analyzed for the CETPs in 2007 and 2013 are provided in Table 1. Analysis results obtained for different parameters are discussed in detail as below. Seven CETPs which were commissioned during 1998-99 discharge the wastewater after physicochemical treatment. During the year 2007, the CETPs were monitored for its performance (Table 1) vis-à-vis consent conditions (Table 2). Conductivity ranges from 7419 mg/l to 11216 mg/l for the outlet samples. The important parameters such as BOD, COD and TDS were far exceeding the prescribed limits of 30 mg/l, 250 mg/l and 2100 mg/l respectively. The raw effluents have BOD level in the range of 190 mg/l to 390 mg/l which is reduced by 74mg/l to 310 mg/l through the treatment facilities available during 2007. BOD values up to 300 mg/l were obtained during the similar studies (**Samuel Rajkumar and Nagan, 2011**). COD outlet values have not reduced (Range 840 to 2410 mg/l) owing to the concentration rise during the homogenization and ineffective treatment systems. As far as TDS is concerned the outlet samples recorded as high as 7510 mg/l which is much higher than the prescribed limits of 2100 mg/l. For Chloride (418 to 914 mg/l), Sulphates (1612 to 2212 mg/l), T. phosphates (3.1 to 12.6 mg/l), Sodium (629 to 1164 mg/l), Potassium (17 to 42 mg/l) and Total kjeldahl nitrogen (2.4 to 11.2 mg/l), the reduction is very less and in some cases their concentration in the treated effluent were found to be increased. This is attributed due to the usage of excess quantity of chemicals in the CETP operations.

The values are comparable to the results obtained during the water quality studies done on Noyyal river by **Geetha *et al.*, 2008**. The results of the present study revealed once again that the treatment facilities at various CETPs during 2007 are inadequate and need to be upgraded by incorporating ZLD scheme so as to meet the tolerance limits prescribed for discharge of treated effluent. For the same CETPs, the samples collected during 2013 shows considerable reduction in different chemical parameters. The analysis results are presented in Table 1. Results indicate that there is considerable reduction in values for various parameters. Conductivity readings have significantly reduced to the range of 1012 to 1462 mg/l.

**Table 1. Physicochemical characteristics of Effluent at inlet and outlet of CETPs at Tiruppur during 2007 and 2013**

| Characteristics of Effluent at Inlet and Outlet of CETPs located in Tiruppur Area, Tamil Nadu during 2007 & 2013 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.No | Parameters | Sample | Angeripalayam | | Andipalayam | | Chinnakarai | | Kasipalayam | | Kunnangalpalayam | | Mannarai | | Veerapandi | |
| | | | July '07 | July '13 | July '07 | July '13 | July '07 | July '13 | July '07 | July '13 | July '07 | July '13 | July '07 | July '13 | July '07 | July '13 |
| 1 | Conductivity, (µs/cm) | Inlet | 7112 | 10288 | 9640 | 10617 | 10241 | 12411 | 8940 | 9765 | 7964 | 11624 | 9619 | 13165 | 8941 | 10621 |
| | | Outlet | 7419 | 1067 | 10188 | 1174 | 11216 | 1462 | 9318 | 1232 | 8409 | 1012 | 10016 | 1361 | 9222 | 1223 |
| 2 | BOD, (mg/l) | Inlet | 310 | 210 | 280 | 190 | 190 | 340 | 210 | 140 | 280 | 170 | 340 | 220 | 310 | 130 |
| | | Outlet | 220 | 19 | 210 | 26 | 170 | 21 | 190 | 17 | 240 | 31 | 310 | 24 | 270 | 20 |
| 3 | COD, (mg/l) | Inlet | 1920 | 1230 | 1340 | 1040 | 910 | 1610 | 1020 | 1120 | 1610 | 1310 | 2010 | 990 | 2200 | 860 |
| | | Outlet | 1940 | 60 | 1410 | 79 | 840 | 64 | 1050 | 60 | 1840 | 99 | 2100 | 102 | 2410 | 59 |
| 4 | TDS, (mg/l) | Inlet | 4765 | 6870 | 6535 | 4350 | 6865 | 8350 | 5980 | 6635 | 5400 | 7775 | 6445 | 8910 | 6055 | 7110 |
| | | Outlet | 4955 | 712 | 6966 | 765 | 7510 | 970 | 6308 | 840 | 5610 | 675 | 6710 | 910 | 6255 | 820 |
| 6 | Chloride, (mg/l) | Inlet | 409 | 713 | 823 | 914 | 890 | 976 | 636 | 725 | 552 | 912 | 619 | 1017 | 519 | 826 |
| | | Outlet | 418 | 258 | 864 | 214 | 914 | 274 | 694 | 201 | 603 | 267 | 766 | 251 | 598 | 196 |
| 7 | Sulphates, (mg/l) | Inlet | 1516 | 2019 | 1910 | 2161 | 2114 | 2315 | 1719 | 1819 | 1604 | 1729 | 1800 | 2416 | 1726 | 1841 |
| | | Outlet | 1612 | 214 | 2126 | 219 | 2212 | 256 | 1906 | 219 | 1719 | 243 | 1912 | 235 | 1814 | 167 |
| 8 | Sodium, (mg/l) | Inlet | 716 | 1172 | 846 | 896 | 1025 | 1217 | 912 | 929 | 592 | 1112 | 816 | 1204 | 769 | 902 |
| | | Outlet | 761 | 41 | 894 | 36 | 1164 | 44 | 1014 | 29 | 629 | 35 | 952 | 28 | 851 | 43 |
| 9 | Potassium, (mg/l) | Inlet | 21 | 58 | 14 | 34 | 19 | 67 | 11 | 28 | 34 | 29 | 16 | 55 | 21 | 25 |
| | | Outlet | 24 | 4.6 | 17 | 7.3 | 24 | 2.8 | 17 | 4.5 | 42 | 7.1 | 24 | 3.5 | 36 | 3.1 |
| 10 | T.Hardness, (mg/l) | Inlet | 736 | 1096 | 894 | 865 | 916 | 1120 | 799 | 884 | 725 | 1042 | 909 | 969 | 816 | 896 |
| | | Outlet | 751 | 201 | 979 | 148 | 974 | 164 | 864 | 137 | 919 | 168 | 994 | 179 | 888 | 193 |
| 11 | T.Phosphates, (mg/l) | Inlet | 7.1 | 5.4 | 2.4 | 2.7 | 2.9 | 6.4 | 6.3 | 3.7 | 2.9 | 4.4 | 10.2 | 5.9 | 7.5 | 4.8 |
| | | Outlet | 9.5 | 1.6 | 3.7 | 1.3 | 3.1 | 1.1 | 7.5 | 1.1 | 3.1 | 1.7 | 12.6 | 1.3 | 9.1 | 2.4 |
| 12 | NH3-N, (mg/l) | Inlet | 2.9 | 4.7 | 4.3 | 6.2 | 7.5 | 7.5 | 2.1 | 5.5 | 3.5 | 3.1 | 7.4 | 8.5 | 2.4 | 4.1 |
| | | Outlet | 6.5 | 1.2 | 6.1 | 3.5 | 9.8 | 3.1 | 2.9 | 1.9 | 11.1 | 2.7 | 11.5 | 2.9 | 3.6 | 1.3 |
| 13 | TKN, (mg/l) | Inlet | 19 | 28 | 11 | 40 | 21 | 48 | 34 | 32 | 17 | 19 | 20 | 26 | 35 | 21 |
| | | Outlet | 24 | 5.2 | 19 | 4.1 | 36 | 12 | 45 | 6.4 | 26 | 8.3 | 27 | 6.2 | 47 | 7.4 |
| 14 | Oil & Grease, mg/l | Inlet | 11.2 | 21.6 | 7.3 | 7.9 | 2.9 | 11.5 | 3.5 | 18.4 | 3.9 | 7.2 | 4.5 | 12.5 | 2.4 | 6.3 |
| | | Outlet | 16.7 | 1.5 | 18.9 | 1.3 | 11.1 | 0.97 | 16.1 | 0.34 | 11.5 | 0.27 | 19.3 | 0.93 | 9.5 | 0.75 |

**Table 2. Tolerance limits for effluent discharge prescribed by Tamil Nadu Pollution Control Board for CETPs, Tiruppur region**

| S.No. | Characteristics | Tolerance limits |
|---|---|---|
| 1 | pH | 5.5 - 9.0 |
| 2 | Temperature, ºC | 40 ºC at the point of disposal |
| 3 | Particle size of total suspended solids, mm/micron | Shall pass 850 IS sieve |
| 4 | Total suspended solids, mg/1 | 100 |
| 5 | Total dissolved solids (Inorganics), mg/ | 2100 |
| 6 | Chloride as (Cl), mg/1 | 1000 |
| 7 | Sulpide (S), mg/1 | 2 |
| 8 | Sulphate as (SO4), mg/1 | 1000 |
| 9 | Fluoride as (SO4), mg/1 | 2 |
| 10 | Ammoniac Nitrogen as (N), mg/1 | 50 |
| 11 | Copper as (Co), mg/1 | 3 |
| 12 | Zinc as (Za), mg/1 | 1 |
| 13 | Phonemic Compounds as (C6 H5 OH), mg/1 | 1 |
| 14 | Oil and Grease, mg/1 | 10 |
| 15 | Baron as (B), mg/1 | 2 |
| 16 | BOD 5 days at 20 ºC, mg/1 | 30 |
| 17 | COD, mg/1 | 250 |
| 18 | Total Residual Chlorine, mg/1 | 1 |
| 19 | Arsenic as (As), mg/1 | 0.2 |
| 20 | Cadmium as (Cd), mg/1 | 2 |
| 21 | Total Chromium as (Cr), mg/1 | 2 |
| 22 | Chromium as (Hexavalent Cr+6), mg/1 | 0.1 |
| 23 | Lead as (Ph), mg/1 | 0.1 |
| 24 | Selenium as (Se), mg/1 | 0.05 |
| 25 | Mercury as (Hg), mg/1 | 0.01 |
| 26 | Pesticides, mg/1 | Absent |
| 27 | Alpha emitters , Micro Curie/ml | $10^{-7}$ |
| 28 | Delta emitters, Micro Curie/ml | $10^{-6}$ |
| 29 | Free Ammonia (NH3), mg/1 | 5 |
| 30 | Dissolved Phosphates as (P), mg/1 | 5 |
| 31 | Total Kjeldahl Nitrogen as (N), mg/1 | 100 |
| 32 | Cyanide as (CN), mg/1 | 0.2 |
| 33 | Nickel as (N), mg/1 | 3 |

BOD and COD values show remarkable reduction and ranges from 17 to 31mg/l and 59 to 102 mg/l which is within the prescribed standard limits. For TDS, the values are in the range of 675 to 970 mg/l for the outlet samples. Chlorides, Sulphates and Total Phosphates are also lesser as compared to the inlet samples and ranges from 196 to 274 mg/l , 167 to 256 mg/l and 1.1 to 2.4 mg/l respectively.

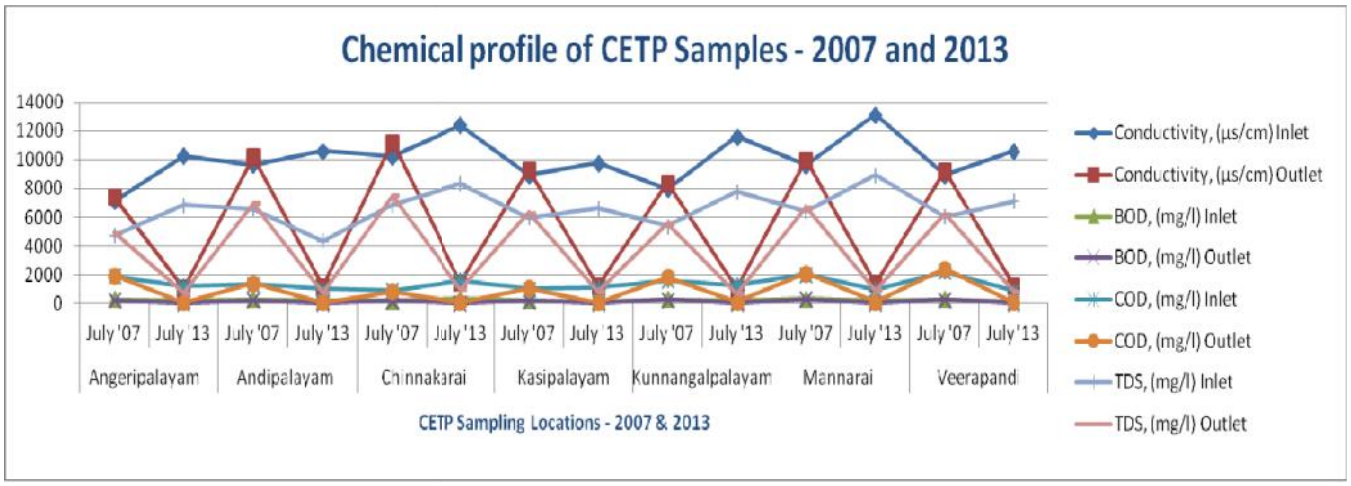


**Fig.1. Conductivity, BOD, COD and TDS profile of CETP during 2007 and 2013**

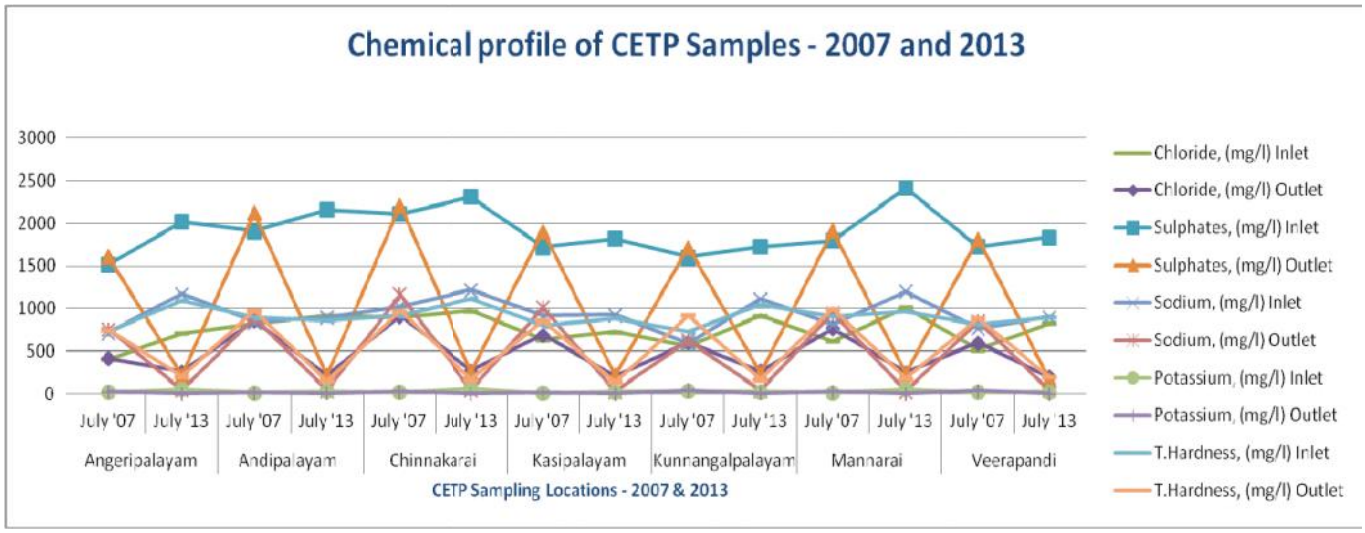


**Fig.2. Chloride, Sulphate, Sodium, Potassium and T.Hardness profile of CETP during 2007 and 2013**

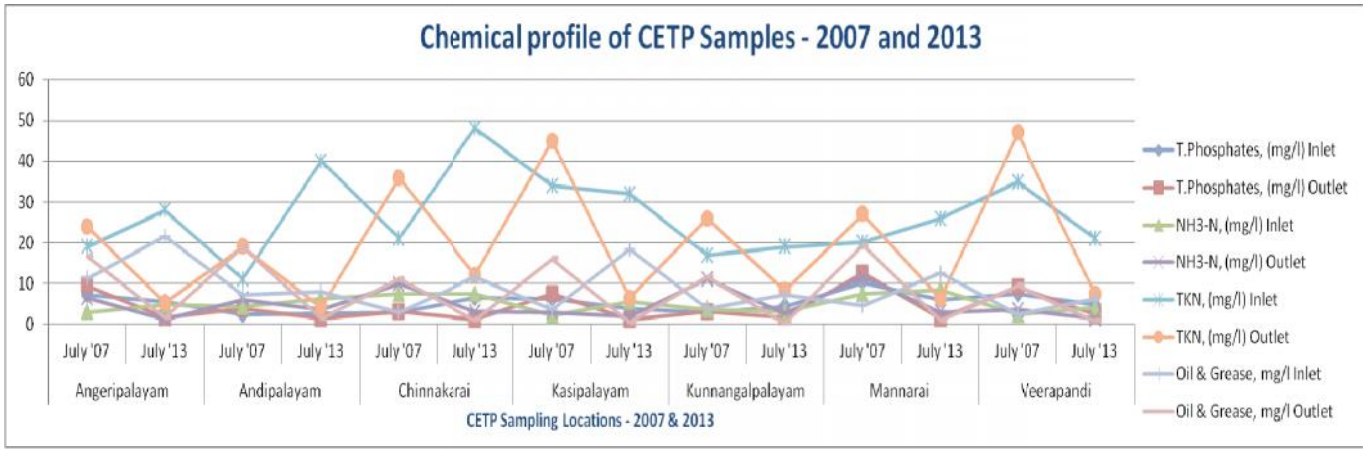


**Fig.3. T. Phosphates, NH3-N, TKN and Oil and Grease profile of CETP during 2007 and 2013**

The outlet CETP samples shows considerable reduction in Sodium, Potassium, Total hardness, NH3- N, TKN, Oil & Grease and the levels recorded ranges from 28 to 44 mg/l, 2.8 to 7.3 mg/l, 137 to 201 mg/l , 1.2 to 3.5 mg/l , 4.1 to 12 mg/l and 0.27 to 1.5 mg/l respectively. The comparative results are plotted in graph and presented in Fig.1 to Fig.3.

## Conclusion

The up gradation of CETPs with advanced treatment systems have contributed significantly to the reduction in the different parameters of combined effluent generated from various dyeing and bleaching units in Tiruppur. Noyyal river basin was

polluted heavily due to the indiscriminate release of partially treated effluent till the TNPCB and other law enforcement agencies strictly came forward to stop this. At present the bleaching and dyeing units shall have either their own Individual Effluent Treatment systems or to be connected with a CETP to be able to operate. As there is no discharge of any more waste water to the Noyyal, this river had dried up at several areas. However the ground water quality near to the Noyyal river is not suitable for human consumption owing to the high level of TDS resulted from the effluent discharge and it will take years together to restore the land and water resources in the area.

**Acknowledgement**

The author is thankful to TNPCB, Tiruppur and CPCB South Zonal office, Bangalore for helping with the field sampling, data collection and other studies needed for this work**.**

## REFERENCES

APHA, 2005. Standard method for examination of water and wastewater, 21st Ed., Washington D.C., U.S.A.

Census of India, 2011. Provisional Population Totals, Urban Agglomerations / cities having population I lakh and above.

Central pollution control board, Delhi. 2000. Environmental standards for ambient air, automobiles, fuels, industries and noise.

Geetha, A. Palanisamy, P. N. Sivakumar, P. Ganesh Kumar, P. and Sujatha M. 2008. Assessment of underground water contamination and effect of textile effluents on Noyyal River basin in and around Tirupur town, Tamilnadu, *E-Journal of Chemistry*, 5(4),696-705.

Institute of Water Studies, 2002. PWD, Environmental impact of industrial effluent in Noyyal river basin.

Madras School of Economics, 2002. Environmental Impact of Industrial Effluents in Noyyal River Basin", Chennai

Ramasamy V. and Rajagopal, 1991. Ground water quality in Tiruppur, *Ind. J. Environ. Hlth*., 33(2), 187-191.

Samuel Rajkumar, A. and Nagan, S. 2011. Study on Tiruppur CETPs discharge and their impact on Noyyal River and Orathupalayam Dam, Tamil Nadu, *Journal of Environmental Research and Development*, Vol. 5, No.3, pp 558-565.

Senthilnathan, S. and Azeez, P. A. 1999. Water quality of effluents from dyeing and bleaching industry in Tiruppur, Tamil Nadu, India, *J. Ind. Poll. Con.*, 15(1)**,** 79-88.

Thoker Farook Ahmed, Manderia Sushil and Manderia Krishna, 2012. Impact of Dye Industrial Effluent on Physicochemical Characteristics of Kshipra River, Ujjain City, India, *I. Res. J. Environment Sci.,* Vol. 1(2), 41-45.

TNPCB, 2009. Report on Bleaching and dyeing Industries in Tiruppur, Tamil Nadu, India.

*******