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Research Paper

Analysis of Physico-Chemical Characteristics of Industrial Effluents in Tirupati, Andhra Pradesh

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ABSTRACT:- *Physico-chemical characteristics of industrial effluents were collected from three industrial sites in and around Tirupati. Industrial effluents were studied in two years month by month from Jan 2014 - Dec 2015. The present research work deals with the study of some of the important physico-chemical parameters of industrial waste water collected from Tirupati industrial region. Results indicated that pH values of effluent samples ranged from 4.8 to 8.8, it was slightly above and below the limit by ISI and WHO. The average values of Total Dissolved Solids are 2009.8 mg/L in 2014 and 2233.8 mg/L is in 2015 and correspondingly high TSS which was significantly higher than limit set by ISI. The BOD and COD values in all the study sites are above the permissible limit 100 and 200mg/L by ISI and WHO. DO levels more than 4 mg/L is desirable but all the samples show very negligible amount of DO. The study has shown that almost all the parameters are on the higher levels than the prescribed limit and hence proper treatment methods are needed. Some large scale industries have their own effluent treatment plants, but small scale industries are not following the guidelines prescribed for the industrial effluents.*

Key-words:- *Physico-chemical characteristics, Industrial effluents, BOD, COD, TDS, DO*

I. INTRODUCTION

Industrialization is an important tool for the development of any nation. Consequently, the industrial activity has expanded so much all over the world. Today, it has become a matter of major concern in the deterioration of the environment. With the rapid growth of industries in the country, pollution of natural water by industrial waste water has increased tremendously. Water is the most vital resource for all kinds of life on this planet, but it is being adversely affected both quantitatively and qualitatively by all kinds of life. Today most of the rivers receive millions of liter sewage domestic waste and industrial effluents containing varying in characteristics from simple nutrient to highly toxic substances. In recent years, increasing industrialization, urbanization and developmental activities with the population explosion leads to generation of large amount of waste water from domestic, commercial, industrial and other sources [1]. Studies of water quality in various effluents revealed that man made activities have an important negative impact on water quality in the downstream sections of the major rivers. This is a result of cumulative effects from upstream development but also from inadequate wastewater treatment facilities [2].

Most of the major industries have treatment facilities for industrial effluents. But this is not the case with small scale industries, which cannot afford enormous in-vestments in pollution control equipment as their profit margin is very slender. Consequently, the water pollution problem particularly due to toxic heavy metals has become menacing concern. As a result in India there are sufficient evidences available related with the mismanagement of industrial wastes [3-6]. It is found that one-third of the total water pollution in India comes in the form of industrial effluent discharge, solid wastes and other hazardous wastes. India has failed in waste management strategies adopted to keep pace with the industrial growth and urbanization. That impact on Indian economy holds a double edged sword of economic growth and ecosystem collapse [7]

Our present area of research is the Tirupati industrial region, of Andhra Pradesh; It is undergoing rapid urbanization and industrialization since last two decades. It has many engineering, textiles, food, electrical and pharmaceutical industries. Effluents rising from their industries are going to pollute water resources; the present paper is aimed to detail study of physico-chemical properties industrial effluents of Tirupati Region Industrial vicinity.

II. MATERIALS AND METHODS

2.1. Study Area

The study was carried out at Tirupati urban industrial area which is one of the most rapidly developing and polluted industrial area of Tirupati. The industrial area is spread over 863.18 hectares of land consisting of about 600 large and medium scale industries like engineering units, steel processing industries, chemical units, paints, pharmaceutical units, textile industries and battery industries etc. The study area lies between latitude 19°3'39"N longitudes 73°6'57"E. Water from these industries is continuously disposed off into soil. Populations around these areas are under risk of environmental pollution.

Figure.1. Geographical map of the study area.

2.2 Industrial Effluent Sampling And Preservation

The industrial effluent samples were collected randomly month by month in polythene cans for a period of 2 years from different industrial sites like, Gajulamandyam industrial area, Renigunta industrial area and Karakambadi industrial area of Tirupati. The samples were collected from January 2014 to December 2015. The sample container cans were thoroughly cleaned with hydrochloric acid, cleaned with tap water to render free of acid, washed with distilled water twice, again rinsed with the water sample to be collected and then filled up the cans with the sample leaving only a small air gap at the top. The sample cans were Stoppard and sealed with paraffin wax. Every sample was labeled properly and brought back to the laboratory for the chemical analysis [8].

2.3. Physico-Chemical Study

The samples were collected and analyzed for Temperature, pH, EC, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD) Chemical Oxygen Demand (COD) and Dissolved Oxygen (DO). The techniques and methods followed for collection, preservation and analysis are given by (APHA, 2002).

III. RESULTS AND DISCUSSION

The analysis of effluent at three sites of two year i.e. 2014 and 2015 month by month result was carried out. Physico-chemical characterization of an effluent result was presented in Table. 1

Water Temperature

In the present investigation the water temperature ranged from 27.9 ^{0}C to 33.7 ^{0}C. Gajulamandyam Industrial Area effluent, 28.4^{0}C to 33.7^{0}C and average temp in 2014 is 29.7 ^{0}C and 30.5 ^{0}C in 2015, at Renigunta Industrial Area effluent, 28.1^{0}C to 32.9 ^{0}C and average temp is 28.9 ^{0}C in 2014 and 30.1 ^{0}C in 2015, at Karakambadi Industrial Area 28.6 ^{0}C to 33.1 ^{0}C and average temp. is 29.8 ^{0}C in 2014 and 29.7 ^{0}C in 2015 respectively. Temperature influences water chemistry, e.g. DO, solubility, density, pH etc. Temperature in one of the most significant factors that affect the aquatic environment [9]

PH

pH is the hydrogen ion activity and a measure of acidity and alkalinity in aquatic bodies. The variations were recorded in the pH level. The values of pH were ranges from 4.4 to 8.8. The lowest pH value was 4.4 at Renigunta Industrial site and highest pH value was 8.8 at Karakambadi industrial site. pH is one of the important biotic factors that serves as index for pollution[10]

Electrical Conductivity

Electrical Conductivity of water is a measure of the ability of a solution to conduct an electric current; this ability depends upon the presence of ions, their total concentration, mobility and temperature of water. It is useful indicator for salinity or total salt content of waste water [11]. In present study, Karakambadi industrial effluent shows EC within limits prescribed by WHO (1200μS/cm) and other samples exceeds limits, and hence they are unfit for irrigation. All industrial waste waters very higher value compare to limit set by Indian Standards.

Total Dissolved Solids

The average values of Total Dissolved Solids are 2009.8 mg/L in 2014 and 2233.8 mg/L is in 2015 at Gajulamandyam Industrial area, in 2014 is 2766.5 and 2908.5 mg/L is in 2015 at Renigunta Industrial site, karakambadi industrial area average TDS is 675 mg/L in 2014 and 705 mg/L in 2015. The total dissolved solids concentration in the effluent represent the colloidal form and dissolved specters. Discharge of water with a high TDS level would have adverse impact on aquatic life, render the receiving water unfit for drinking, reduce crop yields if used for irrigation, and exacerbate corrosion in water systems [12]

Total Suspended Solids

The total suspended solids affect the light intensity of water; suspended solids are the cause of suspended particle inside the water body influencing turbidity and transparency. In the present investigation shows high TSS values of 575 mg/L and 131.2 mg/L respectively, while Renigunta industrial waste waters shows high TSS value of 575 mg/L and corresponding low TS value of 131.2 mg/L at Karakambadi industrial waste waters compare to limit (200 mg/L) set by Indian Standards.

Biological Oxygen Demand

Biological Oxygen Demand ranged from 210 to 679 mg/L, 430- 660 mg/ L at Gajulamandyam Industrial site, the average BOD is 556 in 2014 and 499.6 mg/L in 2015. Renigunta Industrial site BOD range from 535- 679 mg/L, the average in 2014 is 572.1mg/L; 617.3 mg/L is in 2015, at Karakambadi Industrial site 210-315 mg/L, the average in 2014 is 281.6 mg/L 269.1 mg/L in 2015.

On an average basis, the demand for oxygen is proportional to the amount of organic waste to be degraded by aerobically[13] BOD it is important here to note that low BOD content is an indicator of good quality water, while a high BOD indicates polluted water. BOD directly affects the amount of dissolved oxygen (DO) in rivers and streams. The greater the BOD, the more rapidly oxygen is depleted in the water. The consequences of high BOD are the same as those for low DO: aquatic organisms become stressed, suffocate, and die. The results were very similarity to the previous reports of industrial waste water by [14]

Chemical Oxygen Demand

The chemical oxygen demand (COD) is used as measure of the oxygen equivalent of the organic matter content of the sample that is susceptible to oxidation by strong chemical oxidants .The average values of COD values are 750.5, 835.3 mg/L at Gajulamandyam Industrial site, 880.6, 937.5 mg/L at Renigunta industrial site and karakambadi industrial site, 482.1, 507.6 mg/L in 2014 and 2015 respectively.. In the present investigation high COD values 935 mg/L (Table.1) permissible limit of Indian Standards (250mg/L) at Renigunta Industrial waste waters indicative of the presence of chemically ioxidisible carbonaceous matter as well as inorganic matter observed by [15]

Dissolved Oxygen

Dissolved oxygen fluctuated in between 1.1- 5.8 mg/L the average DO is 2.31mg/L in 2014, 2.1 mg/L in 2015 at Gajulamandyam industrial site, at Renigunta Industrial 1.46-1.58 mg/L in 2014,2015, at karakambadi industrial site average DO is 5.26-5.37 ,mg/L in 2014 and 2015 respectively. Dissolved oxygen levels are found to be very low and hence a lot of oxygen has been used up. It shows the increased concentration of organic matter. The presence of free oxygen in water is an indication of the ability of that water to support biological life. Low value of DO may be due to higher water temperature and increased activity of microorganisms in the water which consumes a lot of oxygen due to metabolic process and the decomposition of organic material [16],[17]

Table: 1 Physico-chemical characterization of different industrial wastewater collected during Jan 2014 to Dec 2015

		2014							2015							
Sampling sites	**Physico-Chemical proper-ties**	January	March	May	July	September	November	**Average**	February	April	June	August	October	December	**Average**
Gajulamandyam Industrial Area	Temp	28.4	30.8	32.9	29.2	29.1	28.3	**29.7**	28.9	31.8	33.7	31.3	29.5	28.2	**30.5**
	pH	6.9	7.1	7.7	7.4	7.9	7.1	**7.35**	6.5	7.7	8.1	8.5	7.1	7.5	**7.5**
	EC	940	1120	1240	1170	990	1280	**1123.3**	1090	1240	1300	1380	1290	1250	**1258.3**
	TDS	1943	2451	1874	1720	1921	2150	**2009.8**	2243	1981	1910	2570	2443	2256	**2233.8**
	TSS	257	281	360	310	290	350	**308**	380	462	480	390	475	510	**449.5**
	BOD	528	590	468	570	660	520	**556**	482	430	450	510	590	536	**499.6**
	COD	770	750	690	768	736	789	**750.5**	845	881	896	830	870	690	**835.3**
	DO	2.6	2.2	2	2.8	1.8	2.5	**2.31**	2.4	2.1	1.6	1.8	2.6	2.2	**2.1**
Industrial Renigunta Area	Temp	28.1	29.6	30.9	28.6	28.4	28.1	**28.9**	27.9	30.8	32.9	31.6	28.7	28.2	**30.1**
	pH	5.5	6.1	6.5	4.8	4.4	7	**5.7**	6.9	6.5	5.2	7.5	6.7	7.1	**6.65**
	EC	1350	1280	1330	1190	1250	1330	**1288.3**	1400	1260	1180	1370	1290	1370	**1311.6**
	TDS	3347	3115	2687	2148	2736	2566	**2766.5**	2841	2456	2982	3143	3290	2739	**2908.5**
	TSS	419	515	490	612	670	580	**547.6**	670	522	486	575	653	544	**575**
	BOD	620	570	568	535	558	582	**572.1**	579	589	618	611	679	628	**617.3**
	COD	910	870	920	898	858	828	**880.6**	970	990	958	935	883	889	**937.5**
	DO	1.6	1.8	1.4	1.1	1.2	1.8	**1.46**	1.6	1.4	1.9	2	1.2	1.4	**1.58**
Karakambadi Industrial Area	Temp	29.2	30.3	31.7	29.8	29.3	28.9	**29.8**	28.8	29.7	33.1	28.6	29.1	28.9	**29.7**
	pH	7.5	7.1	7.9	8.4	8.8	7.6	**7.8**	6.9	7.7	8.5	7.9	8	8.5	**7.9**
	EC	650	610	740	790	690	550	**671.6**	810	890	750	510	660	730	**725**
	TDS	500	720	630	590	830	780	**675**	690	740	590	650	770	790	**705**
	TSS	121	158	205	165	143	185	**162.8**	190	140	110	90	125	138	**132.1**
	BOD	280	290	260	310	280	270	**281.6**	210	265	240	275	310	315	**269.1**
	COD	460	410	555	598	450	420	**482.1**	510	520	508	490	450	568	**507.6**
	DO	5.2	5.5	5	4.8	5.5	5.6	**5.26**	5.2	5.1	5.6	5.8	5.2	5.4	**5.37**

Fig.2. Average temperature levels from different industrial wastewater collected during Jan 2014 to Dec 2015

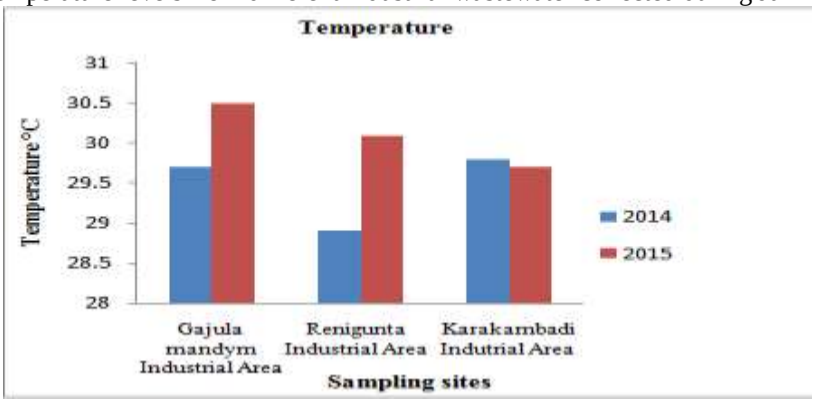

Fig.3. Average pH levels from different industrial wastewater collected during Jan 2014 to Dec 2015

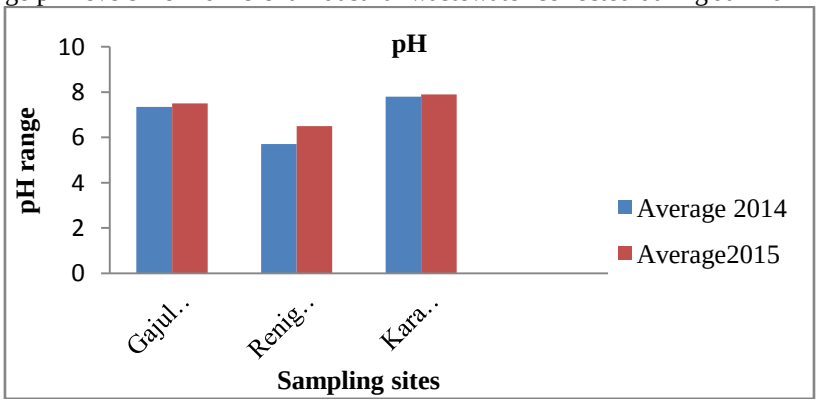

Fig.4 Average EC levels from different industrial wastewater collected during Jan 2014 to Dec 2015

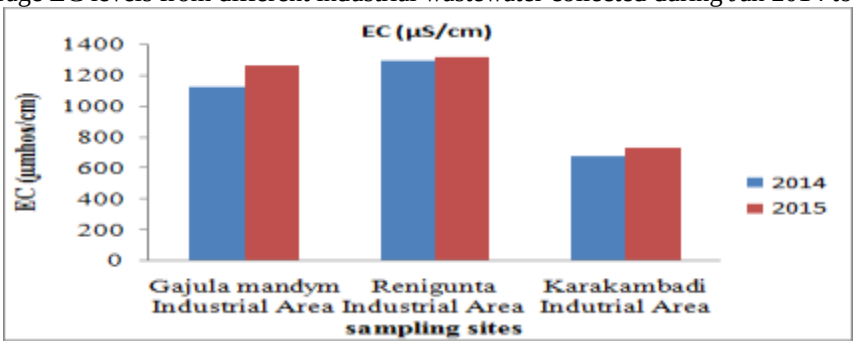

Fig.5 Average TDS levels from different industrial wastewater collected during Jan 2014 to Dec 2015

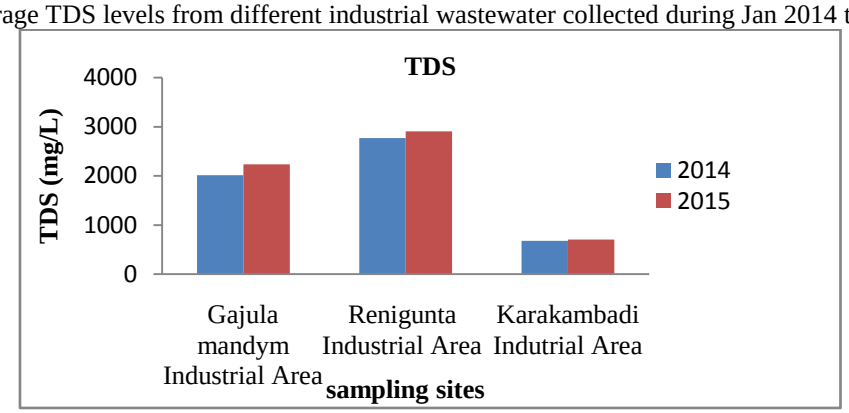

Fig.6 Average TSS levels from different industrial wastewater collected during Jan 2014 to Dec 2015

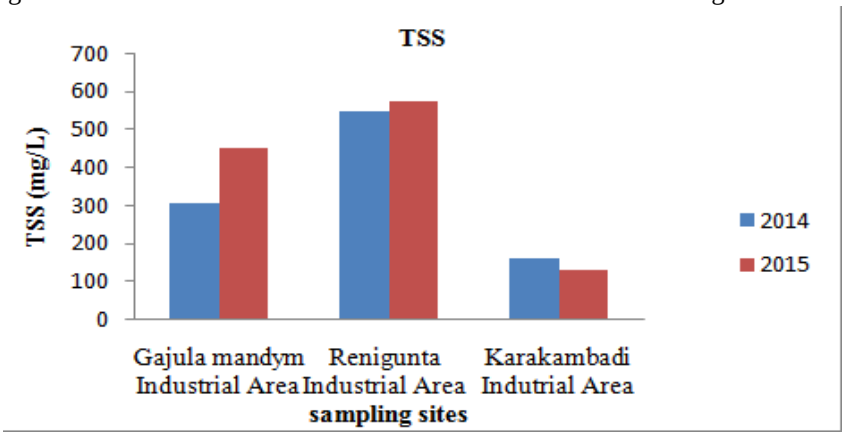

Fig.7 Average BOD levels from different industrial wastewater collected during Jan 2014 to Dec 2015

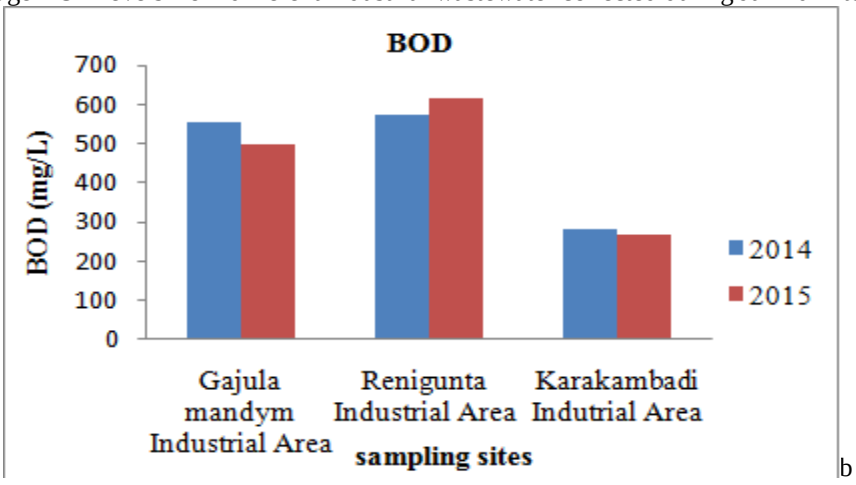

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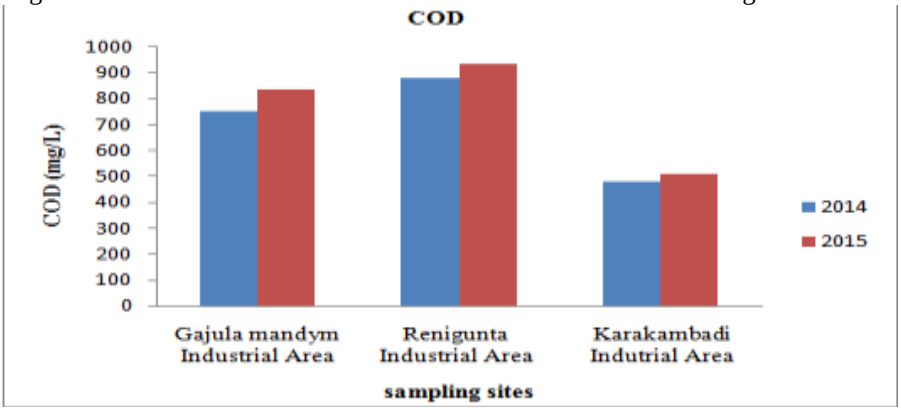
Fig.8 Average COD levels from different industrial wastewater collected during Jan 2014 to Dec 2015



IV. CONCLUSIONS

The present experimental data indicates high level of pollution along Tirupati Industrial sites. From the result of physico-chemical analysis of industrial effluents, it has been concluded that Temperature, pH, EC, TDS, TSS, BOD, COD, and DO are very high in concentration compared to the standards prescribed by ISI and WHO. Few samples show negligible amount of DO. Such effluent should not be discharged in to the nearby water body or soil without treatment. They are unfit for irrigation. The high level pollution of the industrial effluents cause's environmental problems which will affect plant, animal and human life.

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