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THOMSON REUTERS

[FRTSSDS- June 2018]
DOI: 10.5281/zenodo.1321909

ISSN 2348 – 8034
Impact Factor- 5.070

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

PHYSICO-CHEMICAL ANALYSIS OF SOME INDUSTRIAL EFFLUENTS FROM INDORE, M.P., INDIA

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ABSTRACT

Physico-chemical characteristics of industrial effluents were collected from eight industries in and around Indore. The present work deals with the study of 26 parameters of industrial waste water. The studied parameters includes pH, conductivity, turbidity, solids, demand analyses, alkalinity, hardness, calcium, magnesium, sodium, potassium, chloride, sulphates, fluoride, phosphates, nitrates, nitrites, ammonia, TKN and boron. The result reveals that 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.

Keywords: *Physico-chemical characteristics, Industrial effluents, BOD, COD, TDS.*

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 [7-9].

II. MATERIALS AND METHOD

The study was carried out at Indore industrial area which is one of the most rapidly developing and polluted city. The industrial area is spread over large area consisting of about 300 large and medium scale industries like engineering units, steel processing industries, chemical units, paints, pharmaceutical units, etc. Indore covers an area of 3831 sq km with a total population of the district 32,72,335 (2011 census) with the density of 9,718 per sq. Km. It is bounded by N latitudes 22˚ 31' and 23˚05' and E longitudes 75˚25' and 76˚ 15' [10]. Water from these industries is continuously disposed off into soil. Populations around these areas are under risk of environmental pollution.

Industrial Effluent Sampling and Preservation

The industrial effluent samples were collected in polythene cans from different industrial sites. 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 labelled properly and brought back to the laboratory for the chemical analysis [11].

Physico-Chemical Study

The samples were collected and analyzed for pH, conductivity, turbidity, solids, demand analyses, alkalinity, hardness, calcium, magnesium, sodium, potassium, chloride, sulphates, fluoride, phosphates, nitrates, nitrites, ammonia, TKN and boron. The techniques and methods followed for collection, preservation and analysis are given by Standard Methods for the Examination of Water and Wastewater [11].

III. RESULTS AND DISCUSSION

The analysis of industrial effluents from the different industries is shown in Table. 1

Table 1: The physic-chemical analyses data of the industrial effluents.

S. No.	Parameters	Units	Industry - 1	Industry - 2	Industry - 3	Industry - 4	Industry - 5	Industry - 6	Industry - 7	Industry - 8
1	pH	pH Unit	8	8.3	7.5	7.7	8.4	8	8.9	8
2	Conductivity	µMhos/cm	1534	1829	1869	1303	614	2753	596	788
3	Turbidity	NTU	1.7	2.9	3.1	2.6	1.7	2	4.1	6.4
4	Total solids	mg/L	988	1398	1230	1090	373	1935	478	606
5	TDS	mg/L	982	1390	1222	1082	369	1927	468	592
6	SS	mg/L	6	8	8	8	4	8	10	14
7	FDS	mg/L	657	874	791	552	223	1162	284	360
8	BOD	mg/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
9	COD	mg/L	19	18	16	17	16	18	17	20
10	Alkalinity	mg/L	470	356	300	420	180	560	192	320
11	Total hardness	mg/L	500	660	620	444	200	870	253	372
12	Ca. hardness	mg/L	368	496	432	340	112	520	184	300
13	Mg. hardness	mg/L	132	164	188	104	88	352	68	72
14	Calcium ions	mg/L	147.2	198.4	172.8	136	44.8	208	73.6	120
15	Magnesium ions	mg/L	31.68	39.36	45.12	24.96	21.12	84.48	16.32	17.28
16	Chloride ions	mg/L	202.7	282.2	235.7	122.5	94.29	282.8	41.49	146.14
17	Sulphate ions	mg/L	98.34	100.46	101.12	92.12	46 42	150.6	15.42	59.23
18	Sodium	mg/L	140	170	168	144	72	190	28	58
19	Potassium	mg/L	2	2.2	2	2	1.8	2	2	2.4
20	Fluoride ions	mg/L	0.73	1.242	1.406	1.312	0.763	1.642	0.652	0.84
21	Phosphate ions	mg/L	0.027	0.023	0.033	0.021	0.019	0.087	0.026	0.024
22	Nitrite ions	mg/L	0.056	0.062	0.069	0.013	0.016	0.022	0.028	0.016
23	Nitrate ions	mg/L	6.409	7.436	7.521	5.829	3.264	8.816	1.787	6.421
24	Ammonia	mg/L	0.013	0.014	0.016	0.006	0.002	0.018	0.008	0.036
25	TKN	mg/L	5	7	7	4.2	2.8	9.8	5.6	8.4
26	Boron	mg/L	0	0	0	0	0.004	0	0.008	0.009

pH

From Table 1 it is seen that the pH value of all the samples ranges between 7.5 and 8.9. The lowest value is observed for water sample Industry-3 i.e., 7.5 whereas higher pH value was observed in sample Industry-7 while other water samples showed good pH values.

ISSN 2348 – 8034
Impact Factor- 5.070

Electrical Conductivity

This parameter indicates the presence and concentration of electrolytes in water. Electrical conductivity (EC) is a useful tool to evaluate the purity of water. Maximum EC is recorded for sample Industry-6 (2753 µmhos/cm) and the minimum for sample Industry-7 (599 µmhos/cm). In general the EC for nearly all the samples is well within the prescribed limits.

Solids

The Total Dissolved Solids (TDS) of the water samples ranged from 369 mg/L to 1927 mg/L. TDS value of 369 mg/L is shown by sample Industry-5, whereas water sample Industry-6 showed a value of 1927 mg/L. Rest of the samples lie within the permissibility of 2000 mg/L for drinking water as per Indian Standards.

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 value of COD is 17 mg/L and BOD is < 2 mg/L.

Alkalinity

The values of alkalinity in the water samples varied from 180 - 560 mg/L. Alkalinity of nearly 80% of the samples have crossed the desirable limit of 200 mg/ L. Highest alkalinity is observed for sample Industry-6.

Hardness

Total Hardness of the analyzed water samples have been found to vary from 200 to 870 mg/L. The hardness is mainly due to calcium and magnesium salts soluble in water. The maximum hardness is shown by the sample Industry-6.

Calcium

Calcium ions contribute the greatest portion of the hardness occurring in natural waters. The concentration of Ca^{++} varies from 44.8 to 208 mg/L. The minimum and maximum concentrations of Ca^{++} have been observed for sample Industry-5 and Industry-6 respectively. For all the rest water samples the values for calcium are well below the permissible limit prescribed by Indian Standards (Ca^{++} = 200 mg/L).

Magnesium

Magnesium ion (Mg^{++}) concentration is seen to vary from 16.32 to 84.48 mg/L, being minimum for sample Industry-7 and the maximum value for sample Industry-6. All the samples show values well below the permissible limit prescribed by Indian Standards for Drinking Water (Mg^{++} = 100 mg/L).

Chloride

Chloride salts in excess of 100 mg/L give salty taste to water particularly when sodium and potassium ions are also present in water. Calcium and magnesium chlorides are reported to increase the corrosive activity of water. It is therefore recommended that chloride content should not exceed 250 mg/L. It is observed that all the water samples have chloride ion concentration less than the desirable limit of 250 mg/L. The highest concentration has been recorded for water sample Industry-2 and Industry-6 (282 mg/L) which is seen to be at the upper limit. The lowest concentration however is found to be 41.49 mg/L in sample Industry-7.

Sulphate

Sulphate ion concentration is varying from 15.42 to 150.6 mg/L and these values are within the desirable limits prescribed by Indian Standards for Drinking Water (200 mg/L).

Sodium

Sodium (Na^{+}) when present in large amounts gives a salty taste when combined with chloride. Na^{+} ion concentration varies from 28 to 190 mg/L. The minimum value is obtained for sample Industry-7 while the maximum value is obtained for sample Industry-6. No permissible limit is provided for sodium.

[FRTSSDS- June 2018] ISSN 2348 – 8034
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Potassium

Similar to sodium ion potassium ion also when present in large amounts especially when chloride ion is also present gives salty taste to water. Potassium ranges from 2 to 2.4 mg/L. Indian Standards for Drinking Water do not provide any permissible limit for potassium.

Fluoride

Fluoride has dual significance. If its content is less, it may result in problem like dental caries. But if high in content it causes fluorosis. As per the WHO guidelines the fluoride range is 0.5- 1.5mg/L. Fluoride level in the samples was found to be > than 0.5 mg/L but < 1.5 high mg/L.

Nitrate

The minimum and maximum concentration values obtained for nitrate ions lie in the range 1.787 to 8.816 mg/ L. None of the samples crossed the permissible limit of 100 mg/L and are well within the desirable limit prescribed by Indian Standards (45 mg/L).

IV. CONCLUSIONS

The present experimental data indicates high level of pollution along Indore Industrial sites. From the result of physico-chemical analysis of different industrial effluents, it has been concluded that pH, electrical conductivity, TDS, TSS, alkalinity, chloride, etc. are very high in concentration compared to the standards prescribed by ISI and WHO. 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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