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Physico-chemical Study of Effluents of Pharmaceutical Industries of Hyderabad Division Sindh Pakistan

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Abstract: The Pakistan Pharmaceutical Industry is one of indispensable industries of this country. This industry manufactures very important life saving as well as life-enhancing medicines. This industry produces a wide variety of chemical products which are consist of antibiotics, analgesics, disinfectants, anesthetics, muscle relaxants, water soluble salts,, anti-clotting agents, cardiovascular medicines and vitamin in different forms like tablets, capsules, ampoules, syrups. This industry plays the role of life saving institute. At the same time this huge industry has been witnessed a source of liquid pollution, if run without treatment plant or proper disposable measures. Present study of effluents of selected Pharmaceutical industries of Hyderabad Division was conducted. Total five industries were brought under study of Hyderabad and Jamshoro site area. Sampling was done on monthly basis during the year 2015. Samples were analyzed for Physico-chemical parameters. The results were compared with National Environmental Quality Standard (NEQS) for municipal and liquid industrial effluent of Pakistan. The average ranging results of studied parameters were found as pH (4.64 – 7.74), E. C (1072 – 3021 µs/cm), salinity (0.6 – 1.5 ppt), TDS (684.1 – 2126.4 mg/L), Chlorides (86.83 – 1136.122 mg/L), Alkalinity (740.64 – 1491.2 mg/L), Hardness (125 – 346 mg/L), Sodium (30.08 – 69.18 mg/L), Potassium (47.49 – 66.96 mg/L), Calcium (140.06 – 185.4 mg/L), Magnesium (23.022 – 39.574 mg/L), Lead (0.0164 – 0.018 mg/L), Copper (2.328 – 2.984) and Zinc (0.0398 – 0.0448 mg/l). The concentration of pH, TDS, Zn and Pb, except Copper, of industrial effluents was found within permissible limits of NEQS for municipal and liquid industrial effluent of Pakistan.

Keywords: Pharmaceutical, Effluents, Hyderabad

1. Introduction

The Pharmaceutical Industry of Pakistan is a high technology based important industry. It represents the single major joint multinational financial investment in our country Pakistan. This industry produces a wide range of life saving and life-enhancing medicines. This sector is a major contributor to economic well being and better health for Pakistani People.

The pharmaceutical industry flourished in Pakistan since very beginning. Mostly research based transnational pharmaceutical industries played very important role. They made a lot of financial investment in the country. They brought innovative technology and above all they served the best quality medicines to the people of this country. This industry also produces a wide range of products to be used for animal medications. The pharmaceutical Manufacturing industry goes under five main processes such as fermentation, extraction, chemical synthesis, formulation and in last packaging.

The main environmental problem of this industry is wastewater pollution. No doubt the produced wastewater or effluent by this industry is not found in much bigger quantity but it is always observed extremely polluted, due to fatal amount of organic and inorganic pollutants [1]. On the other hand solid waste is found comprised of expired or rejected

medicines, spent solvents, packaging material and damaged bottles. The contribution of effluent pollution varies from industry to industry [2].

It has been observed that most of pharmaceutical industries don't have proper effluent treatment plants. They are not found with proper measures as defined by environmental protection agencies. The effluent of pharmaceutical industries contains concentrations of anti-inflammatory, tranquilizers, antibiotics, lipid regulators, antiepileptics, and cosmetic ingredients containing oil and grease [3].

The toxic materials are very harmful to human, animal and plant life. They are generally resistant to biological decomposition processes unless very diluted. The high or low concentration of pH also effect the metal present in effluents [4].

Chemical oxygen demand (COD) and biological oxygen demand (BOD), turbidity, conductivity, total suspended solids (TSS) and total hardness are very important pollution index for industrial wastewaters [5].

There are very serious impacts of the industrial effluents on the flora and fauna [6]. The untreated pharmaceutical industrial effluent also contains algae materials, non biodegradable organic matter and heavy metals [7, 8]. An effluent of pharmaceutical industries penetrates in the soil and ground water environment through seepage from landfills sites [9, 10].

2. Materials and Methods

2.1. Sampling Area

Samples were collected from pharmaceutical companies from Hyderabad site area and Sandoze Road Jamshoro Sindh. Wastewater Samples were collected from 1. Alkemy, 2. Khos, 3. Standard, 4. Sandoz and 5. Zanctok pharmaceutical industries. The samples were collected in pre cleaned plastic bottles which have been previously washed with 20% nitric acid and subsequently with demineralized water. The samples were collected from the outlets of each industry. Monthly sample of waste water were collected from Feb. to June 2015 from each industry.

2.2. Laboratory Analysis

Conductivity, salinity, TDS, pH of effluent samples was determined according to standard methods [APHA 1989]. Chloride, Alkalinity; Hardness of samples was carried by Standard titration methods [APHA 1989]. Iron, Copper, Zinc, Cadmium, Lead, Sodium, Potassium, Calcium and Magnesium of samples were determined by Flame Atomic Absorption Spectrometer [FAAS].

3. Result and Discussion

Temperature is a very important physical parameter. Temperature is vital for behavioral characteristics of organisms, solubility of gases and for the concentration in salts in water. The temperature being physical factors is a base for all life functions and biochemical reactions. Decease or increase in temperature affects the microbial activity. Increased temperature creates hindrance to fish development and reproduction of other water species. In the present study, the average temperature of industrial effluents was observed as 28.22, 27.74, 30.2, 28.48 and 28.16°C for Alkemy, Khos, Standard, Sandoz, and Zanctok industries respectively from the month of February to June as shown in table 1.

The parameters acidity or alkalinities of water are measured by pH. The pH is extremely important and simple parameter as well. Liquid if highly acidic or alkaline will affect its surrounding environment. At particular pH the toxicity of heavy metals also gets enhanced. In the present study, the average pH of industrial effluents was observed as 7.3, 6.84, 7.16, 4.64 and 7.74 for Alkemy, Khos, Standard, Sandoz, and Zanctok industries respectively from the month of February to June as shown in table 1.

In all natural waters chlorides occurs in widely varying concentrations. High concentration of chlorides in drinking water is harmful for human health. In the present study, the average Chlorides of industrial effluents was observed as 96.4, 86.83, 1801.3, 130, and 1136.12 for Alkemy, Khos, Standard, Sandoz, and Zanctok industries respectively from the month of February to June as shown in table 1.

The average EC of industrial effluents was observed as 3201.4, 1433, 1525.4, 1072.4 and 1948.8 µS/cm for Alkemy, Khos, Standard, Sandoz, and Zanctok industries respectively from the month of February to June as shown in table 1. The average Salinity of industrial effluents was observed as 1.5, 0.8, 0.9, 0.6, and 1.06 for Alkemy, Khos, Standard, Sandoz, and Zanctok industries respectively from the month of February to June as shown in table 1.

TDS is very basic and important chemical parameter for understanding waste water. In the present study, the average TDS of industrial effluents was observed as 2126.4, 875.8, 1239.6, 684.1 and 1235.2 mg/L forAlkemy, Khos, Standard, Sandoz, and Zanctok industries respectively from the month of February to June as shown in table 1. The average concentration of sodium of industrial effluents of pharmaceutical industries was observed as 69.128, 34.08, 42.652, 35.684 and 53.62 mg/L for Alkemy, Khos, Standard, Sandoz, and Zanctok respectively from the month of February to June as shown in table 1.

The average concentration of Potassium of industrial effluents of pharmaceutical industries was observed as 51.272, 47.49, 66.462, 50.662 and 66.968 mg/L for Alkemy, Khos, Standard, Sandoz, and Zanctok respectively from the month of February to June as shown in table 1.

The average concentration of Calcium (Ca) of industrial effluents of pharmaceutical industries was observed as 185.4, 171.8, 157.8, 149.8 and 140.6 mg/L for Alkemy, Khos, Standard, Sandoz, and Zanctok respectively from the month of February to June as shown in table 1.

The average concentration of magnesium (Mg) of industrial effluents of pharmaceutical industries was observed as 39.574, 23.022, 29.362, 23.676 and 33.078 mg/L for Alkemy, Khos, Standard, Sandoz, and Zanctok

respectively from the month of February to June as shown in table 1. The average concentration of lead (Pb) of industrial effluents of pharmaceutical industries was observed as 0.017, 0.0164, 0.018, 0.018 and 0.0178 mg/L for Alkemy, Khos, Standard, Sandoz, and Zanctok respectively from the month of February to June as shown in table 1.

The average concentration of copper (Cu) of industrial effluents of pharmaceutical industries was observed as 2.328, 2.792, 2.742, 2.984 and 2.858 mg/L for Alkemy, Khos, Standard, Sandoz, and Zanctok respectively from the month of February to June as shown in table 1. The average concentration of Zinc (Zn) of industrial effluents of pharmaceutical industries was observed as 0.0448, 0.0442, 0.0398, 0.0448 and 0.0422 mg/L for Alkemy, Khos, Standard, Sandoz, and Zanctok respectively from the month of February to June as shown in table 1.

4. Conclusion

It was observed that the average pH of industrial effluents during study months was below the permissible limits (6-9) of National Environmental Quality Standard (NEQS) for municipal and liquid industrial effluent of Pakistan. The chloride concentration of industrial effluents was below the permissible limits (1000 mg/L) of National Environmental Quality Standard (NEQS) for municipal and liquid industrial effluent of Pakistan except two industries Standard and Zanctok.

The average concentration of TDS of industrial effluents during study months was below the permissible limits (3500 mg/L) of National Environmental Quality Standard (NEQS) for municipal and liquid industrial effluent of Pakistan. The average concentration of Lead and Zinc of industrial effluents during study months was below the permissible limits (0.5 and 5 mg/L) of National Environmental Quality Standard (NEQS) for municipal and liquid industrial effluent of Pakistan. The average concentration of copper of industrial effluents during study months was higher the permissible limits (1 mg/L) of National Environmental Quality Standard (NEQS) for municipal and liquid industrial effluent of Pakistan. g

Table 1. *Showing the physico-chemical properties of effluents of pharmaceutical industries.*

Industry	Physicochemical Properties	February	March	April	May	June	Average
Alkemy	Temp	26.2	27	28.3	29.1	30.5	28.22
	pH	7.5	7.4	7.3	7.1	7.2	7.3
	E. C	3328	3118	3215	3189	3157	3201.4
	Salinity	1.7	1.6	1.5	1.3	1.4	1.5
	T. D. S	2167	2015	2150	2145	2155	2126.4
	Chloride	98.3	97.7	90.0	97.9	98.1	96.4
	Alkalinity	740.3	738.2	742.5	736.6	744.7	740.46
	Hardness	350	350	340	345	347	346
Khos	Temp.	26	26.5	28	27.6	30.6	27.74
	pH	2.7	6.6	6.5	7.1	6.8	6.84
	E. C	1520	1301	1215	1818	1311	1433
	Salinity	0.8	0.6	0.9	0.7	1.0	0.8
	T. D. S	996.5	899.1	853.0	849.5	780.9	875.8
	Chloride	88.625	85.675	86.890	87.085	85.909	86.83
	Alkalinity	1500	1510	1489	1458	1499	1491.0
	Hardness	125	130	120	122	128	125
Standard	Temp.	26.2	26.5`	27.4	30	29.7	30.2
	pH	7.7	6.9	7.3	7.1	6.8	7.16
	E. C	740	1593	1358	1430	1506	1525.4
	Salinity	1.4	0.8	0.4	0.9	1.0	0.9
	T. D. S	1772	1028	1201	1089	1108	1239.6
	Chloride	1803.5	1799.1	1800.2	1795.4	1808.3	1801.3
	Alkalinity	975	800	858	890	840	872.6
	Hardness	280	170	279	260	275	272.8
Sandoz	Temp.	26.3	27.4	28.3	30	30.4	28.48
	pH	4.4	4.5	4.4	4.6	5.0	4.64
	E. C	1074	1084	1065	1069	1070	1072.4
	Salinity	0.5	0.6	0.7	0.4	0.8	0.6
	T. D. S	695.5	680	683.7	670.9	690	684.1
	Chloride	130	125	135	128	132	130
	Alkalinity	812.5	800.6	795.5	789.9	799.0	799.0
	Hardness	250	240	249	248	243	246
Zanctok	Temp	26	27.3	28.1	29.4	30	28.16
	pH	8.0	7.4	7.8	7.6	7.9	7.74
	E. C	1736	2120	2018	1880	1990	1948.8
	Salinity	0.9	1.1	1.0	1.2	1.1	1.06
	T. D. S	1126	1376	1205	1189	1280	1235.2
	Chloride	990	1271.61	1050	1154	1215	1136.122
	Alkalinity	1350	1428	1390	1301	1259	1345.6
	Hardness	250	249	140	245	235	243.8

Industry	Physicochemical Properties	February	March	April	May	June	Average
Alkemy	Na (mg/L	71.12	68.16	70.26	66.32	70.05	69.128
	K (mg/L)	51.24	51.78	52.66	49.89	50.70	51.272
	Ca (mg/L)	192	180	187	178	190	185.4
	Mg (mg/L)	44.36	38.16	39.04	36.19	40.12	39.574
	Pb (mg/L)	0.016	0.019	0.018	0.015	0.017	0.017
	Cu (mg/L)	2.18	2.39	2.51	2.25	2.31	2.328
	Zn (mg/L)	0.046	0.049	0.043	0.047	0.039	0.0448
Khos	Na (mg/L)	34.90	30.71	34.99	36.18	33.62	34.08
	K (mg/L)	43.74	45.75	50.19	49.01	48.76	47.49
	Ca (mg/L)	200	163	146	185	165	171.8
	Mg (mg/L)	22.05	24.67	20.04	25.29	23.06	23.022
	Pb (mg/L)	0.019	0.014	0.018	0.015	0.016	0.0164
	Cu (mg/L)	2.75	2.79	2.80	2.72	2.90	2.792
	Zn (mg/L)	0.050	0.047	0.042	0.037	0.045	0.0442
Standard	Na (mg/L)	31.11	53.10	41.98	43.02	44.05	42.652
	K (mg/L)	76.70	63.08	56.12	63.01	64.40	66.462
	Ca (mg/L)	148	168	137	162	156	157.8
	Mg (mg/L)	31.85	27.35	23.39	31.18	33.04	29.362
	Pb (mg/L)	0.019	0.017	0.016	0.018	0.021	0.018
	Cu (mg/L)	3.00	2.58	2.97	2.49	2.58	2.742
	Zn (mg/L)	0.043	0.050	0.039	0.026	0.041	0.0398
Sandoz	Na (mg/L)	34.16	35.28	37.26	36.32	35.40	35.684
	K (mg/L)	5168	50.42	49.31	51.00	50.90	50.662
	Ca (mg/L)	153	148	147	150	151	149.8
	Mg (mg/L)	24.19	23.32	24.01	22.98	23.88	23.676
	Pb (mg/L)	0.017	0.020	0.019	0.016	0.018	0.018
	Cu (mg/L)	3.01	2.99	3.00	2.99	2.97	2.984
	Zn (mg/L)	0.044	0.043	0.042	0.045	0.050	0.0448
Zanctok	Na (mg/L)	62.12	50.54	37.03	63.01	55.40	53.62
	K (mg/L)	50.31	76.70	69.22	70.25	68.36	66.968
	Ca (mg/L)	144	135	144	142	138	140.6
	Mg (mg/L)	35.00	29.62	30.32	36.17	34.28	33.078
	Pb (mg/L)	0.018	0.015	0.020	0.019	0.017	0.0178
	Cu (mg/L)	2.82	2.93	2.91	2.81	2.82	2.858
	Zn (mg/L)	0.049	0.44	0.041	0.032	0.045	0.0422

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