Appraisal of Effluents of Some Selected Industries of Hayatabad Industrial Estate, Peshawar

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Summary: Wastewater samples of ten selected industries of Hayatabad industrial estate Peshawar were analyzed for both physical and chemical parameters. The findings of the research are, temperature at the spot: 26.0 -42.0 °C; pH: 6.90 - 9.65; electrical conductivity: 0.20 - 3.13 mS; total solids: 0.794 - 16.52 mg/ dm^3; total dissolved solids: 0.260 - 7.56 mg/ dm^3; suspended solids: 0.014 – 8.96 mg/dm^3; total hardness: 210 - 800 mg/ dm^3; total alkalinity: 160 - 1402 mg/ dm^3; chloride: 72 - 580 mg/ dm^3; sulphate: 79.0 - 481.0 mg/ dm^3; sulphite: 2.83 -43.92 mg/ dm^3; nitrate: 0.75 - 11.60 mg/ dm^3; fluoride: 0.0 -16.00 mg/ dm^3; phosphate: 3.40 - 24.0 mg/ dm^3; nickel: 0.01-0.4 mg/ dm^3; sodium: 20-70 mg/ dm^3. The results were compared with the standard permissible levels for industrial waste water effluents. Some of the parameters were found to have values beyond those of the permissible levels.

Introduction

North West Frontier Province (N. W. F. P) has an area of about 74521 km^2 and Peshawar is its capital city. The total population of the province is 17,5,54,674 (population census 1998), an extra load is also added due to Afghan refuges. To fulfill the needs of the increasing population, an industrial estate has been set up at Hayatabad in Peshawar. The effluents of the industries, after flowing through a dense populated area, drops in to the Kabul river. Pollution is considered as the main problem caused by the discharge of such untreated effluents in to the water streams, seriously degrading its quality [1]. The use of polluted water has been reported to have adverse effects on the livestock, soil and vegetation [2, 3] and produces a number of diseases such as typhoid, diarrhea, infective hepatitis and skin rashes [4].

The physical and chemical parameters of the industrial, drinking and river waters have been reported by the author in the earlier papers [5-11]. It is important to appraise the effluents of the selected industries in the Hayatabad industrial state, which have not been studied earlier, for their possible pollution of the receiving waters..

Result and Discussion

Various properties of the effluents from the industries (Table-1) are given in Table-2 and 3. The values show that the temperatures of the samples at the source are in the range of 26.0-42.0 °C. Sarhad Ghee Mill (Pvt.) Ltd. effluent has the highest temperature of 42.0 °C which is above the permissible limit, [12]. Other industries show temperatures within the permissible limits. Continuous discharge of hot effluents in appreciable quantity can cause decrease in the dissolved oxygen level in water bodies, which is regarded as damaging to aquatic life and can destroy flora and fauna [13].

Table 1: Symbols for the selected industries of Hayatabad industrial estate, Peshawar.

S.NO	Industries	Samples.
1	Olympia Paper and Board Mill (Pvt) Ltd.	A
2	Noor Match Factory	B
3	Saydon Pharmaceutical Industries (Pvt) Ltd.	C
4	Gulab Vanaspathi Gee Mill (Pvt) Ltd.	D
5	Amir Marble (Pvt) Ltd.	E
6	Omer Glass Industries (Pvt) Ltd.	F
7	Hizat Pharmaceutical Industries (Pvt) Ltd.	G
8	Mohammad Steel (Pvt) Ltd.	H
9	Sarhad Gee Mill (Pvt) Ltd.	I
10	Gulab Soap, (Gulab Gee Mill) (Pvt) Ltd.	J

pH of the various industrial effluents was found to be in the range: 6.90 - 9.65 which is within the acceptable levels as per NEQS, and shows that all the industrial effluents are alkaline. The highest pH was of the effluents of Olympia Paper and Board Mill (Pvt.) Ltd., while the lowest was that of Mohammad Steel (Pvt.) Ltd. pH of water affects the ions stability and solubility [14]. The electrical conductivity of

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Table 2: Physico-chemical parameters of the industrial effluents of some selected industries of Hayatabad industrial estate.

Sample	Tem. at the spot (°C)	Temp. in the lab (°C)	pH	Electrical conduc-tivity (mS)	Total solids (mg/ dm^3)	Total dissolved solids (mg/ dm^3)	Suspended solids (mg/ dm^3)	Total hardness (mg/ dm^3)	Total alk alinity (mg/ dm^3)
A	28.0	23.0	9.65	3.13	4.40	0.13	4.260	355	300
B	31.7	30.5	8.63	1.13	3.01	0.41	2.601	400	160
C	28.0	21.0	8.16	0.82	6.48	0.26	6.220	340	240
D	39.0	29.5	8.37	0.89	16.5	7.56	8.960	260	190
E	32.6	17.0	8.82	0.23	3.13	0.31	2.820	800	1402
F	26.0	21.0	7.50	0.20	0.79	0.78	0.014	320	280
G	38.0	31.0	7.06	0.63	4.58	0.29	4.290	300	320
H	28.5	26.0	6.90	0.50	1.66	0.94	0.720	450	330
I	42.0	40.0	8.72	1.39	1.31	0.44	0.866	250	300
J	40.0	30.0	7.99	0.69	4.30	0.94	3.362	210	220

Table 3: Sodium, nickel and anions in the effluents of some selected industries of Hayatabad industrial estate.

Sample	Cl^-(mg/dm^3)	SO_4^{-2} (mg/ dm^3)	SO_3^{-2} (mg/ dm^3)	NO_3^{-1} (mg/ dm^3)	PO_4^{-3} (mg/ dm^3)	F^- (mg/ dm^3)	Ni^{+2} (mg/ dm^3)	Na^{+1} (mg/ dm^3)
A	370	307	17.38	11.60	15.40	16.0	0.03	50
B	160	481	22.64	3.70	7.13	10.0	0.015	35
C	72	382	43.92	6.20	4.80	8.21	0.04	50
D	340	324	17.06	7.70	6.10	3.22	0.02	50
E	104	275	31.28	6.00	3.40	4.80	0.03	40
F	95	120	17.06	3.90	24.0	0.00	0.05	25
G	95	352	15.80	6.00	6.00	7.30	0.30	20
H	88	282	18.96	6.40	5.55	12.60	0.20	35
I	580	352	23.38	5.20	16.0	6.30	0.40	25
J	300	79	2.83	0.75	4.30	4.50	0.50	70

water is due to the presence of soluble salts and depends also on the ions mobility. The conductivity values of various effluents are in the range: 0.20 - 3.13 mS. Highest conductivity is shown by the effluents of Olympia Paper and Board Mill (Pvt.) Ltd., indicating large quantities of dissolved salts, while the lowest conductivity is for the effluents of Omer Glass Industries (Pvt.) Ltd.

The amount of total solids (TS), total dissolved solids (TDS) and suspended solids (SS) in the industrial effluents as listed in Table-2 shows that their values are in the ranges: 0.794 -16.52 mg. dm^{-3}, 0.26-7.56 mg. dm^{-3} and 0.014-8.96 mg. dm^{-3} respectively, which are with the limits of NEQS [12]. The highest values of these three parameters found for the effluents of Gulab Vanaspathi Ghee Mill (Pvt.) Ltd. and the lowest were shown by the Omer Glass Industries (Pvt.) Ltd. TDS contents indicate the ability of water to dissolve the organic and inorganic constituents. High concentration of dissolved solids increase the density of dissolving water and reduces the solubility of oxygen gas, creating danger for the aquatic life. TDS also determines the hardness of water. Moreover, these parameters if present above the permissible limits, cause high turbidity in the receiving water which prevent light from entering into the water body and therefore effect the normal growth of biological population [15].

The total hardness as $CaCO_3$, is in the range of 210 - 800 mg. dm^{-3}. The desirable limit for total hardness is 500 mg. dm^{-3} [12, 16]. Highest hardness value was found in the effluents of Amir Marble (Pvt.) Ltd., which is beyond the permissible limit, where as the lowest value was observed in the effluents of Gulab Vanaspathi Ghee Mill (Pvt.) Ltd. High concentration of $CaCO_3$ in water causes corrosion of pipes and in human beings cause gastro intestinal irritation, diarrhea, dehydration, gas trouble, kidney stone and cardio vascular diseases [17].

Alkalinity is mainly caused by bicarbonates, carbonates and hydroxide ions, although other ions also contribute partially. Total alkalinity was found to be in the range: 160 - 1402 mg. dm^{-3}. The permissible range for total alkalinity recommended by World bodies is 500 mg. dm^{-3} [16, 18, 19]. Highest alkalinity was noted in the discharge of Amir Marble (Pvt.) Ltd., the value of which is above the permissible limit whereas the lowest alkalinity was showed by Noor Match Factory (Pvt.) Ltd.

The concentration of chloride in various effluents is in the range: 72 - 580 mg. dm^{-3} which are within the permissible limits of 1000 mg. dm^{-3} [12]. The effluents of Gulab Vanaspathi Ghee Mill (Pvt) Ltd. show highest Cl^- concentration and Saydon Pharmaceutical Industries (Pvt) Ltd has the lowest. The high Cl^- concentration may be harmful to metallic pipes and agricultural crops [20]. Moreover the high Cl^- concentration in drinking water may cause kidney stone, cardiovascular diseases and gas trouble [17].

Sulfate concentration was found to be in the range: 79 - 481 mg. dm^{-3}. Noor Match Factory (Pvt.) Ltd. effluents show high sulfate concentration while Gulab Vanaspathi Ghee Mill (Pvt.) Ltd. show the lowest value. The concentration of sulfate, when exceed the recommended level, then laxative and corrosive mode of its action results [21]. At high levels in drinking water, it also causes diarrhea and dehydration [15]. In domestic waters, sulfate contributes to the permanent hardness. The concen-tration of SO_4^{-2} in all the effluents is below the permissible limit of 600 mg. dm^{-3} [12]. Sulfite concentration was found to be in the range: 2.83 - 43.92 mg. dm^{-3}. The highest SO_3^{-2} concentration was recorded in the effluents of Saydon Pharmaceutical Industries (Pvt.) Ltd. and the lowest is shown by Gulab Vanaspathi Ghee Mill (Pvt.) Ltd. As sulfite is short lived and immediately converts in to sulfate therefore standards for sulfite are not recommended by the health authorities. However, sulfite arising from the acid drainage and oxidation of pyrite if present in high concentrations in water can cause diarrhea and dehydration [22].

The nitrate level in the effluents of various industries is in the range: 0.75 - 11.6 mg. dm^{-3}, while the permissible levels of NO_3^{-1} in water given by the Environmental Protection Agency [22] is 0.021 - 1.25 mg. dm^{-3}. In the present investigation almost all the samples show nitrate levels beyond the permissible limit except Gulab Vanaspathi Ghee mills which discharge 0.75 mg. dm^{-3} of it in the effluents. When effluents of high nitrate level are disposed off in to rivers it results in the eutrophication [23]. Water containing high concentration of NO_3^{-1} is extremely toxic for human because the bacteria in digestive system converts this nitrate to nitrite which then diffuse into the blood stream and change the oxygen carrier hemoglobin into methaemoglobin [21]. High nitrate concentration in drinking water also causes cardiovascular effects [15].

The range of fluoride in effluents is 3.22 - 16.0 mg. dm^{-3}. The highest concentration is for Olympia Paper and Board mill (Pvt.) Ltd. whereas the lowest concentration for Gulab Vanaspathi Ghee Mill (Pvt.) Ltd., while it was not found in the effluents of Omer Glass Industries (Pvt.) Ltd. According to NEQS [12] the recommended level for F^- is 20 mg. dm^{-3} suggesting that all the effluent samples studied have F^- concentration within the permissible limit. Beyond the optimum concentration it may generate both acute and chronic toxicity. Acute toxicity include nausea, vomiting, pulse alternates and muscular weakness while chronic toxicity includes mottled and brittle teeth, dense bones, loss of weight/ strength and pain in legs and backbone [15].

The concentration of phosphate was found in the range: 3.40 - 24.0 mg. dm^{-3}. The highest concentration was in the Omer Glass Industries (Pvt.) Ltd., where the lowest concentration was shown by Amir Marble (Pvt.) Ltd. Standards for PO_4^{-3} are not recommended by the health authorities for industrial effluents but high concentration of it is mainly responsible for the process of eutrophication [23].

Concentration of sodium in the effluents was found to be in the range: 20 - 70 mg. dm^{-3}. No permissible limits for sodium are given by NEQS [12] due to the lack of its toxicity. However its high concentration may cause pudding of agricultural soil, making it hard for the germination of seeds [27]. The nickel concentration in the samples was found to be within the permissible limits [12], however if present in high concentration in some drinking water it may cause problems like eczema, cancer, hypersensitivity and dyspnea [5].

Experimental

Industrial waste water samples were collected from two points, one from source and other 20 meter down the source, from the selected industries, in clean polyethylene bottles. Before collecting the effluents the bottles were washed with water. The sample bottles were filled to overflow so that no air bubbles were trapped in the bottles. Temperature was noted at the spot. The bottles were then carried to the laboratory and stored in refrigerator till analysis. The samples were studied for parameters like pH, conductivity, T.S, T.D.S, S.S, total hardness, total alkalinity, chloride, sulfate, sulfite, nitrate, fluoride, phosphate and metals like nickel and sodium.

Temperature was noted by using ordinary thermometer, pH was measured by pH meter and conductivity by conductometer. Measurements of total hardness and total alkalinity were carried out by titration with standard EDTA [24, 25]. TS, TDS, and SS were determined by standard methods. Chloride [20], SO_4^{-2} and SO_3^{-2} [26] were investigated by volumetric methods while NO_3^-, PO_4^{-3} and F^- were determined spectrophotometrically [27] (Bosh and Lomb Co. Spectrophotometer). Nickel was determined by atomic absorption spectrophotometer (Perkin-Elmer Analyst 700) and sodium by flame photometer.

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