Monitoring of Industrial Effluents

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Summary: Effluents collected from industries of different localities of NWFP were investigated for various parameters such as DO, BOD, total alkalinity, total hardness, chlorides, nitrites, sulphites and various cations, physical parameters like temperature pH, conductivity, TDS, DS and SS were also investigated in the same effluents. The values were compared with the standard, general variation in some of the parameters were observed. The implications of these parameters were also discussed.

Introduction

Water the real thing of life, occurs abundantly on the surface of the earth. The continuous growth of population, urbanization, transportation and industrialization, mining, weathering of soil and Municipal waste water discharges various pollutants into water. Such as oxygen demanding waste-oil, synthetic organic compounds, inorganic radicals (Acidic and basic), mineral substances, radioactive materials and heat etc. These disturb the normal use of water for public water supply recreaction, fish, aquatic life, wildlife and agriculture. Some of these cause acute effects such as skin disease (burns, rashes etc.) and chronic effects such as cancer, lungs disease, bone abnormalities, sexual sterility and disorder in digestive system.

Earlier workers used different methods for determination of nitrites sulphites and chlorides. Prasad determined nitrites in the industrial effluents of Udaipur (Rajastan) India [1]. Alcaraz found that nitrites causes the mortality of fish [2]. Earlier workers determined chlorides by Volhard, Mohr and Mercuric methods [3]. Potentiometric titration method was also used for chloride determination in water [4]. Sulfite arises from acid drainage from oxidation of pyrite and high concentration causes diarrhoea and dehydration [5].

Earlier workers used various method for cation determination (e.g.) Miller used spectrophotometric method for manganese determination [6]. Svanidze, determined CdII by polarographic method [7]. Rowland used photoelectric calorimetric method for chromium determination [8], Ghais [9] Berninger [10] and Rao [11] studies the toxicity of heavy metals (Hg, cd, pb, Mn, Fe^{++}, Cr, Cu, Ni, Mg, Zn) Sarkar and Yuhaun [12,13] found heavy metal in river water.

The present work was therefore undertaken with a view to assess the effluents of various industries of different localities of NWFP towards contribution of pollution to our environment.

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Table-1: Environmental quality standards for municipal and liquid industrial effluents

S.No.	Parameters	Standards
1.	Temperature [19]	40°C
2.	pH value (Acidity/Basicity) [19]	6-10 pH
3.	Total suspended solids [19]	150 mg/L
4.	Total dissolved solids [19]	3500 mg/L
5.	Total Alkalinity according to WHO [23]	500 mg/L
	- Alkalinity according to EWPCA [24]	500 mg/L
	- Alkalinity according to AWWA [25]	500 mg/L
6.	Hardness according to WHO [23]	500 mg/L
7.	Zinc [19]	5.0 mg/L
8.	Calcium [22]	75 mg/L
9.	Iron [19]	2.0 mg/L
10.	Manganese [19]	1.5 mg/L
11.	Cadmium (Tetravalent and Hexvalent) [19]	0.1 mg/L
12.	Chromium (Tetravalent and Hexavalent) [19]	1.0 mg/L
13.	Copper [19]	1.0 mg/L
14.	Lead [19]	0.5 mg/L
15.	Nickel (Tetravalent) [19]	1.0 mg/L
16.	Silver (Tetravalent) [19]	1.0 mg/L
17.	Chlorides [19]	1000 mg/L
18.	Nitrites [26]	1.0 mg/L
19.	Sulphite	---

Results and Discussion

pH, temperature conductivity, BOD, DO, TDS, TDS, SS, total alkalinity, total hardness, nitrites, sulfites, chlorides and some cations were determined in the industrial effluents of different localities of NWFP and have been given in the table (1-4).

Table-2 shows the temperature range of various industrial effluents (10-36°C). This indicates that the temperature of each industrial effluent is below the permissible limit (i.e.) 40°C. Above this temperature the aquatic life adversely affects.

pH of various effluents ranges from acidic to high alkaline (i.e.) 0.86-12.2, as can be seen from the Table-2. Very low pH was observed in the effluents of Pakistan Electroplating Works, low pH affect the solubility of metals which in turn increases the concentration of various metals in water [20]. The table also shows that the pH of Al-Raza Engineering Works, Bessmillah Corporation and Marwat Aluminium Work; were found to be above the permissible limit, which may form hydroxides and sulphides with metals present in water at high pH.

The dissolved oxygen was noted in the range of 96-288 mg/1. No dissolved oxygen standards were issued by Health Authorities, which may be mainly due to lack of toxicity of dissolved oxygen. The lowest value of dissolved oxygen was noted in the effluents of Azeem Match Factory which may cause corrosion of pipes and psychological effects on consumers [22].

The value of BOD of various effluents varies from 44-182 mg/1. The permissible range for BOD according to NEQS is 80 mg/1 [19]. High value of BOD was noted in the effluents of Umar Glass Industry, Frontier Foundry Mills, Bessmillah Corporation and Khazana Sugar Mills, which may cause the depletion of dissolved oxygen, affect the aquatic life and increased salinity of the soil [21].

The amount of TDS, TS and SS of various effluents have also been given in the table-2, which shows that the range of TDS, TS and SS are 0.04-19.83 mg/l, 0.37-18.79 mg/1 and 0.85-18.75 mg/l respectively. All these ranges were found to be within the permissible limit of NEQS [19]. The recommended limit of which is 3500 mg/l, 150 mg/l respectively. These pollutants if present above the permissible limit causes high turbidity in the receiving water body, which prevent light from

Table-2: Determination of Industrial effluents of different localities of N.W.F.P.

S.No.	Name of Industries	Temp at the spot (°C) (Average)	Temp at the lab (°C) (Average)	pH at the spot (Average)	pH in the lab (Average)	EC mS (Average)
1.	Kohl-Sufaid Marble Industry (HIE)	10.11	15.9	7	8.52	1.03
2.	Marwat Aluminum Work (HIE)	10.00	15.5	9	11.51	5.06
3.	Frontier Foundary Steel Mills (HIE)	11.00	14.7	7	9.16	1.13
4.	Hizat Pharmaceutical Industries (HIE)	10.00	14.4	7	8.93	1.0
5.	Umar Glass Industries (HIE)	11.00	14.6	7	8.84	1.16
6.	Azeem Match Factory (HIE)	12.00	14.2	7	8.15	2.20
7.	Khazana Sugar Mills Peshawar	36.00	11.3	6	8.31	1.30
8.	Pakistan Electroplating Work (KRIE)	10.00	16.0	1	0.89	55.22
9.	Al-Raza Engineering Works (KRIE)	11.00	12.0	10	12.21	22.7
10.	Besmillah Corporation (KRIE)	10.00	14.1	10	11.1	4.80

Table-2 (continued)

S.No.	Name of Industries	Hardness (mg/L)	TDS (mg/L)	SS (mg/L)	TS (mg/L)	DO (mg/L)	BOD (mg/L)
1.	Kohl-Sufaid Marble Industry (HIE)	340	0.19	1.238	1.428	136	54
2.	Marwat Aluminum Work (HIE)	5020	3.84	4.26	8.10	132	44
3.	Frontier Foundary Steel Mills (HIE)	440	0.04	6.33	0.37	132	86
4.	Hizat Pharmaceutical Industries (HIE)	293	0.04	0.19	0.68	166	66
5.	Umar Glass Industries (HIE)	380	0.47	0.085	0.385	152	84
6.	Azeem Match Factory (HIE)	416	1.57	0.25	1.32	96	46
7.	Khazana Sugar Mills Peshawar	470	0.92	0.43	0.49	288	182
8.	Pakistan Electroplating Work (KRIE)	9750	--	18.79	18.77	--	--
9.	Al-Raza Engineering Works (KRIE)	320	19.83	1.04	18.79	--	--
10.	Besmillah Corporation (KRIE)	770	19.51	0.25	10.26	168	128

HIE = Hayatabad Industrial Estate KRIE = Kohat Road Industrial Estate
EC = Electrical Conductivity TDS = Total Dissolved Solids
SS = Suspended Solids TS = Total Solids
DO = Dissolved Oxygen BOD = Biological Oxygen Demand.

Table-3: Determination of industrial effluents of different localities of NW.F.P. Pakistan

S.No.	Name of Industries	Alkalinity (mg/L)	SO_3^- (mg/L)	NO_2^- (mg/L)	Cl^- (mg/L)
1.	Kohl-Sufaid Marble Industry (HIE)	690	131.3	0.0354	1490
2.	Marwat Aluminum Work (HIE)	1440	145.1	0.0436	70.05
3.	Frontier Foundary Steel Mills (HIE)	200	134.4	0.0431	647.8
4.	Hizat Pharmaceutical Industries (HIE)	240	145.5	0.062	346.5
5.	Umar Glass Industries (HIE)	320	132.9	0.0446	647.8
6.	Azeem Match Factory (HIE)	260	134.4	0.0848	124.16
7.	Khazana Sugar Mills Peshawar	300	132.9	0.184	298
8.	Pakistan Electroplating Work (KRIE)	Nil	132.9	3.833	26.60
9.	Al-Raza Engineering Works (KRIE)	9200	180.3	0.205	52.00
10.	Besmillah Corporation (KRIE)	3160	132.7	0.1161	224.0

HIE = Hayatabad Industrial Estate
KRIE = Kohat Road Industrial Estate

Table-4: Determination of industrial effluents of different localities of NWFP Pakistan

S.No.	Name of Industries	Zn mg/L	Ca mg/L	Fe mg/L	Mn mg/L	Cd mg/L	Cr mg/L	Cu mg/L	Pb mg/L	Ni mg/L	Ag mg/L	Sb mg/L
1.	Kohl-Sufaid Marble Industry (HIE)	0.00039	0.055	0.00086	--	--	--	--	--	--	--	--
2.	Marwat Aluminum Work (HIE)	0.00035	0.012	0.0052	0.0005	--	0.0082	0.0002	--	0.0843	--	--
3.	Frontier Foundary Steel Mills (HIE)	0.00022	0.0186	0.00206	--	--	--	0.00034	--	--	--	--
4.	Hizat Pharmaceutical Industries (HIE)	0.00039	0.035	0.00096	--	--	--	--	--	--	--	--
5.	Umar Glass Industries (HIE)	0.0002	0.035	0.00123	--	--	--	--	--	--	--	--
6.	Azeem Match Factory (HIE)	0.000133	0.042	0.00137	--	--	--	--	--	--	--	--
7.	Khazana Sugar Mills Peshawar	0.00063	0.058	0.00613	0.00022	--	--	--	--	--	--	--
8.	Pakistan Electroplating Work (KRIE)	0.01	0.051	0.26	0.00135	--	0.0001	0.0072	0.00083	0.373	--	--
9.	Al-Raza Engineering Works (KRIE)	0.00036	0.0086	0.002	--	--	--	--	--	--	--	--
10.	Besmillah Corporation (KRIE)	0.00037	0.064	0.0037	--	--	--	--	--	--	--	--

HIE = Hayatabad Industrial Estate
KRIE = Kohat Road Industrial Estate

entering into the water and therefore affect the normal growth of biological population.

Total alkalinity indicate the concentration of carbonate, bicarbonates and hydroxides of metal ions and were found to be in the range of 0-9200 mg/l (Table-3). Among the different effluents the highest concentration was noted in the effluents of Al-Raza Engineering Works (Table-3), which may affect the plant growth and aquatic life. The permissible range for total alkalinity recommended by W.H.O. EWPCA and AWWA is 500 mg/l [23-25].

Total hardness was observed in the range of (293-9750 mg/l) as shown in the Table-2. The desirable limit recommended by W.H.O. is 500 mg/l [23]. High value was recorded in the effluents of Pakistan Electroplating Works which is beyond the

permissible limit, high concentration may cause diarrhea, dehydration gas trouble, kidney stone and cardiovascular disease [22].

Nitrites is one of the major pollutant in water. Its range was found in the effluents from (0.0354-3.833 mg/1). The highest concentration was found in the effluents of Pakistan Electroplating Works, which is higher than the desirable limit i.e. mg/1 [26]. Higher concentration of nitrites may cause vasodilatory and cardiovascular effects and methemoglobinemia in infants [22,16].

The chlorides concentration in the effluents varies from 26.60-14.90 mg/1. The sample of Kohi-Sufaid Marble Industries shows higher concentration from NEQS limits i.e. 1000 mg/1 [19] and EWPCA limit 250 mg/1 [24]. The high concentration of chlorides may be harmful to metallic pipes and agriculture crops [16]. Sulphites concentration was found to be in the range of 131.3-180.3 mg/l. No standard was issued by Health authorities however, high concentration of sulphite may cause diarrhoea and dehydration [22].

Table-4 shows the concentration of various cations in the different industrial effluents of NWFP. The table shows that the concentration of Zn in the effluents was 0.000133-0.01 mg/1. The permissible limit according to NEQS is 5 mg/1 [19]. The effluents of all industries shows the concentration of zinc within the permissible limit. Higher level of Zn from permissible limit cause irritation of respiratory tract and physiological disorder [22]. Lead (Pb) was found in the range of (0-0.00083 mg/l) and its permissible limit according to NEQS is 0.5 mg/l [19]. The table-4 shows that all these effluents contain no lead except in the effluents of Pakistan Electroplaring Works, which is found to be within the acceptable limit. Above the NEQS limit it can cause sexual sterility, miscarriages, blurred vision, headache etc. [27].

The range for Cu in our effluents was 0-0.0072 mg/l. The desirable level recommended by NEQS is 1.0 mg/l [19]. The concentration of Cu found in all industrial effluents were within the recommended value. High concentration may cause gastroenteritis with nausea [22] and haemochromatosis [28].

Table-4 shows the concentration of iron in the range of 0.00086-0.26 mg/l. Its recommended value according to NEQS is 2.0 mg/1 [19]. The concentration of iron in all samples were found within the acceptable range (Table-4). Beyond the permissible limit it may cause corrosion of pipes, leaching of iron salts from soil and rocks [22].

Ca and Cr contents of the effluents are also within the permissible limit (Table-4). The acceptable range for Ca according to W.H.O. is 75 mg/1 [22] and for Cr and NEQS limit is 1.0 mg/1[19]. The effluents of different industries shows the concentration of both metals within the desirable limit, however beyond the recommended limit it may cause kidney damage, ulcer of nasal septum [27] and bronchiogenic carcinomia [29].

The Mn concentration varies from 0-0.00135 mg/l. The desirable value according to NEQS is 1.0 mg/l [19]. Except Pakistan Electroplating Works all industrial effluents shows no concentration of Mn, which is also within the acceptable range, however concentration above the desirable level may cause a disease with effect similar to Parkinson's disease [22].

The value of Nickel(Ni) was recorded within the permissible limit (Table-4) as recommended by NEQS i.e. 1.0 mg/l [19]. High concentration of nickel above the permissible level may cause skin cancer, eczema, dyspnea and hypersensitivity [27]. The effluents were also analyzed for Cd, Ag, Sb, were not founded in each effluents.

Some of the parameters shows variations from the standards but when the effluents are discharged into nearby estuaries or river its value may become within the permissible limit of various agencies and thus may not have any hazardous affects. However the villages near the bank of estuaries or river may be affected by these pollutants. Therefore, it is suggested that the effluents must be treated in more effective way and the effluents may be processed for recovery of waste materials before leaving into the environment.

Experimental

Samples of different industrial effluents were collected in clean polyethylene bottles and were

analysed for different parameters. The parameters analysed were temperature, pH, DO, BOD, TS, TDS, SS, conductivity, total hardness, total alkalinity, sulphite, nitrites, chlorides and some cations.

pH was measured using portable pH meter (Hanna - model HI 8418) and conductivity by a conductometer (Pcm^3 - Jenway) TDS, TS, SS were determined gravimetrically by standard method. BOD and DO were determined volumetrically [14]. Analysis for total alkalinity and total hardness was carried out by titrating it with standard H_2SO_4 and EDTA respectively [18-15]. Chlorides [16] nitrites [17] and sulphates [18] were estimated by volumetric method. The concentration of various cations were estimated using atomic absorption spectrophotometer (model Pu 9100X).

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