

Investigation of Pollutants Load in Waste Water of Hayatabad Industrial Estate, Peshawar, Pakistan

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Abstract: Industrialization has not only provided the basic facilities for human being but also has generated different environmental problems. The environmental consequences of industrial estates are in the forms of air, water, soil and solid waste pollution. The industries play a vital role in the socioeconomic development of an area and provide one of the basic amenities of life and employment. Industrial development changes the social structure of an area, develops and promotes its infrastructure that's why man is bent on industrializing his domain from earlier. The environment acts like a source to supply raw materials for production processes. The present study was conducted in Hayatabad Industrial Estate (HIE), Peshawar, to investigate the individual industrial effluent load. All the industries were divided into five categories like Marble, Match, Steel, Pharmaceutical and Paper and three industries from each category were selected. The samples were collected from end-up-pipe of individual industrial process and were analyzed for different physical and chemical parameters. Effluent of Marble, Match, Steel, Pharmaceutical, and Paper industries were analyzed for pH, Temperature, DO, TDS, TSS, COD and BOD. Heavy metals like Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu were investigated in the effluents of selected industries. The concentrations of BOD, COD, TSS, TDS, Pb, Cr and Ni were found higher than NEQS for industrial discharges. The wastewater flow rate was also calculated for industrial effluent. Wastewater treatment facilities are not present in the industrial estate. The study suggests that huge quantities of wastewater is generating in industrial estate can be minimized through process modification, change in existing equipment, installation of recycling plants and selection of proper trained employees.

Keywords: Pollutants Load, Waste Water, Industrial Estate and Water Pollution

Introduction

Water is absolutely essential to lives of animals, human and plants. Indeed it is a part of life itself, because the protoplasm of most living cells contain about 80% of water. Most of the metabolic activities of human body involve water. Man use water for many purposes like drinking, cleaning, washing, bathing, heating, air conditioning and industries etc. In every activity of man involves some use of water. The used water returns to the environment with pollutants, which changes its natural level in the environment. Now a day's water is also used for disposal of pollutants, which is of special concern. Any undesirable change in the physical, chemical or biological characteristics of water that may harmfully affect human life or industrial process, that deteriorate natural resources is called water pollution (Khan and Ullah, 1991). Heavy metals from industrial processes are of special concern, because they produce water or chronic poisoning in aquatic animals (Ellis, 1989). Industrial wastewater contain a lot of hazardous substances, therefore, its discharge into the municipal sewage system should be strictly controlled. Some industries are using water for heating purposes and emitting their wastewater into nearby water bodies, which cause to increase the water bodies temperature and affecting aquatic organism because every aquatic species has its own adaptability to certain temperature (Trived and Raj, 1992).

Pakistan is basically an agricultural country and passing from developing stages. In Pakistan the water quality is deteriorating from much of activities, like wastewater discharge from industries and agricultural runoff containing fertilizers and pesticides residues. The large rivers, Ravi and Chanab are heavily polluted due to unplanned, industrialization and over using of pesticides and fertilizers. Today, the seawater of Pakistan is also polluting by ships and oil spills. There are about 50 metals that are of special interests with respect to their toxicological impacts, contributing to water bodies by industrial wastewater. Tanneries and slaughterhouses also discharge wastewater-containing bacteria. The Metropolitan City of Karachi has major Industrial Estate

at four places. Sindh Industrial Trading Estate (SITE), Landhi Industrial Trading Estate (LITE), Korangi and West Wharf. (SITE) area alone at present has 1605 industrial units, which discharge their effluents into Lyari river. Similarly, industrial units in LITE discharge their effluents into Malir river. In dumping pollutants, include high level of organic and heavy metals. The Korangi River receives heavy load of organic effluents and of heavy metals as the Mair River enters it. In Multan the major source of pollution is the Pak Arab fertilizer factory which releases highly polluted wastes in to Multan canal through a Katcha Channel without any check. This untreated waste poses great threat to over one-lac acres of agricultural land.

Deaths of animals have been also reported on account of drinking the heavily polluted water or by grazing on the affected crops. Industrial wastewater pollution in Multan is city tannery wastewater, which either disposed on land or dumped into the Multan Development Authority sewerage system. These wastewater contain excessive amount of settleable solids, chromic sulfides and color. In Faisalabad there are about 235 industries producing effluents. The industrial wastewater is mixed here with domestic wastewater with the result that the municipal sewage can no more be used for irrigating the fertile land around the city, large areas have been spoiled to industrial wastewater on the fertile land. Most of the present industrial liquid discharge is pumped to Paharag Main Drain that is heavily polluted with high colored effluents. Large quantities of hot wastewater are also being sent into municipal sewers. Pollution problem at Kala Shah Kaku is also more acute in severity. Industrial wastewater generated from the huge industries are dumped untreated into Deg Nallah that eventually joins the river Ravi. The total discharge of Deg Nallah in 1979 varied from 12 to 427 cusics, while the combined discharge of industrial waste effluents varied from 2.1 cusics to 5.9 cusics. The discharge of strong hydrochloric acid and highly injurious waste have completely destroyed the aquatic life in the Nallah and rendered it unfit for irrigation and live stock consumption (GOP/EUAD., 1987).

There are no proper wastewater treatment facilities in cities of N.W.F.P. In most urban areas wastewater is disposed of in an open drain, in a shallow pit to be emitted later into a septic tank connected to an open drain, or into municipal sewers. The industrial effluent and sewage run together in the open drains, most of which are unlined and have no primary treatment work or safe out falls. The hospitals, clinics and clinical laboratories, commercial and industrial units also discharge untreated wastewater into existing drainage network, where it mixes with municipal liquid waste and eventually finds its way into nearby water bodies wastewater then find their way into ground water, on which lives of the most of peoples are dependent.

All the industries in Peshawar discharge their untreated wastewater into Bara River, which has an average daily discharge of 304 cusecs. The absence of any treatment of the industrial wastes has resulted in the discharge of highly polluted wastes to the river Kabul. Down stream the river Kabul gets an additional load of pollutants from the industries situated at Nowshera, which further deteriorates its quality. Kalpani Nullah is passing through Mardan City and mixing the effluents with itself and there joins Kabul River down stream of Nowshera (GOP/EUAD. 1987).

Peshawar is the provincial capital of NWFP and is the 7th largest city of Pakistan. It is the main business, commercial and industrial center of the province. The department of industries Govt. of Pakistan on 30th October 1963 established Hayatabad Industrial Estate (HIE). HIE is located in North, West of Peshawar, from 6 and 7 miles on Jamrud road. On the North Khyber Agency is present bordered by Afghanistan. The Warsak high level canal passes from the West side of estate, the Eastern and Southern sides of the estate is surrounded by the area of non irrigated land (Ali, M. and Zaib, A. 1998).

Objectives: The general objective of the study was to investigate wastewater pollution load of different industries in HIE.

Specific objectives were to:

- Study the physical parameters of wastewater.
- Analyze the chemical pollutants.
- Study the existing wastewater discharge system.

Materials and Methods

The methodologies adopted to achieve the objectives were consisted on field visits, interviews, meetings, personal observation, literature study and Lab. Work. Composite samples of industrial wastewater were taken in clean polythene, bottles. During sampling, pH, Temperature, Dissolved oxygen (DO) and flow rate of wastewater were determined. Different physical parameters were studied and measured i.e., temperature

of wastewater sample by centigrade thermometer (china made), pH of waste water sample by portable digital pH meter (206 model, pH, MV), Dissolve Oxygen by HANNA instrument (Model H19134, Microprocessor, Autocollaborating Dissolved Oxygen meter), Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) by Gravimetric method, Biochemical Oxygen Demand (BOD₅) by VELP apparatus (Manometric Method), Chemical Oxygen Demand (COD) by Orbeco-Heliage, Orbeco Analytical System (Model 975 MP, Digestion Method) and Heavy Metals through Flame Atomic Absorption Spectrometry, Shimadzu, A.A 6601 F model. Heavy Metals, which investigated in wastewater samples, were Lead (Pb), Cadmium (Cd), Iron (Fe), Zinc (Zn), Nickel (Ni), Chromium (Cr), Cobalt (Co), Manganese (Mn) and Copper (Cu). Analysis of effluents was carried out three times 1st in January 2001, 2nd in February 2001 and finally in March 2001. All the samples were analyzed in the laboratory of NWFP-EPA.

Results and Discussion

Wastewater of different industries at HIE was analyzed in respect to investigate pollutants load. At HIE total number of industries were 130. Out of all industrial units 101 were opened and 29 were closed industries. All of the production units in the HIE were divided into five categories like Match Factory, Marble industry, Pharmaceutical industry Paper mill and Steel mill from each category three industries were selected, effluents of which were analyzed for pollutants load.

Marble Industries: In the category of marble industries, Shakeel Marble, Afridi Marble and Kohi-Sufaid Marble factories were selected as representatives. The effluents were analyzed for different physical and chemical parameters. In the effluents of Shakeel Marble factory, the values of pH, Temperature, DO, TDS, TSS, BOD and COD were 8.05, 12.7°C, 7.13 mg/L, 2000 mg/L, 10,000 mg/L, 229 mg/L and 180.5 mg/L respectively. Similarly the effluents of Afridi Marble factory were contained pH (8.03), Temperature (12.5°C) DO (7.10 mg/L), TDS (1980 mg/L), TSS (9580 mg/L), BOD (181.8 mg/L) and COD (227 mg/L). While the wastewater of Kohi Sufaid Marble factory were analyzed for, pH, Temperature, DO, TDS, TSS, BOD and COD and were found 8.07, 13.2°C, 6.20 mg/L, 1950 mg/L, 9280 mg/L, 182 mg and 225 mg/L respectively (Table 4.1A). Analyzed values were compared with NEQS limits for wastewater (Table 4.5), and the values of BOD, COD and TSS were found higher than permissible limits.

The wastewater flow rate of Shakeel Marble factory was 1236.3 m³/day, Afridi Marble factory was 181.8 m³/day and Kohi-Sufaid Marble factory was 182 m³/day (Table 4.1A).

Table 4.1 (A): Values of PH, Temp, DO, TDS, TSS, COD and Flow Rate in the Effluents of Marble Industries at H.I.E..

Name of Industry	pH	Temp (°C)	DO	TDS	TSS	COD	F.R (m ³ /day)	BOD mg/L
				Mg/L				
Shakeel Marble	8.05	12.7	7.13	2000.0	10,000	229	1236.3	180.5
Afridi Marble	8.03	12.5	7.10	1980.0	9580	227	1230.2	181.8
Kohi Sufaid Marble	8.07	13.2	6.20	1950.0	9280	225	1220.0	182.0
Mean	8.05	12.8	6.81	1976.6	9620	227	1228.0	181.3

Table 4.1 (B): Concentration of Heavy Metals in Samples Collected from the Effluent of Marble Industries at H.I.E.

Name of Industry	Pb	Cd	Fe	Zn	Ni	Cr	Co	Mn	Cu
	mg/L								
Shakeel Marble	3.21	0.06	0.03	0.06	0.03	0.50	0.0010	0.01	0.43
Afridi Marble	3.18	0.04	0.02	0.05	0.01	0.30	0.0000	0.02	0.44
KohiSufaid Marble	3.22	0.07	0.04	0.07	0.05	0.60	0.0030	0.03	0.45
Mean	3.20	0.056	0.03	0.06	0.03	0.46	0.0013	0.02	0.44

Table 4.5: National Environmental Quality Standards (NEWS) For Industrial Effluents

Parameters	Standards
Temperature	40 °C
pH value (acidity / basicity)	6-10 pH
5-days Biochemical Oxygen Demand (BOD) at 20 °c.	80 mg/L
Chemical Oxygen Demand (COD)	150 mg/L
Total Suspended solids	150 mg/L
Total dissolved solids	3500 mg/L
Grease and oil	10 mg/L
Phenolic compounds (phenol)	0.1 mg/L
Chloride (Cl)	1000 mg/L
Fluoride (F)	20 mg/L
Cyanide (CN)	2 mg/L
An-ionic detergents 2 (MBAS)3	20 mg/L
Sulphate (SO ₄ ⁻²)	600 mg/L
Sulphide (S)	1.0 mg/L
Ammonia (NH ₃)	40 mg/L
Pesticides, herbicides, fungicides and insecticides	0.15 mg/L
Cadmium	0.1 mg/L
Chromium	1.0 mg/L
Copper	1.0 mg/L
Lead	0.5 mg/L
Mercury	0.01 mg/L
Selenium	0.5 mg/L
Nickel	1.0 mg/L
Silver	1.0 mg/L
Total toxic metals	2.0 mg/L

Source: Khan, S. 1997.

The heavy metals were also investigated in effluents of selected marble industries. The wastewater of Chicle Marble factory was analyzed for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu, which were found 3.21 mg/L, 0.06 mg/L, 0.03 mg/L, 0.06 mg/L, 0.03 mg/L, 0.5 mg/L, 0.001 mg/L, 0.01 mg/L and 0.43 mg/L respectively. The Affright Marble factory's effluent was found to contain Pb (3.18 mg/L), Cd (0.04 mg/L), Fe (0.02 mg/L), Zn (0.05 mg/L), Ni (0.01 mg/L), Cr (0.3 mg/L), Co (0.00 mg/L), Mn (0.02 mg/L) and Cu (0.44 mg/L), while the effluents of Kohli-Seafood Marble factory were contained Pb (3.22 mg/L), Cd (0.07 mg/L), Fe (0.04 mg/L), Zn (0.07 mg/L), Ni (0.05 mg/L), Cr (0.6 mg/L), Co (0.003 mg/L), Mn (0.03 mg/L) and Cu (0.45 mg/L). (Table 5.1B). By comparing the results of heavy metals with NEWS limits for industrial discharges, only Pb was found above permissible limits (Table 4.5).

Match Industries: In the category of match industries, Aim Match, Frontier Match and Mohsin Match factories were selected as representatives. The effluent were analyzed for different physical and chemical parameters. The effluents of Aim Match factory was analyzed for pH, Temperature, DO, TDS, TSS, COD and BOD. The values of above mentioned parameters were 6.03, 12.7°C, 2.07 mg/L, 59000 mg/L, 1380 mg/L, 370 mg/L and 191.07 mg/L respectively.

Similarly the effluents of Frontier Match factory were contained pH (6.00), Temperature (12.9°C), DO (2.03 mg/L), TDS (58580 mg/L), TSS (1385 mg/L), COD (372 mg/L) and BOD (193 mg/L). While the wastewater of Mohsin Match factory analyzed for pH, Temperature, DO, TDS, TSS, COD and BOD and the values of analyzed parameters were found 7.01, 13°C, 2.09 mg/L, 5880 mg/L, 1378 mg/L, 368 mg/L and 190.3 mg/L respectively (Table 4.2A).

The analyzed values were compared with NEQS values

for industrial effluents (Table 4.5) and parameters like TDS, TSS, BOD and COD were found above permissible limits.

The wastewater flow rate of Asim Match factory was 726.5 m³/day, Frontier Match factory was 728 m³/day and Mohsin Match factory was 725.7 m³/day (Table 4.2A).

The heavy metals were also investigated in the effluents of selected match industries. The wastewater of Aim Match factory was analyzed for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu, which were found 2.75 mg/L, 0.05 mg/L, 0.07 mg/L, 0.03 mg/L, 0.07 mg/L, 3.96 mg/L, 0.07 mg/L, 0.03 mg/L and 0.12 mg/L respectively. The Frontier Match factory's effluents was found to contain Pb (2.70 mg/L), Cd (0.03 mg/L), Fe (0.04 mg/L), Zn (0.01 mg/L), Ni (0.05 mg/L), Cr (3.89 mg/L), Co (0.03 mg/L), Mn (0.00 mg/L) and Cu (0.10 mg/L), while the Mohsin Match factory's effluents were contained Pb (2.77 mg/L), Cd (0.04 mg/L), Fe (0.06 mg/L), Zn (0.04 mg/L), Ni (0.08 mg/L), Cr (3.90 mg/L), Co (0.02 mg/L), Mn (0.04 mg/L) and Cu (0.11 mg/L) (Table 4.2B).

The resulted values were compared with NEWS limits for industrial effluent discharges (Table 4.5). The values of Pb and Cr were found above permissible limits.

Steel Industries: In category of steel industries, Myka Steel, Khurram steel and Lahore steel mills were selected as representatives. Different physical and chemical parameters were determined in effluents of selected industries. Effluents of Myka steel mill was analyzed for pH, Temperature, DO, TDS, TSS, BOD and COD, which were found as 7.17, 18.4°C, 15.2 mg/L, 1200 mg/L, 6660 mg/L, 192.67 mg/L and 160 mg/L respectively.

Similarly the effluents Khurram Steel Mill were found to contain pH (7.15), Temperature (20°C), DO (14 mg/L), TDS (1210 mg/L), BOD (193.5 mg/L) and COD (162 mg/L) while the wastewater of Lahore Steel Mill was analyzed for pH, Temperature, DO, TDS, TSS, BOD and COD, which values found were, 7.12, 19.8°C, 14.7 mg/L, 1205 mg/L, 6670 mg/L, 195.2 mg/L and 160.8 mg/L respectively (Table 4.3A). By comparing the results with NEWS limits for industrial discharges (Table 4.5). The values of TSS, BOD and COD were found above permissible effluent discharges.

Heavy metals were also investigated in selected steel industries. The effluents of Myka Steel Mill was analyzed for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu, which were found as 1.50 mg/L, 0.06 mg/L, 0.01 mg/L, 0.05 mg/L, 2.00 mg/L, 0.02 mg/L, 0.002 mg/L, 0.01 mg/L and 0.38 mg/L respectively. The Khurram Steel Mills effluent was found to contain Pb (1.48 mg/L), Cd (0.01 mg/L), Fe (0.02 mg/L), Zn (0.03 mg/L), Ni (2.02 mg/L), (2.02 mg/L), Cr (0.04 mg/L), Co (0.005 mg/L), Mn (0.03 mg/L) and Cu (0.40 mg/L), while the effluent of Lahore Steel Mill was analyzed for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu, the results found of mentioned heavy metals were 1.51 mg/L, 0.08 mg/L, 0.04 mg/L, 0.07 mg/L, 2105 mg/L, 0.03 mg/L, 0.003 mg/L, 0.05 mg/L and 0.39 mg/L respectively (Table 4.3 B). The results of heavy metals were compared with NEWS values for industrial effluents (Table 4.5). The value, of Pb and Ni were found above permissible limits.

Pharmaceutical Industries: In category of pharmaceutical industries, polyfine, Bryon and saydoon pharmaceutical industries were selected as representatives. The effluents of above mentioned industries were analyzed for different physical and chemical parameters. The effluent of polyfine pharmaceutical industry was analyzed for pH,

Temperature, TSS, TDS, COD and BOD, which values were found as 7.47, 24.9°C, 270 mg/L, 1600 mg/L, 675 mg/L and 6.66 mg/L respectively.

Similarly the effluents of Bryon pharmaceutical industry was analyzed and found to contain pH (7.50), Temperature (25°C), TSS (273.8 mg/L), TDS (1605 mg/L), COD (672 mg/L) and BOD (6.58 mg/L), while the wastewater of Saydoon pharmaceutical was analyzed for pH, Temperature, TSS, TDS, COD and BOD, which values were found as 7.45, 24.5°C, 271 mg/L, 1602 mg/L, 673 mg/L and 6.63 mg/L respectively (Table 4.4A). The analyzed values were compared with NEWS limits for industrial discharges and the values of TSS and COD were found above permissible limits (Table 4.5). The wastewater flow rate of polyfine pharmaceutical industry was 107.627 m³/day, Bryon pharmaceutical industry was 108 m³/day and Saydoon pharmaceutical industry was 107.7 m³/day (Table 4.4A).

Heavy metals were also investigated in the effluents of selected pharmaceutical industries. The wastewater of polyfine pharmaceutical industry was analyzed for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu, which values were found 0.7 mg/L, 0.03 mg/L, 0.08 mg/L, 0.02 mg/L, 0.00 mg/L, 0.05 mg/L, 0.02 mg/L, 0.03 mg/L and 0.07 mg/L respectively.

The effluents of Bryon pharmaceutical industry's effluents was found to contain Pb (0.6 mg/L), Cd (0.02 mg/L), Fe (0.07 mg/L), Zn (0.01 mg/L), Ni (0.01 mg/L), Cr (0.04 mg/L), Co (0.01 mg/L), Mn (0.02 mg/L) and Cu (0.08 mg/L). While the effluent of Saydoon pharmaceutical industry was analyzed for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu, which values were found 0.8 mg/L, 0.04 mg/L, 0.08 mg/L, 0.03 mg/L, 0.02 mg/L, 0.06 mg/L, 0.03 mg/L, 0.04 mg/L and 0.04 mg/L respectively (Table 4.4 B). The resulted data was compared with NEWS (Table 4.5), and the value of Pb was found above permissible limits.

Paper Industry: In category of paper industries, effluents of Olympia paper mill was analyzed for different physical and chemical parameters. Effluent of Olympia paper mill was analyzed for pH, Temperature, TSS, TDS, DO, COD and BOD, the values of which were found as 11.45, 24.5°C, 7200 mg/L, 27300 mg/L, 2.35 mg/L, 676 mg/L and 292.2 mg/L respectively. The wastewater flow rate was found 719.019 m³/day.

The resulted data was compared with NEQS (Table 4.5), and the values of TSS, BOD and COD were found above permissible limits.

The heavy metals were also investigated in the effluents of Olympia paper mills and analyzed for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu. The values of above mentioned parameters were found as 1.00 mg/L, 0.03 mg/L, 0.010 mg/L, 0.03 mg/L, 0.01 mg/L, 4.3 mg/L, 0.001 mg/L, 0.00 mg/L and 0.03 mg/L respectively. The resulted values of heavy metals were compared with NEWS (Tables 4.5), and the values of Pb and Cr were found above permissible limits.

Conclusion

The mean values of pH, Temperature, DO, TDS, TSS, COD and BOD in the effluents of marble industries were 8.05, 13.8°C, 6.81 mg/L, 1976.6 mg/L, 9620 mg/L, 227 mg/L and 181.3 mg/L respectively. In which BOD, COD and TSS were above permissible limits. While the wastewater flow rate was 122 m³/day. Average concentration of heavy metals in the effluents of marble industries were Pb (3.20 mg/L), Cd (0.056 mg/L), Fe (0.03 mg/L), Zn (0.06 mg/L), Ni (0.03 mg/L), Cr (0.46

mg/L), Co (0.0013 mg/L), Mn (0.02 mg/L) and Cu (0.44 mg/L). Only Pb was found above permissible limits.

The values of pH, Temperature, DO, TDS, TSS, COD and BOD in the effluents of match industries were 6.35, 12.86°C, 6.19 mg/L, 58793 mg/L, 1381 mg/L, 370 mg/L and 191.4 mg/L respectively, in which TSS, TDS, BOD and COD were found above permissible limits. While the wastewater flow rate of match industries was 226.7 m³/day. The concentration of heavy metals like Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu, in the effluents of match industries were 2.74 mg/L, 0.04 mg/L, 0.056 mg/L, 0.026 mg/L, 0.08 mg/L, 3.91 mg/L, 0.12 mg/L, 0.023 mg/L and 0.11 mg/L respectively. The values of Pb and Cr were found above permissible limits, set by NEWS for industrial effluents.

The values of pH, Temperature, DO, TDS, TSS, BOD and COD in the effluents of steel industries were 7.14, 194°C, 14.6 mg/L, 1205 mg/L, 6665 mg/L, 193.79 mg/L and 160.9 mg/L respectively. In which TSS, BOD and COD were found above then permissible limits set by NEWS. Mean concentration of heavy metals in the effluents of steel industries were 1.49 mg/L, 0.07 mg/L, 0.02 mg/L, 0.05 mg/L, 2.02 mg/L, 0.03 mg/L, 0.003 mg/L, 0.03 mg/L and 0.39 mg/L for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu respectively. In these metals Pb and Ni were found above NEQS.

Mean values of pH, Temperature, TSS, TDS, COD and BOD in the effluents of Pharmaceutical mg/L were 7.47 mg/L, 24.8 mg/L, 271.6 mg/L, 1602.3 mg/L, 673.3 mg/L and 6.62 mg/L respectively. Mean wastewater flow rate of Pharmaceutical industries were 107.7 m³/day. In these parameters TSS and COD were found above NEQS. The mean values of heavy metals in the effluents of Pharmaceutical industries were 0.7 mg/L, 0.03 mg/L, 0.08 mg/L, 0.02 mg/L, 0.01 mg/L, 0.05 mg/L, 0.02 mg/L, 0.03 mg/L and 0.08 mg/L for Pb, Cd, Fe, Zn, Ni, Cr, Co, Mn and Cu. The only heavy metal Pb was above NEQS.

The mean values of pH, Temperature, TSS, TDS, DO, COD and BOD in the effluents of paper industry were 11.45, 24.5°C, 7200 mg/L, 27300 mg/L, 2.35 mg/L, 676 mg/L and 292.2 mg/L respectively. The mean value of effluents flow rate was found 719.019 m³/day. In these TSS, BOD and COD were found above NEQS.

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