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Evaluation of Current Industrial Effluents in Port City Chattogram, Bangladesh

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Abstract— *The study area is Chattogram, the second largest metropolis of Bangladesh and the economic area of the country, is situated on the right bank of the river Karnaphuli. The study was carried out in five industries as a sampling station before and after treatment of industrial discharges and covered mainly two seasons, winter and dry seasons from October 2017 to June 2019.The range of results of waste water obtained were 163 – 197 mg L^{-1} for total suspended solids (TSS), 2015 – 2,505 mg L^{-1} for total dissolved solids (TDS), 2407- 2656 mg L^{-1} for Total solids,148 – 192 mg L^{-1} for hardness, 4.01 – 6.08mg $L^{-1}$for dissolved oxygen, 76 – 112 mg $L^{-1}$for biochemical oxygen demand (BOD), 249 – 281 mg $L^{-1}$for chemical oxygen demand (COD), 0.008 mg $L^{-1}$for Cd. From this research work, it is seen that almost all the parameters of industrial discharges are out of range prescribed by the Department of Environment (DoE), Bangladesh which is so much alarming for us. So, the accurately untreated industrial waste water mainly heavy metals are deposited in our bodies through food cycle and impacts on our body. From this research work it is observed that all of the industries in designated area do not establish the ETP section. Most of the experimental industries used almost analogous types of ETP and their effluent treatment ways were capable to reduction their different parameters but not effective to maintain the standard discharge limit prescribed by the Department of Environment (DoE), Bangladesh.*

Keywords— *Effluents, Dry and Wet Seasons, ETP, Environmental Impact.*

I. INTRODUCTION

Water pollution due to discharge of untreated industrial effluents into water bodies is a major problem in the global context (1). The problem of water pollution is being experienced by both developing and developed countries. Human activities give rise to water pollution by introducing various categories of substances or waste into a water body (2). The more common types of polluting substances include pathogenic organisms, oxygen demanding organic substances, plant nutrients that stimulate algal blooms, inorganic and organic toxic substances. Majority of manufactures are water based and a considerable volume of effluent is ejected to the environment either treated or inadequately treated leading to the problem of surface and ground water pollution (3). Due to unplanned industrialization in terms of Effluent Treatment Plant's (ETP) efficiency and availability, most of the industries in our country have been established randomly here and there. That's why all the industries in our country do not establish Effluent Treatment Plant (ETP) and polluted our environment (4). Moreover, the industries whose have Effluent Treatment Plant (ETP) do not treat the effluents properly and impacts on our environment as well as public health (5). ETP are used by industries to purify waste water & remove any toxic & non toxic materials or chemicals from it. So an ETP is a plant where the treatment of industrial effluents & waste water is performed. The industrial areas in Bangladesh are situated in the midst of densely populated regions and the growth of industries has generally been unplanned without keeping the issue of environmental protection in careful consideration (6). In the production process industries, a lot of solid, semi-solid and liquid wastes are generated that may contain substantial amount of toxic organic and inorganic pollutants, and if dumped in the environment without treatment then this may lead to serious environmental consequences. This will also undoubtedly deteriorate soil productivity and adversely affect crop production in the surrounding land area (7). Industrial effluents had remarkable changes in the distribution of ions and their concentrations in wheat and bean plants (8). The environmental pollution especially water pollution, air pollution and soil pollution are increasingly getting priority in the country's development strategies and plans. Environmental degradation is affecting country's economic growth. Lack of proper implementation and monitoring of environmental rules hinder the achievement of environmental goals (9).

II. MATERIALS AND METHODS

The study was carried out in 5 industries as a sampling station before and after treatment of industrial discharges and covered mainly two seasons, winter and dry seasons between October 2017 and June 2019 in Chittagong, the second largest metropolis of Bangladesh. The waste water samples were collected for physico-chemical and heavy metal analysis from thirteen stations of the industrial discharge. Samples were collected in 100 ml Plastic bottles. All samples for laboratory analysis had been pre-washed with 10% nitric acid and rinsed with distilled water before use. Each bottle was rinsed three times with the appropriate amount of sample before final sample collection. For heavy metal 90 ml of effluent samples from each sampling point was transferred to 100 ml plastic bottles. For the analysis of heavy metals 10 ml 2M HNO_3 solution was taken to protect water samples from any fungal and other pathogenic attack (10). These samples were placed in a lightproof box to protect from direct sunlight and then taken to the laboratory for analysis. To provide necessary information for each sample, date of collection, location etc were recorded in the note book and each sample collected in a plastic bottle was labeled separately with a unique identification number. Effluent samples were then filtered

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through filter paper (Whatman No. 42) to remove undesirable solid and suspended materials. In the laboratory, the bottles were kept in a clean, cool, dark and dry place. The chemical analyses of effluent were performed as quickly as possible on arrival at the Laboratory of DoE.

Electrical Conductivity (EC):

The conductivity meter and cell were calibrated using 0.005 M KCl solution. Water samples were used directly for measurement of specific conductance within 5 – 10 minutes of sample collection by using Combo meter.

Dissolved Oxygen (DO):

The DO meter was calibrated before every measurement using 2 % Na_2 SO_3 solution (M.K. Mohanta et al. 2010). DO was measured immediately after collection of each sample within 5- 10 minutes at the sampling spot by using DO meter.

Biochemical Oxygen Demand (BOD_5):

The sample was taken in the bottle and diluted with the water. The probe of the multimeter was placed inside the bottle and the reading was taken and finally the bottle was placed inside the refrigerator at 200 ° C of temperature for 5 days. After 5 days, the data was taken again trough the multi meter and the result was obtained.

BOD= Initial DO – Final DO

Chemical Oxygen Demand (COD):

Turned on the reactor and preheated to 150°C. Hold the vial at 45 degree angle and 2ml of sample. Then the sample was mixed by inverting the vial. The sample was heated for two hours with a strong oxidizing agent. After the vial was placed inside, the spectrophotometer and compared it with the blank vial. Thus the result was obtained.

Total Dissolved Solid (TDS):

TDS were measured after collection of sample within 5- 10 minutes at the sampling spot by using Combo meter.

Total Solid (TS) and Total Suspended Solid (TSS):

100 ml of water sample was taken in a beaker or glass dish and evaporated to dryness in an oven at 103- 105 ^{0}C then cooled in a desicator and weighed.

$$\text{Total solids (ppm)} = \frac{\text{mg of total solid x 1000}}{\text{ml sample}}$$

Total suspended solids = Total solids – Total dissolved solids

Total Dissolved Solids (TDS):

The sample water was taken in the beaker and the probe of the multimeter was placed inside the beaker for few minute. The static result shown on the screen of the multimeter was the TDS of the water.

III. Results & Discussion

Alkalinity:

TABLE 1: Comparison of ETP outlet water Alkalinity values with standard

Name of plant	Before treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	309± 6	285 ± 4.5	175± 5	161± 6	150
PHP Glass lndustry	321± 6	2980 ± 6	165± 5	194 ± 6	
Asian Paints Ltd.	485±5	507± 5	176± 5	179± 6	
Smart Jeans Industry	308± 5	364± 4	171± 5	168± 5	
Confidence Cement Factory	245± 7	316± 8	173± 8	180± 7	

Turbidity:

TABLE 2: Comparison of ETP outlet water Turbidity values with standard

Name of plant	Before treatment (NTU)		After Treatment (NTU)		Standard value of Dept. of Environment, Bd. (NTU)
	Dry Season ± SD	Winter Season± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	38± 5	36± 6	12± 5	13± 6	< 10
PHP Glass lndustry	35± 8	38± 10	15± 5	14± 6	
Asian Paints Ltd.	47± 5	69± 6	27± 6	23± 6	
Smart Jeans Industry	35± 5	32± 5	15± 5	14± 5	
Confidence Cement Factory	39± 6	42± 8	18± 7	19± 5	

Electrical Conductivity (EC):

TABLE 3: Comparison of ETP outlet water EC values with standard

Name of plant	Before treatment (µS cm^{-1})		After Treatment (µS cm^{-1})		Standard value of Dept. of Environment, Bd. (µS cm^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	2246± 10	2310± 11	1467± 5	1491± 5	< 1200
PHP Glass lndustry	2463± 5	2481± 6	1422± 5	1302± 8	
Asian Paints Ltd.	2499± 7	2581± 8	1375± 8	1452± 10	
Smart Jeans Industry	3001± 5	2918± 6	1369± 5	1397± 6	
Confidence Cement Factory	2770± 9	2843± 8	1379± 6	1290± 7	

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Total Dissolved Solid (TDS):

TABLE 4: Comparison of ETP outlet water TDS values with standard

Name of plant	Before treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	3985± 9	3790 ± 11	2456± 6	2015± 6	< 2100
PHP Glass lndustry	3345± 10	3478 ± 9	2300± 8	2439± 7	
Asian Paints Ltd.	4065± 6	3927 ± 7	2505± 5	2460± 6	
Smart Jeans Industry	4408± 8	4303± 7	2394± 6	2409± 5	
Confidence Cement Factory	3470± 9	3500± 10	2232± 7	2362± 9	

Total Suspended Solid (TSS):

TABLE 5: Comparison of ETP outlet water TSS values with standard

Name of plant	Before treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	410± 2	394± 5	185± 5	197± 3	< 150
PHP Glass lndustry	365± 5	401± 4	167± 2	179± 3	
Asian Paints Ltd.	298± 2	371± 3	180± 2	192± 4	
Smart Jeans Industry	305± 3	323± 2	181± 3	186± 3	
Confidence Cement Factory	390± 2	368± 3	163± 3	167± 2	

Total Solids (TS):

TABLE 6: Comparison of ETP outlet water TS values with standard

Name of plant	Before treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	4677± 10	4602± 11	2467± 6	2421± 6	< 2250
PHP Glass lndustry	4809± 11	4902±9	2407± 6	2465± 5	
Asian Paints Ltd.	4779± 10	4820±9	2410± 5	2501± 7	
Smart Jeans Industry	4900± 8	4883±5	2656± 7	2500± 3	
Confidence Cement Factory	4930± 8	5045±5	2503± 7	2497± 7	

Hardness:

TABLE 7: Comparison of ETP outlet water Hardness values with standard.

Name of plant	Before treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	403 ± 5	369 ± 5	167± 5	173± 6	< 120
PHP Glass lndustry	380± 6	398± 6	156± 5	1703± 6	
Asian Paints Ltd.	456± 5	411± 7	174± 4	180± 5	
Smart Jeans Industry	312± 5	377± 3	148± 2	179± 3	
Confidence Cement Factory	389± 6	402± 7	187± 5	192± 6	

Dissolved Oxygen (DO):

TABLE: 8 Comparison of ETP outlet water DO values with standard

Name of plant	Before treatment (mg/L^{-1})		After Treatment (mg/L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	3.09± 0.35	3.58± 0.62	5.45± .6	6.03± .4	5.00
PHP Glass lndustry	3.67± 0.4	3.87± 0.4	6.08± 0.5	5.378± 0.5	
Asian Paints Ltd.	4.45± 0.5	4.87± 0.6	4.98± 0.7	5.12± 0.5	
Smart Jeans Industry	3.98± 0.4	4.02± 0.5	5.32± 0.5	5.03± 0.6	
Confidence Cement Factory	3.97± 0.6	3.60± 0.5	4.35± 0.6	4.01± 0.6	

Biological Oxygen Demand (BOD):

TABLE 9: Comparison of ETP outlet water BOD values with standard

Name of plant	Before treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	136± 6	141± 5	86± 6	79± 5	< 50
PHP Glass lndustry	175± 5	145±3	112± 5	102± 4	
Asian Paints Ltd.	125± 5	153± 4	76± 4	89± 3	
Smart Jeans Industry	147± 3	135± 3	103± 2	108± 1	
Confidence Cement Factory	178± 5	158± 6	90± 4	98± 2	

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Chemical Oxygen Demand (COD):

TABLE 10: Comparison of ETP outlet water COD values with standard

Name of plant	Before treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	369± 9	402± 8	249± 6	258± 4	< 200
PHP Glass lndustry	397± 7	376± 6	253± 4	274± 6	
Asian Paints Ltd.	467±4	489± 5	268± 4	275± 6	
Smart Jeans Industry	458± 4	463± 5	278± 3	281± 3	
Confidence Cement Factory	501± 5	497± 6	265± 5	254± 5	

Cadmium:

TABLE 11: Comparison of ETP outlet water Cadmium values with standard

Name of plant	Before Treatment (mg L^{-1})		After Treatment (mg L^{-1})		Standard value of Dept. of Environment, Bd. (mg L^{-1})
	Dry Season ± SD	Winter Season ± SD	Dry Season ± SD	Winter Season ± SD	
KDS Samuda plant	0.056±0.007	0.073±0.008	0.005±0.001	0.04±0.001	0.005
PHP Glass lndustry	0.082±0.001	0.076±0.002	0.007±0.002	0.007±0.001	
Asian Paints Ltd.	0.034±0.002	0.023±0.002	0.005±0.001	0.003±0.001	
Smart Jeans Industry	0.076±0.004	.082± 0.005	0.006±0.001	0.008±0.001	
Confidence Cement Factory	Not detected	Not detected	Not detected	Not detected	

IV. CONCLUSION

From this research work it is seen that all of the industries in Bangladesh do not establish the ETP section. From this research work it is clear that in every parameters of effluents, the value is much more higher than acceptable limit which is so much frightening for us. So, the properly untreated waste water mainly heavy metals are deposited in our bodies through food cycle and we have to face kidney diseases, lever diseases and even cancer. The government can easily acquire land to set up specialized economic zone where CETP can be established. So, in these situations only practicable alternatives that must be maintained are dumping location should be properly managed to minimize its effects on the environment, proper laws should be strongly preserved and maintained, suitable distance from the surrounding water body should be maintained, appropriate laws on dumping of industrial effluents should be set up as well as some lessening measures should be taken for example, alertness should be also built up among the people about the environment degradation due to the discharging of industrial effluents.

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