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Treatment of Municipal Water at Pakistan Steel Mill Waste Water Treatment Plant Considering Its Social and Environmental Impacts

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ABSTRACT

Clean Water is one of the indispensable needs of living beings as well as for the ecosystem. All living species require clean and affordable water to avoid health-threatening hurdles and a better environment that helps acquire sufficient and clean environmental air. Hence, the untreated municipal water discharged in water bodies or the agricultural fields poses a threat to human beings, the environment, and all living species. The organic and inorganic substances of municipal water have profound effects when the wastewater is utilized for irrigation purposes or empty spaces. The treatment of sewage is inevitable in this rapidly growing population situation and the growing urbanization that requires the massive availability of clean water. Therefore, this study focuses on treating wastewater (coming from Gulshan-e-Hadeed, Township, and Industrial area) at Pakistan Steel Mill Wastewater Treatment Plant Karachi to meet the requirement of clean water, avoiding threat the environment. Pakistan Steel Mill WWTP can treat the wastewater according to the NEQS set by the Pakistan Environment Protection Agency considering the Pakistan environment protection act 1997. Hence, the necessary parameters are removed from the wastewater through physical and biological treatment processes to reuse the wastewater avoiding public health harm and damage to the environment. The treated water parameters' concerning the NEQS are achieved approximately 70%-80%. The wastewater was brought useable for agricultural and empty space purposes.

Keywords:

Clean Water
Ecosystem
NEQS
Public health
Population

1. Introduction

The water discharged from different sources: most often municipal that contains domestic and industrial is wastewater. The impurities present in-ground, rainwater, and the effluent coming from domestic water include households and organizational wastewater. The contaminated water comprises pathogen micro organs, inorganic solids, biodegradable inorganic compounds,

nutrients, and other inorganic suspended solids. These impure solids are most often food, body, and industrial waste. While the wastewater comprising surface sediments, metals, and salts come from inorganic solids [1].

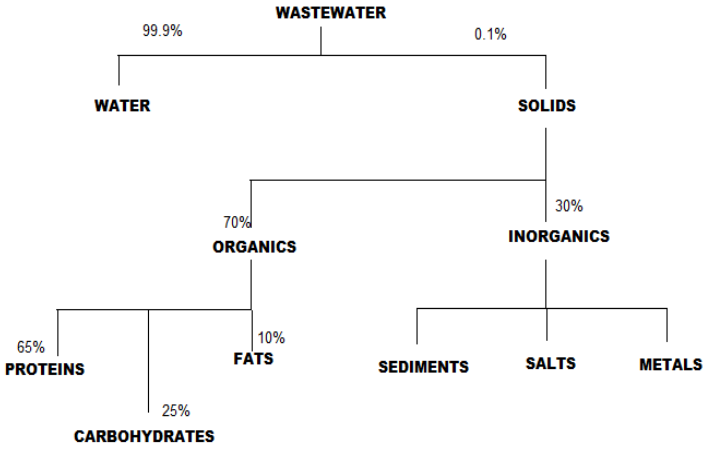


Fig. 01: Approximate composition of wastewater

Moreover, the protein, carbohydrates, and lipids present in biodegradable organic materials contain carbon converted into carbon dioxide and nitrogen in protein. Therefore, they must be removed; otherwise will create more demand for Oxygen in the water.

The recycle and reuse techniques provide real solutions of wastewater treatment where the massive quantity of water is required due to the rapid increase in Population and to avoid environmental degradation. The treated water can irrigate crops, clean equipment, and maintain [2][3].

The free disposal of municipal water discharged in the water bodies of irrigation leads to contamination of freshwater that causes low agriculture production, deteriorates human health (waterborne disease) environmental degradation. So, the outgrowth in urbanization and industrialization in less time has seriously caused the degradation of the ecosystem above and under the Seas [4]. Hence, the free flow of this toxic water affects the water life and reduces economic dependence on aquatic species [5]. Therefore, the Pakistan Steel Mill Wastewater treatment plant was installed to make the water clean and eco-friendly. The plant had been engineered to treat municipal (Domestic) 80% and Industrial wastewater 20% of Pakistan Steel Mills biological before being disposed of.

The wastewater (Domestic) coming from Steel Township, Ghulshan-e-Hadeed Phase 1 & 2, Labor camp, and the Mill sewerage are pretreated by automatic screens and sand traps. Water stored in two separate surge tanks in subsequent activation unit then treatment process carried out in

Aeration basin by introducing Oxygen (AIR) through Helixes, which generates bacteria beneficial for horticulture. Hence, municipal water treatment is the necessity of time while water scarcity in dams or the ground water [6].

2. Research Methodology

Wastewater treatment processes

2.1.1 Primary treatment – removal of floating and settleable solids.

Screening

Initially, the wastewater is screened. The floating debris and large contaminating objects (paper, rags, and plastics) are removed.

Grit Removal

The objects that do not come under screening are entertained in grit like sand, gravel, and any fragmented parts. Grit removal protects mechanical equipment's efficiency.

Coagulation, Flocculation, Clarification

A sand filter removes the water containing silt and mud through three processes: coagulation, flocculation, and clarification. Coagulant (a chemical substance) is added to the water to break the material into flocs. So the mixing of coagulant will further be responsible for settling and forming of flocs in the chambers. Finally, the suspended solids will sink; that is called clarification of water that makes it clear [7][8].

2.1.2 Secondary treatment (Biological) – removal of most organic matter

The organic impurities are taken away through sedimentation in the form of cell biomass.

The Oxygen is put together into wastewater to support the process called aerobic process.

Impure organic objects +Oxygen+ Bacterial Material →cell biomass + Carbon Dioxide, Water

3. Results and discussion

The water Treatment Laboratory performs Physical and chemical testing of domestic & industrial influents and effluents from different sample points inside the plant and EPD (Environment Pollution department) of Pakistan Steel.

Samples from Waste Water Treatment Plant Pakistan Steel, Where domestic as well as industrial waste were treated, after the treatment processes, the results were compared to NEQS Limit [9], set up by Pakistan

Environment Protection Agency and followed by Pakistan Steel mill under the notification mentioned in the Table1.

Table 01: Pak Steel Mill Waste Water Treatment Laboratory Capacity w.r.t, NEQs

Parameters	**Domestic**	**Industrial**	**Effluent**	**NEQS**
PH	6.5 -7.2	6.9 – 7.6	6.5 – 7.5	6-9
Temperature C	25 – 30 C	28 – 30 C	26 C	30C
Chemical Oxygen Demand (COD)	200 mg/l	300 – 500 mg/l	120 – 140 mg/l	150mg/1
Biological Oxygen Demand (BOD)	180 – 200 mg/l	250 – 300 mg/l	22 – 25 mg/l	80mg/1
Suspended Solids	250 – 300 mg/l	400 – 450 mg/l	18 – 22 mg/l	200mg/1
Settle ability Test	0.5 to 1.0 mg/l	0.6 to 1.3 mg/l	NIL	-------

Moreover, after adding the coagulant (Alum), the results are mentioned in Table 3. This mixed water is then sent to the aeration tank, where the biological process is carried out. Oxygen is supplied to grow the bacteria to bring the water under the NEQS limit shown in Table 4.

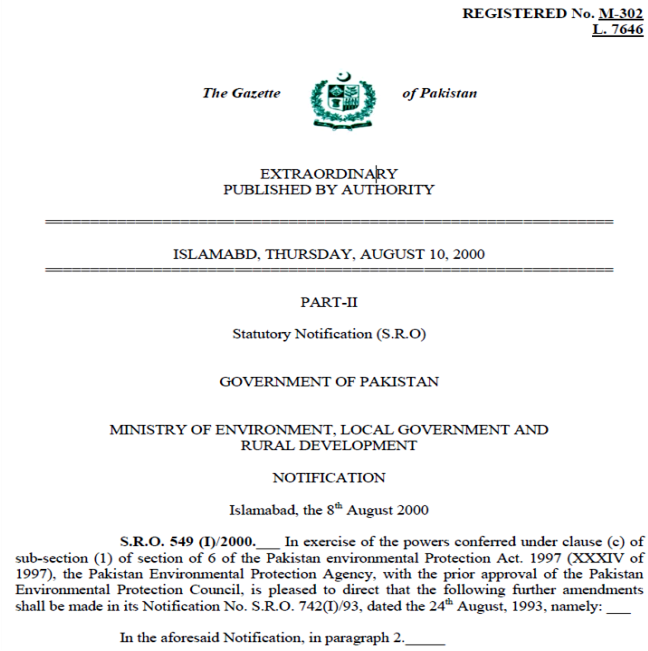
After carrying out the coagulation process, the results mentioned in Table 3 do not meet NEQS. Therefore, the Activated sludge process was required to bring the water quality parameters under the limit set by NEQs mentioned in Table 4.

Environment Protection

It was in 1977 for the first time in Pakistan to make legislation for environmental protection. The federal and provincial actors introduced policy development, including Pakistan Environmental Protection Act 1977 and Pakistan Environmental Protection Ordinance 1983. To avoid the free flow of industrial leftover, gaseous and mechanical vehicles' fumes, National Environmental Quality Standards (NEQs) were set in 1993.

Therefore, to exercise the necessary parameters to protect the environment, the Sindh government issued a notification to protect the environmental pollution when the untreated wastewater is discharged in the water bodies or likewise channels. Following are the respective notification schedules. Therefore, the discharge of this treated water carried out at Pakistan Steel Mill

Wastewater Treatment Plant is acceptable to flow in the water bodies or agricultural land and maintain empty spaces with the parameters mentioned in Table 4.



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PART-II

Statutory Notification (S.R.O)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August 2000

S.R.O. 549 (I)/2000.___ In exercise of the powers conferred under clause (c) of sub-section (1) of section of 6 of the Pakistan environmental Protection Act. 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely: ___

In the aforesaid Notification, in paragraph 2._____

Fig. 02: Notification for the amendments in Pakistan Environmental Protection Regulations

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/I, UNLESS OTHERWISE DEFINED)

S. No.	Parameter	Existing Standards	Revised Standards Into Inland Waters	Into Sewage Treatment (5)	Into Sea ( )
1	2	3	4	5	6
1.	Temperature or Temperature Increase *	40°C	≤3°C	≤3°C	≤3°C
2.	pH value (H^+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20°C (1)	80	80	250	80**
4.	Chemical Oxygen Demand (COD) (1)	150	150	400	400
5.	Total Suspended Solids (TSS)	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as $C1^-$)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) (2)	20	20	20	20
13.	Sulphate (SO_4^{2-})	600	600	1000	SC***
14.	Sulphide (S^{2-})	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40
16.	Pesticides (3)	0.15	0.15	0.15	0.15

Fig. 03: National Environmental Quality Standards for Municipal effluents

The 1997 Act: Pakistan Environmental Protection defines the sustainable and environmental upswing to conserve, rehabilitate and avoid pollution [9].

Table 02: Pretreatment Parameters of Waste Water

Parameters	**Discharge from Domestic /Industrial waste**	**NEQs Limit**
Temperature	34.5 – 37.5 ^{0}C	39 ^{0}C
pH	6.48-8.0	6-09
COD	3600-3900	150 mg/L
BOD_5	1300-1400	80 mg/L
TSS	400-590	170 mg/L
TDS	5000.5-5500.5	3500 mg/L
Oil and Grease	36-39	09 mg/L
Phenolic compounds (as phenol)	450-750	0.101 mg/L
Chloride (as Cl)	3750-3950	1100 mg/L
Sulphate (SO_4)	1150-1450	550 mg/L
Ammonia (NH_3)	750-1350	50 mg/L
Iron	65-85	2.5 mg/L
Cyanide	25-75	2.05 mg/L
Sulphide	30-40	1.03 mg/L

Table 03: After Treatment Parameters of Waste Water

Parameters	**Fresh Sample**	**Coagulation dose (Alum) / L**	
		After coagulation	**Removal %**
PH value	7.8	6.50	83
COD	3650	1599	44
BOD	985	500	51
Total suspended solids	368	Not Detect	100
Total dissolved solids	5300	4000	75
Grease and oil	35	22.5	64.2
Chloride (as Cl)	3965	2590	65.32
Sulphate	1135	1070	94.27
Ammonia (NH_3)	760	600	78.947
Iron	57	46.05	80.08
Sulphide	17	Not Detect	99.99

Hence, in schedule I, sub-section 3 of section D clearly defines the water treatment at small-scale Industrial effluent plants. In schedule II, regulation of subsections 1 and 3 of section C establishes the facility to handle, store, and dispose of toxic materials coming from municipal waste.

Therefore, in Pakistan Steel Mill Waste Water Treatment Plant, the NEQS and the scheduled water treatment regulations are followed to avoid environmental and water pollution. This treated water does not contain those odorous compounds (Amines, Ammonia, diamines, hydrogen Sulfides, organic sulfides, and skatole) that are unfriendly for both the living species and the agricultural

land. Following parameters are maintained in the treatment of wastewater w.r.t, NEQS mentioned in Table 5.

Table 04: Results after ASP and in ppm except for pH

Parameters	**After Coagulation Sample**	**At 5 ppm Dissolved Oxygen and 3600 ppm MLVSS**	
		ASP	**Removal %**
PH value	6.50	7.102	91.5
COD	1599	1460	91.0
BOD	500	430	86
Total suspended solids	No Traces	Not Detect	---
Total dissolved solids	4000	3450	86.25
Grease and oil	22.5	13.75	61.11
Chloride (as Cl)	2590	1600	61.7
Sulphate	1070	580	54.20
Ammonia (NH_3)	600	465	77.5
Iron	57	35	61.4
Sulphide	No Traces	Not Detect	--

Table 05: Characteristics of Compounds that are Environmental Friendly

Parameters	**Value**	**NEQS**
PH value	6.47	6-9
COD	145 Mg/L	150 mg/L
BOD	40 Mg/L	80 mg/L
TSS	80 Mg/L	170 mg/L
TDS	3456 Mg/L	3500 mg/L
Grease and Oil	07 Mg/L	09 mg/L
Chloride	907Mg/L	1100 mg/L
Sulphate	550 Mg/L	550 mg/L
Ammonia	27Mg/L	50 mg/L
Iron	4Mg/L	2.5 mg/L
Sulphide	0Mg/L	1.03 mg/L

4. Conclusions, suggestions and recommendations

Therefore, it is the necessity of time to utilize wastewater to recycle and reuse, thus providing the essential need at sustainable cost avoiding the health imposing troubles. Therefore, this study aims the treatment of sewage to provide clean water and a sustainable environment. The untreated water

from the premises of Pakistan Steel Mill is collected to make it useable for agricultural or plantation purposes.

GOS

SEPA

16/12/14

NOTIFICATION

NO.EPA/TECH/739/2014:- Government of Sindh under the Act 2014 Section 37 of the Sindh Environmental Protection Agency is pleased to approve to confer the power to provide the legal articles to exercise the rules defined below.

SCHEDULE 1

D Waste disposal and treatment

1. Waste Material not imposing hazards must be less than 10000 tons annually.
2. The sewerage wastewater treatment plant installed have cost less than 200M
3. Industrial effluent is treated by providing industries wastewater treatment infrastructure at a small scale.

4. SCHEDULE II

(See Regulation 4)

C Waste Disposal and treatment

1. The toxic, hazardous substances or hospital waste material or radioactive be handled or stored.
2. Industries and Municipal be provided facilities to dispose of wastewater annually more than 10000 tons.
3. The Municipal and Industrial leftover water be provided treatment Plant.

The wastewater is treated according to the NEQS set by the Pakistan Environment Protection Agency. The treated water parameters' concerning the NEQS are achieved approximately 70%-80%. The chemical and physical treatment of water was carried out at the Pakistan Steel Mill tests laboratories during its working conditions. The Coagulation and ASP tests were conducted to purify the wastewater according to the parameters set by the Pakistan Environment Protection Agency through the ordinance 1983 and the 1973 environment protection Act. Therefore, wastewater was brought useable for agricultural and empty space purposes. It was made sustainable for the environment and the other species.

From this study, following suggestions and recommendations are drawn,

1. A public and private partnership should be encouraged to avoid water contamination.
2. The treated water should be discharged in the proper enclosed drainage system.
3. A national wastewater monitoring program should be initiated.

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