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SIMULATING THE IMPACT OF WASTEWATER LEACHING ON GROUNDWATER QUALITY IN MADDUANA DRAIN, FAISALABAD

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Abstract:

The groundwater has become apparent as an excessively meaningful water resource but with the passage of time its quality deteriorating continuously. There are lot of reasoning affiliated with disintegration of groundwater. In the developing countries, like our country Pakistan the uncooked wastewater pours into unlined wastewater channels that are enduringly leached down to groundwater, and it polluted the groundwater quality which is a major source of problem. In spite of to simulate the trappings of wastewater leaching on groundwater quality, research has carried out to symbolize the constituents of wastewater in Madduana wastewater drain Faisalabad, and make the comparison of groundwater quality in the study area. To suggest the industries that they make assurance for the installation appropriate wastewater treatment option in their industries for primary treatment of their wastes before pour into drain. From Khurrianwala to Khanuana bypass Faisalabad composite wastewater samples have taken from drain and groundwater samples have collected on spatial and temporal stationed from the surrounding areas and small villages of drain and studies in WASA Faisalabad Laboratory. The study involved determination of water quality parameters of groundwater near the drain. The value of total Hardness (TH), carbonates and bicarbonates, chemical oxygen demand (COD), biochemical oxygen demand (BOD), total dissolved solids (TDS), pH, Turbidity, electrical conductivity (EC) in wastewater having a level of 340-864 mg/l, 1608-2344 mg/l, 146-828 mg/l, 104-833 mg/l, 2130-2810 mg/l, 7.8-9.1, 17.447-89.33 mg/l, 4260-5210 mg/l respectively. Then these parameters were correlated with National Environmental Quality Standards (NEQS) to checked the present quality of that wastewater. From results, it was concluded that the quality of groundwater of the study area is out of order and cannot be drinkable and the wastewater is not feasible for agriculture use.

Keywords — **Wastewater (W.W), Up-Stream (U/S), Down-Stream (D/S), Groundwater (GW).**

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I. INTRODUCTION

Industrializationleads to socio economic uplift, especially in developing countries. However, industrialization also leads to environment deterioration [1]. One of its productions is the industrial wastewater, inadequate unscientific tackling of which has become the most crucial and unsolved problem in developing countries. At the end, it aged in the pollution of receiving water bodies. It not only affects aquatic life but also has adverse impacts on public health [2].

In most of the developing countries like our Pakistan, most of the industrial and domestic waste are discharged in un-lined surface drains without initial treatment. This happened due poor tacklinglack of initial planning and implementations of the environmental legislation. The wastewater discharged by different types of industry have different characteristics of constituents depending on type of raw material used in industry and which process they processed [3]. The wastewater usually contains organic matter, suspended solids, heavy metals, acids, bases and coloring compounds those affects the quality of groundwater as well as surface water [4]. It can cause serious problems to aquatic fauna and flora and downstream users. Different type of diseases like hepatitis are the major illness of that area which occurred due to groundwater contamination. Moreover, Campylobacter disease occurred due to usage of un-chlorinated water, Vibrio choleras disease occurred due to dehydration and electrolyte imbalance. An urgent requirement is to treat industrial wastewater before pour it into nearest drains for the protection of environment [5].

Provision of safe and clean drinking water to the masses should be the foremost priority of every government as it is the basic human right. In order to identify the potential areas for future environmental health problems, regular mapping of groundwater quality is pre-requisite for every city of the country. As water quality index undertakes the analysis of multiple parameters, it is considered as efficient tool for understanding the overall water quality scenario of the area. Faisalabad is the 3rd largest city of the Pakistan. Groundwater is the primary source of drinking water for its population. To maintain to quality of water, the water samples from different tube wells are regularly tested for several water quality parameters. It has deep been detected in the last few years that the water stress, due to increase use of water and expeditious industrialization, has become impend to the aquifer in Faisalabad [6].

In distinct places of Faisalabad, the groundwater level declined day by day which is due to the elevated groundwater pressure [7]. The groundwater level has discarded more than 10m in distinct places of Faisalabad [8]. Therefore, groundwater and surface water quality are also deteriorating by the continuous and extra use of groundwater. The study of the heavy metals getting main focus to check the present condition of water quality which determined the expertise for its supplementary usage [9].

Faisalabad the city of textile, is becoming the third largest populous city of country. A survey tells that 1100 million cubic meter per year wastewater effluents were produced from different sources in Faisalabad city and disposal off through surface lined and unlined drains i.e. Paharang and Madduana drain [10]. Madduana drain collects the wastewater of surrounding Dying and textile industries. Most of the industries may have their treatment plants. First, they treated their wastewater and then pour it into drain. But, some of them pore their wastewater to drain without treated it. The wastewater is permanently leach down which deteriorate the quality of groundwater, therefore people of that areas can't be pumped the groundwater for their usage. In that areas, it is also seen most of people are suffering with different diseases i.e. hepatitis disease. Ecosystem of that area is also polluted. In that areas, untreated wastewater is also used for irrigation purposes which polluted the cropping system. The dumping and disposal system of domestic and industrial wastewater have severed and alarmed threats for natural water resources, public health and agricultural yield. This direction become more crucial in those urban and industrial areas where groundwater contamination caused various diseases and cureless damages to environment [11].

To check the impacts of wastewater on quality of groundwater of Madduana drain which have the wastewater of surrounding industries in Faisalabad. Collect the wastewater samples from the drain as well as groundwater samples from the surrounding area of drain, then take that samples to WASA laboratory to analysis the parameters as chemical oxygen zest (COD), biological oxygen demand (BOD), electrical conductivity (EC), pH, total dissolved solids (TDS), carbonates, bicarbonates, color, turbidity, odor, hardness, Heavy metals which includes total nitrogen, total phosphorus, mercuric Sulphate, ammonia, copper, iron, manganese, nickel, at minimum level chromium and cobalt.

By analyzing above parameters in wastewater as well as in groundwater now it will check how much wastewater deteriorate the groundwater quality. After that, also made comparison of parameters with standard acceptable limits of that constituents.

II. MATERIALS AND METHODS

A. *STUDY AREA*

The area selected for the study are the Madduana drain in the industrial zone of Faisalabad city with the criteria that this drain pass through the area which is expected to be the major source of contamination. That area will be in between the Khurrianwala to Satayana road Faisalabad.

B. *SAMPLING PLAN*

As the part of research, Composite wastewater samples will be collected from drain and groundwater samples will be collected from the surrounding areas of drain. Samples will be randomly taken from whole area to persuade the different quality parameters in groundwater as well as in wastewater. The samples will be collected in 1500 ml bottles. The grab samples should be taken, for this purpose a bucket and rope will be used and after shaking the sample should take. After taking sample, bottled should be labeled with some common information ofthe sampling place i.e. latitude, longitude of the place. The optimized water samples will be collected in the total, from groundwater and wastewater. After collecting the samples from study area, the samples will be conserved and analyzed in the WASA Faisalabad laboratory.

C. 2.3 Location of Samples Points

The position of samples points will be observed with the assist of coordinates of points. The coordinates of the sample points will be taken with the help of Global Positioning System (GPS).

TABLE 1

METHOD/EQUIPMENT USED FOR ANALYSIS OF WASTEWATER EFFLUENTS

Sr. No.	Parameter	Units	Method/Equipment Used
1	Temperature	°C	HANNA digital meter
2	pH		HANNA digital meter
3	EC	µc/cm	HANNA digital meter
4	TDS	mg/l	HANNA digital meter
5	Calcium	mg/l	Titration/USEPA
6	Magnesium	mg/l	Titration/USEPA
7	Chloride	mg/l	Titration/USEPA
8	Sodium	mg/l	Titration/USEPA
9	Bicarbonates	mg/l	Titration/USEPA
10	COD	mg/l	Standard method by APHA
11	BOD_5	mg/l	DO meter

III. RESULTS AND DISCUSSION

Level of Biochemical Oxygen Demand

The figure 1 shows the relationship one of the water quality parameter Biochemical Oxygen Demand of the wastewater samples. Firstly, we found the maximum value of BOD among all of the 20 samples which is 833 mg/l present in sample no. 2 at up-stream of the drain. The minimum value of BOD is shown is sample no. 10which is 104 mg/l. Trend shows that the values of Biochemical Oxygen Demand varies between 104-833 for wastewater samples. The average value of the Biochemical Oxygen Demand is 328.05. As we know that in drinking water there is no value of Biochemical Oxygen Demand as well as in Chemical Oxygen Demand. The most effected samples of Biochemical Oxygen Demand are Khurrianwala sight samples and the least effected samples of Biochemical Oxygen Demand are Maccuana bypass Faisalabad sight samples. According to NEQS, the permissible limit of BOD is 80 mg/l so, most of the samples exceeded the permissible limits for BOD. Biological Oxygen Demand measures the biodegradable materials in water and helps in the development of bacteria and other organic by products (Manahan 1994).

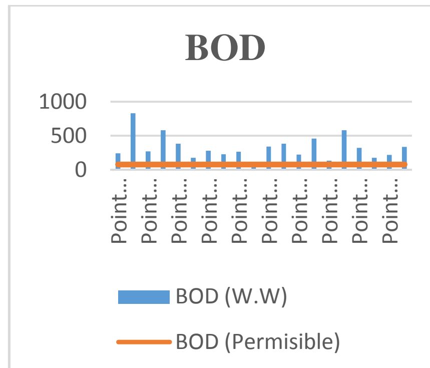

Fig. 1. Biochemical Oxygen Demand level against Wastewater

Level of Chemical Oxygen Demand

The figure 2 shows the relationship one of the water quality parameter Chemical Oxygen Demand of the wastewater samples. Firstly, we found the maximum value of Chemical Oxygen Demand among all of the 20 samples which is 828 mg/l present in sample no. 3 at up-stream of the drain. The minimum value of COD is shown is sample no. 15 which is 146 mg/l. Trend shows that the values of Chemical Oxygen Demand varies between 146-828 for wastewater samples. The average value of the Chemical Oxygen Demand is 460.62. As we know that in drinking water there is no value of Chemical Oxygen Demand as well as in Biochemical Oxygen Demand. The most effected samples of Chemical Oxygen Demand are Khurrianwala sight samples and the least effected samples of Chemical Oxygen Demand are Maccuana bypass Faisalabad sight samples.

Table2Results of physic-chemical parameters of wastewater at U/S and D/S of Study area

Sr. No	Location	Temp	EC	pH	TDS	Ca	Mg	Cl	T.H	F	HCO3 -	Fe
		°C	µs/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	Up Stream	19	3010	7.3	1490	38.4	14	422	152	1.90	1084	0.6
2	Up Stream	18	2960	7.3	1460	43.2	21	422	192	1.75	1064	0.1
3	Up Stream	17	1770	7.2	870	80	45	282	380	1.59	880	0.15
4	Up Stream	19	2900	7.5	1410	33.6	12	472	132	1.61	1124	0.54
5	Up Stream	17	2190	6.8	1090	147.2	173	332	1060	1.30	748	0.1
6	Up Stream	17	2820	6.9	1400	211.2	80	454	848	1.24	1032	0.15
7	Up Stream	17	2450	6.8	1220	134.4	63	398	588	1.18	932	0.1
8	Up Stream	17	2200	6.9	1100	102.4	46	320	440	1.21	960	0.12
9	Up Stream	17	2680	6.9	1330	166.4	52	512	624	0.88	1072	0.1
10	Up Stream	18	2180	7.1	1080	118.4	64	314	552	0.95	916	0.11
11	Down Stream	18	3310	7.3	1650	99.2	51	602	452	1.44	540	0.1
12	Down Stream	18	5090	7.3	2540	96	56	592	464	1.46	864	0.15
13	Down Stream	18	3640	7.3	1810	43.2	20	464	188	1.92	692	0.11
14	Down Stream	22	4340	7	2170	164.8	81	586	736	1.76	868	0.1
15	Down Stream	22	4120	7	2060	150.4	49	578	572	1.63	732	0.1
16	Down Stream	18	4710	7.6	2490	206.4	8	566	484	1.99	908	0.2
17	Down Stream	19	3990	7.7	1970	180.8	6	558	476	1.99	744	0.12
18	Down Stream	18	4310	7.7	2100	156.8	69	548	668	1.95	836	0.1
19	Down Stream	18	4170	7.2	2070	145.6	55	524	584	2.01	772	0.1

According to NEQS, the permissible limit of COD is 150 mg/l so, most of the samples exceeded the permissible limits for COD. Most of the wastewater from the WASA disposal stations will finally join the rivers through drains and some of the wastewater will become part of groundwater through soil profile. COD is a measure of organic matter in a sample including biodegradable fraction as well as fraction that survive bacterial attack but is oxidizable by strong chemical oxidants (Abbasi, 1998).

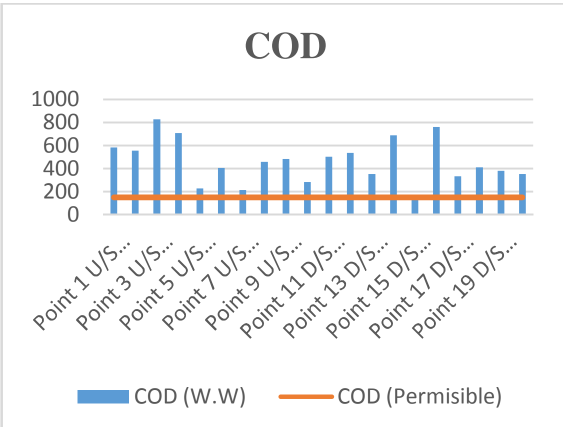

Fig. 2. Chemical Oxygen Demand level against Wastewater

Level of Electrical Conductivity

The figure 3 shows the level of EC in wastewater of Madduana drain as well as in the groundwater of the surrounding of the drain. Trend shows that the values of EC varies between 1770-5090 for groundwater samples and 4260-5210 for wastewater samples. The maximum values of EC in groundwater as well as in wastewater showed in down-stream samples. The results show that at up-stream the level of EC is low but with the contribution of industrial effluents at down-stream its level increased significantly.

Four out of twenty samples exceeded the groundwater samples permissible limits for ECwhile other were close to permissible limits. According to NEQS standards the permissible value of EC is 4000 µs/m. For irrigation water the value of EC should not more than 1500 µs/m according to food and agriculture organization (FAO).

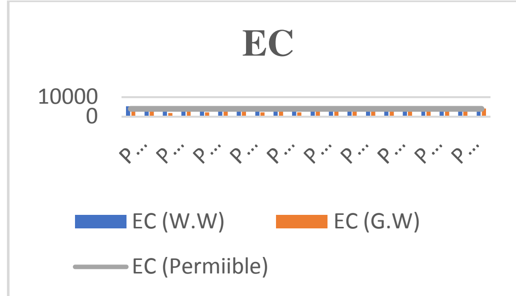

Fig. 3. EC level against Wastewater and Groundwater Samples

Level of Bicarbonates

The figure 4 shows the level of Bicarbonates in wastewater of Madduana drain as well as in the groundwater of the surrounding of the drain. Trend shows that the values of Bicarbonates varies between 540-1124 for groundwater samples and 1608-2344 for wastewater samples. The maximum values of Bicarbonates in groundwater as well as in wastewater showed in down-stream samples. It is also noted that, where the bicarbonates are present that carbonates are absent. The permissible limit of bicarbonates is 1000 mg/l (NEQS 2005).

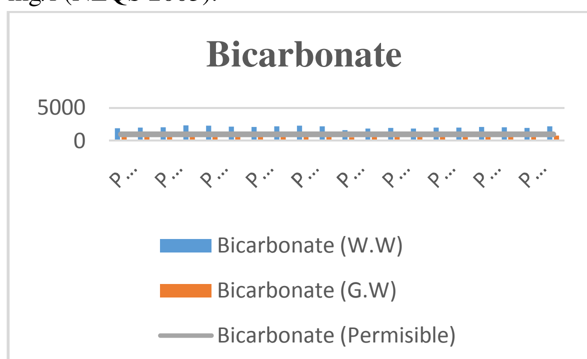

Fig. 4. Bicarbonates level against Wastewater and Groundwater Samples

Level of Chloride

The figure 5 shows the level of Chloride in wastewater of Madduana drain as well as in the groundwater of the surrounding of the drain. Trend shows that the values of chloride varies between 282-602 for groundwater samples and 930-1136 for wastewater samples. The maximum values of chloride in groundwater as well as in wastewater showed in down-stream samples. The results show that at up-stream the level of chloride is low but with the contribution of industrial effluents at down-stream its

TABLE 3 RESULTS OF PHYSIC-CHEMICAL PARAMETERS OF WASTEWATER AT U/S AND D/S OF STUDY AREA

Sr. No	Location	Temp	EC	pH	TDS	Ca	Mg	Cl	T.H	F	HCO3-	COD	BOD_5
		°C	µs/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	Up Stream	16	5210	8.0	2590	129.6	20	1030	404	1.94	1904	582	244
2	Up Stream	17	5100	8.8	2540	144	17	992	428	1.69	2004	556	833
3	Up Stream	17	4400	8.2	2180	156.8	2	930	400	2.02	2048	828	272
4	Up Stream	17	4630	7.8	2300	204.8	19	970	436	1.99	2344	708	584
5	Up Stream	17	4330	8.5	2160	129.6	8	1052	356	1.96	2276	228	384
6	Up Stream	17	4260	8.9	2130	153.6	2	1136	392	1.73	2136	406	180
7	Up Stream	17	4270	8.9	2140	94.4	66	978	500	1.47	2068	215	280
8	Up Stream	18	4320	9	2150	140.8	2	1008	344	1.7	2192	458	232
9	Up Stream	22	4350	8.9	2160	115.2	25	958	388	1.67	2296	482	268
10	Up Stream	23	4350	9	2180	88	36	1078	364	1.68	2192	283	104
11	Down Stream	19	4710	8.4	2350	140.8	2	1118	344	1.91	1608	504	344
12	Down Stream	18	4740	8.5	2360	145.6	6	1062	340	1.91	1824	536	383
13	Down Stream	19	4790	8.4	2610	147.2	19	1018	444	1.98	1940	353	227
14	Down Stream	20	4860	8.1	2590	241.6	65	1042	864	1.99	1836	688	458
15	Down Stream	18	4870	8.3	2440	238.4	57	1018	824	2.01	1968	146	138
16	Down Stream	17	5090	8.9	2780	227.2	33	1002	436	1.98	1980	762	584
17	Down Stream	19	4990	8.6	2450	209.6	32	956	396	2.07	2092	333	322
18	Down Stream	22	4720	8.2	2810	203.2	16	1054	444	2.11	2020	411	180
19	Down Stream	21	5100	8.7	2540	164.8	9	1108	448	2.01	1924	380	220

level increased significantly.

Only four samples were below permissible limits, all other exceeded the permissible limits for chloride i.e. 1000 mg/L (NEQS, 2005). Large concentration of chloride increases water corrosiveness and gives salty taste in combination with sodium (USEPA 2001).

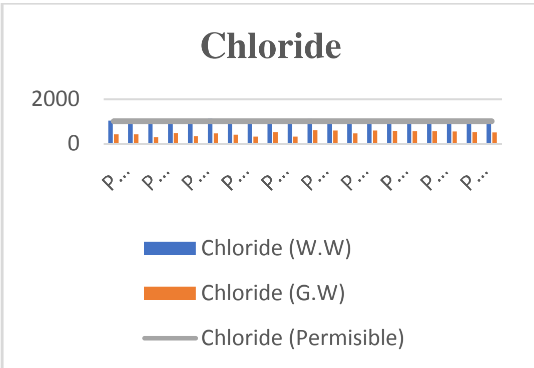

Fig. 5. Chloride level against Wastewater and Groundwater Samples

IV. CONCLUSION

Wastewater discharge were not suitable for water system reason and the majority of the examples were insufficient for water system.

Wastewater contains substantial metals and so forth with profoundly high fixation coming about an immediate danger to soil and groundwater quality. Pollution are on a very basic level influencing human wellbeing as this groundwater is utilized for drinking reason.

All the examples of wastewater beat as far as possible for BOD and COD. The contamination stack measure BOD and COD was figured up to 833 mg/l and 828 mg/l individually.

The synthetic nature of wastewater was discovered second rate for practically every industry regarding pH, TDS, Calcium, Magnesium, Chloride and Bicarbonates.

Overwhelming metal investigation demonstrated the contamination level high in deplete and the contaminants are drained descending and groundwater tests for substantial metal continuously expanding up. This demonstrated the hazardous circumstance for groundwater quality and impacts at last on individual.

V. RECOMMENDATIONS

Wastewater should be applied after some treatment. For this purpose, treatment plants should be constructed in the city where the wastewater is maximizing day by day. If that wastewateris not managed than it will be a great threat for future as its concern with environment.

Farmers should be made aware of all the potential health risks associated with wastewater irrigation areas and guidelines should need to be developed for safer disposal/reuse of wastewater.

National wastewater monitoring program should be initiated with the help of WASA to make the water useable for agriculture.

Mass awareness through media campaign and curriculum should be made to convey message to government.

The drains should be lined to avoid groundwater contamination through seepage and pumping of groundwater near drains for drinking purpose must be avoided

Detailed investigation regarding groundwater contamination is required in order to further investigate in contaminant transport behavior in soil and to accurate determine the area of influence of seepage of contaminants from the drains.

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