THE UNDESIRABLE EFFECTS OF MARVDASHT SUGAR FACTORY IN THE QUALITY OF GROUNDWATER AND ENVIRONMENT

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Abstract— Groundwater contamination is a noteworthy sympathy toward earthy peoplebecause of modern activities. The effluents delivered from pure sweetener businesses are very harmful and if let out untreated can bring about genuine water quality dirt. The object of this study is to assess the impacts of sugar and output sweetener production of Marvdasht manufactory in its adjacent ground water quality. In this present study,data has been collected from ten stations based on sampling in 10 cases selected randomly in the nearest deep wells from tube-wells close to the manufacturing plant for better scrutiny in water quality parameters, for example the total PH, DO, COD, is broke down to solidslike Ca, Mg, Na, Zn, K, Cl, and Fe. The same number of parameters demonstrated the substantive deviation from their endorsed ordinary values, the aftereffects of this study showed that the ground water has been altogether influenced and is not in any manner compact. The healing measures to control this crumbling are additionally talked about.

Index Terms— Groundwater quality, sugar manufactory, Ca, Mg, Na, Zn, K, Cl, and Fe, deep-wells, contamination.

I. INTRODUCTION

Propels in science and innovation and the mechanical transformation have helped people for plot assets. Industrialization is one of the essential tools for the advancement of any country. Thus, the modern action has extended such a great amount of everywhere throughout the world. In the other hand, water is required for local utilization and water system for sanitation and waste transfer as well. Water in nature is never unadulterated in concoction sense. The contaminations introduced in water are actually pitiful, yet because of quick industrialization, overpopulation, unpredictable utilization of chemicals builds this sum enormously making a route for water contamination. Over abuse of ground water likewise, irritates the harmony of the aquifer from where it is acquired. Indeed, even today the greater part of the total populace relies on groundwater for survival. Because of the accessibility of space and other regular assets ventures are for the most part situated in provincial regions. Modern effluents containing substantial metals represent a risk to the environment. The unfavorable impacts on groundwater quality are the weight of the populace weight, impromptu to urbanization, unhindered investigation, inadvertently by residential, horticulture and modern effluents and dumping dirty water at wrong place which augments the invasion of unsafe mixes to the groundwater.[1]

Marvdasht is a city in and the capital of Marvdasht County, Fars(Shiraz) Province, Iran with many agricultural fields situated in its different places in which the most important of them are sugar beets and corns which is not only a hub for the production of herbal products and agronomy but also it has some benefits for industrialization. Marvdasht is one of the major industrialized city in shiraz, not only for generating capital and addition to the national income, but also providing employment and thus helping a wider spread of the benefits of population and industrialization. In this city, there are many working sugar factories. Alongside all the versatile releasing businesses, sugar processes additionally assume a noteworthy part in contaminating the water bodies. [2]

The sugar business assumes a vital part in the monetary advancement which causes a high measure of contamination in both sea-going and earthly biological communities. [3] Sugar industry carries air and soil contamination besides its natural issues connected with water. The effluents in some cases permeate through subsoil and achieve the ground water table shaping debased pool.[4] This aggravates the regular ground water quality changing its compound composition. Chemical defilement of drinking water involves genuine concern. Admission of defiled water affects the well-being and can bring about different water-borne ailments. The purpose of this present study is determination and measuring the chemical parameters of ground water near a sugar industry and cubed sugar manufactory and comparing them to the standard admissible limits determined by the Board of SDWI (Standards for drinking water) and WWISI (Water and Wastewater Industrial Standard Institute) in Iran. The study reveals that the groundwater quality has been extremely affected due to the sewage from the sugar industry. [5] Attempts must be derived so that the water quality can be remade and its subsequent corruption and contamination can be stopped better.

II. MATERIALS AND METHODS

Study Area and Geographical Position

In this study, Marvdasht sugar manufactory is located in Marvdasht city of Fars province in Iran. Marvdasht is located 35 kilometers to the north of Shiraz and its climate is mountainous and temperate. According to

the 1390 census, its population is evaluated to 137, 087 people. Marvdasht which is situated in the northern part of Fars province has an altitude of 1620 meters above sea level and an area of 4649 square kilometers and as a result adequate living conditions are growing and growing. Marvdasht city consists of 4 parts, the central 1859 square kilometers and a population of 137 thousand people, Kamfiruz with an area of 994 square kilometers and 36 thousand inhabitants, Seyedan with an area of 821 square kilometers and 30 thousand population and Doroodzan with an area of 1025 square kilometers with a great section facility of Doroodzan dam which has a temperate climate and fertile land in its central portion.

Fig 1: The map of the study area.

The central part of Marvdasht city with an area of 4649 square kilometers covers 8/3% of the total area allocated to this province. The city arrives at the Khorrambid and Eqlid townsfrom the north, from the west it reaches to Sepidan, and from south to Shiraz and it is limited to Arsenjan and Bavanat countyfrom the east. Marvdasht city which is located almost in the central part of Shiraz in Fars province in part of its center has the 48 minutes 52 degrees' longitude and 29 degrees 52 minutes' latitude and its altitude is 1595 meters above sea level. The sedimentary soils of this region and its ingredients created by the rivers crossed this city and caused the collapse of rocks that are very suitable for farming. The north part of this city from the head point of source of the Kor river to the location of Doroodzan dam is extremely mountainous and south and southeast parts of this city from Doroodzan dam to Bakhtegan lake have flat plains. The most important mountains in this area are: Hussein Mountain and Bid-Sandals Mountain, Dezh Ghale Mountain and Dezh Ghale Shekasteh Mountain. Black Mountain with an altitude of 3400 meters, Seyed Mohammad Mountain with an altitude of 2670 meters, Sauron Mountain with an altitude of 3750 meters and Palengari Mountain with the altitude of 4145 meters include other major mountains of this area. The most important streams and rivers in this city are also Sivand and Kor. Marvdasht city in terms of its climate has four seasons. The weather of this city in mountainous areas is cold and in other areas is temperate. The average annual precipitation in this region is 365 mm and the temperature changes between 9 degrees minimum and 41 degrees maximum.

III. METHODS

In order to evaluate the amount of sugar beet cultivation in Marvdasht city, first we look at a brief review of the features of sugar factories in this area.

Table 1: The brief review of Marvdasht sugar factory.

Marvdasht Sugar Factory	
Sugar Factory	MARVDASHT
Year of Establishment	1935
Factory Area	23 hectares
Distance to the nearest town	in town
Plant height above sea level	1600 m
the production capacity of the factory	1650 tons in 24 hours
Plant operation capacity	1201 tons per day
Factory building companies and countries	Germany- Czechoslovakia- England
Water supply	wells
Acreage of factory farm	4300 Acreage
The maximum distance with farms of Beet production	180m
Sugar beet important areas	Marvdasht- Ramjerd- Korbal Water and Soil (Environment)
The nominal capacity of pulp dryers	120 tons per day
Type of dry pulp production	bullet
Company and Country Producer of pulp dryers	Cal – Germany

Amongst the releasing businesses in marvdasht, sugar industrial facilities playa major noteworthy role in dirtying the water bodies. Although the sugar business grabs an essential part in the monetary advancement of marvdasht, several effluents of this manufactory entered a high level of natural contamination in both soil and water environments. [6] Various sugar industry effluents discarded in soil and water causes significant contamination issuesin both sea-going and earthbound biodiversity. [7] This effluent causes the change of physiochemical attributes of water and for this reason they affect in the life of water bodies. Also, sugar manufacturing sewage which is released into the earth represents a genuine wellbeing peril to the rustic and semi-urban populaces that utilize stream and canal water for horticulture and local purposes. Thus, it is important to concentrate on the physicochemical properties of sugar industrial facility sewages.[8] The effluents of sugar production line permeate the dirt into the underground water reservoir. These sewages influence the ground water mode by changing its substance structure. The impact of sewages on the amount of oxygen and PH quantity of water nearthe chemical toxins like carbonates, bicarbonates,

phosphates must be studied due to contamination in groundwater which may generate the health and medical causes if it is utilized fordrinking. [9]

Fig 2: Study site on map.

Regarding to sewage production in a sugar manufactory, considered standard is about 500 liters for per tons of sugarcane crushed. Sugar mill sullage is mainly caused by wastewater from floor washing and deposit water. [10] The effluent of sugar mill machine has a BOD of 1,000-1,500 mg/Liter. Although exudation in faucet of the sewage pipage of sugarcane syrup and molasses initially are approximately clean, after remaining for some hours in statics position, they are dirty and change their color to darkish and start exhaling impure smell. If insanitary sullage is relinquished in water ditch or waterway, it discharges dissolved oxygen in water and beget the environment improper for sea creatures and fauna life.

As we know the groundwater compounds are different from one site to another site and it also changes with the depth of the tube wells. Thus, in this study data were collected from tube wells which varied with their depths and the water substrate depths, as given in Table I. All these sites were situated within the distance of 1 to 2 Km from the factory. Before starting the operation for collecting data, the depth of each of the bore wells was determined according to the following table.

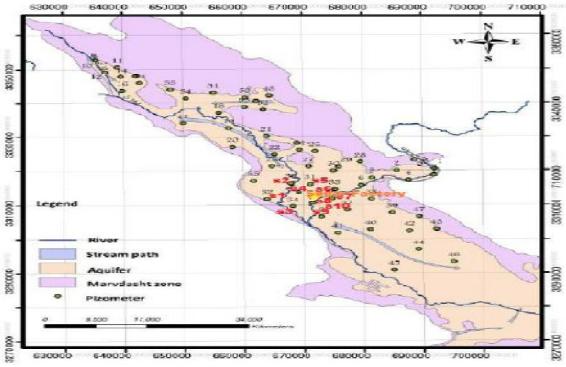

Fig 3: The bore wells stationson map.

Table 2: The depths and the water table depths of each bore wells

Sample	Depth (m)	Water Table (m)
W1	45	40
W2	48	42
W3	55	49
W4	59	52
W5	61	54
W6	66	59
W7	70	62
W8	72	64
W9	74	66
W10	78	69

The groundwater samples were collected in pre-cleaned Polyethylene bottles and while stored in 4^°Cwere brought to the laboratory on the same day within 24 hours of datacollection for the assessment of various Physiochemical properties by using standard method. In this procedure for conforming to the IS standards, these samples were analyzed for pH, chlorine content (Cl), potassium (K), sodium(Na), magnesium (Mg), calcium (Ca), iron (Fe), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Zinc (Zn), Dissolved Oxygen (DO), Total Dissolved Solids (TDS). After achieving the data at any time and for any station in order to ensure the accuracy of test results Chemical Anionic Equilibrium was evaluated with the Excel software program for each sample.

Chemical properties of the study obtained as follows:

Table 3: Physiochemical characteristic of water

Physical Parameters	Chemical Parameters	Physiochemical Parameters
PH, EC, TDS,Temperature	Na^{1},K^{+},Ca^{2+},Mg^{2+},Cl^{-},CO_3,HCO_3,SO_4^{2-},NO_3^{-},NO_2^{-},.....	BOD , COD , DO

Then the results of statistical data of water quality parameter status were confronted with the expected normal values for drinking water and were analyzed by Microsoft excel again.

Table 4: The Anions analyzed parameters for the study area.

STATION NO.	Bicarbonate (HCO_3^-)	Chloride (Cl^-)	Sulfate (SO_4^{2-})	Nitrate (NO_3^-)
S1	281.91	18.1	12.9	5.4
S2	276.24	18.4	13.6	4.7
S3	283.49	20.8	13.4	4..9
S4	291.17	18.7	15.1	4.8
S5	278.14	17.9	14.5	5.1
S6	293.76	18.5	13.8	4.7
S7	298.33	19.1	14.7	5.5
S8	287.28	20.2	13.2	5.4
S9	290.65	19.7	14.3	5.2
S10	274.59	19.4	13.8	4.7

Table 5: The Cations analyzed parameters for the study area.

STATION NO.	Sodium (Na^+)	Calcium (Ca^{2+})	Magnesium (Mg^{2+})	Potassium (K^+)
S1	18.2	108	46.1	58.8
S2	17.6	113	47.5	61.5
S3	16.7	119	48.2	56.8
S4	17.3	121	51.2	64.7
S5	18.1	116	49.6	59.4
S6	17.5	119	52.7	63.8
S7	16.9	123	54.3	65.9
S8	17.4	111	46.9	66..8
S9	17.7	117	52.7	62.7
S10	17.1	124	53.4	57.8

After that, comparing with EEC, WHO, EPA and MCL Iranian Standards Legislation which are given in table II, the results indicated that in current situation, heavy metals were notthe only serious problem for making danger in the quality of groundwater in this region.Because this effluent has been caused by the high amount of BOD and COD, more than heavy metals. Although the contamination source may be because of soil which can operate as a source of heavy metals, different types of ecological hazards are also affiliated with this subject. The physical and physiochemical parameters of this area were also extracted as follows:

Table 6: Other physical and physiochemical analysis of ground water

Station No.	EC (µs/c)	Ammonia (NH_3)	Arsenic (AS)	Total Hardness	Alkalinity	TDS	PH	BOD	COD	DO
S1	869	1.67	0.0517	388	300	754	7.84	59.1	912.3	1.41
S2	891	1.61	0.0486	419	260	822	7.90	62.4	926.5	1.15
S3	866	1.67	0.0463	379	366	798	6.96	58.2	1111.8	1.71
S4	910	1.55	0.0492	371	275	813	7.13	59.6	1012.3	1.92
S5	878	1.54	0.0461	393	289	784	7.72	63.9	981.1	1.83
S6	903	1.65	0.0478	428	317	761	6.81	61.7	952.5	1.26
S7	857	1.58	0.0472	367	356	832	7.24	57.6	982.9	1.77
S8	872	1.61	0.0504	352	348	815	7.45	60.5	943.6	1.27
S9	914	1.63	0.0525	435	272	724	7.26	58.3	991.9	1.11
S10	897	1.52	0.0499	356	331	898	8.51	62.2	937.7	1.90

Regarding to the next table:

Table 7: Present regulations and standards for the drinking water.

Parameter	Unit	EEC[a] – 1998 (MAC)[d]	WHO[b] – 1998 (GV)[e]	EPA[c] – 2002 (MCL)[f]	Iranian Legislation – 1997 (MCL)
Arsenic (As)	$mg\ L^{1-}$	0.01	0.01	0.01	**0.05**
Barium (Ba^{2+})	$mg\ L^{1-}$	-	0.7	2	**1**
Beryllium (Be)	$mg\ L^{1-}$	-	-	0.004	-
Cadmium (Cd^{2+})	$mg\ L^{1-}$	0.005	0.003	0.005	**0.01**
Calcium (Ca^{2+})	$mg\ L^{1-}$	-	-	-	**200**
Chloride (Cl^{-})	$mg\ L^{1-}$	250	-	250	**600**
Chromium (Cr)	$mg\ L^{1-}$	0.05	0.05	0.1	**0.05**
Copper (Cu)	$mg\ L^{1-}$	2	2	1.3	**1**
Fluoride (F^{-})	$mg\ L^{1-}$	1.5	1.5	2	**1.7**
Iron (Fe)	$mg\ L^{1-}$	0.2	-	0.3	**1**
Lead (Pb)	$mg\ L^{1-}$	0.01	0.01	0.0015	**0.05**
Magnesium (Mg^{2+})	$mg\ L^{1-}$	-	-	-	**30[g] – 150[h]**
Manganese (Mn^{2+})	$mg\ L^{1-}$	0.05	0.4	0.05	**0.5**
Mercury (Hg)	$mg\ L^{1-}$	0.001	0.001	0.002	**0.001**
Nitrate (NO_3^-)	$mg\ L^{1-}$	50	50	44	**45**
Nitrite (NO_2^-)	$mg\ L^{1-}$	0.5	0.2	3.3	**0.004**
Potassium (K^{+})	$mg\ L^{1-}$	-	-	-	**-**
Sulfate (SO_4^{2-})	$mg\ L^{1-}$	250	-	250	**250**
TDS	$mg\ L^{1-}$	-	-	500	**500**
Turbidity	NTU	-	-	1	**25**
PH	------	6.5-9.5	-	6.5-8.5	**6.5-8.5**

(a) European Economic Community, (b) World Health Organization, (c) US Environmental Protection Agency, (d) Maximum admissible concentration, (e)Guideline value, (f) Maximum contaminant level, (g) If $SO_4^{2-} > 250$, (h) $SO_4^{2-} < 250$,

Table8:ComparingMarvdasht Sugar Factory Effluents with Surface Water Standard.

Station No.	EC (µs/c)	Ammonia (NH_3)	Arsenic (AS)	Total Hardness	Alkalinity	TDS	PH	BOD	COD	DO
S1	869	1.67	0.0517	388	300	754	7.84	59.1	912.3	1.41
S2	891	1.61	0.0486	419	260	822	7.90	62.4	926.5	1.15
S3	866	1.67	0.0463	379	366	798	6.96	58.2	1111.8	1.71
S4	910	1.55	0.0492	371	275	813	7.13	59.6	1012.3	1.92
S5	878	1.54	0.0461	393	289	784	7.72	63.9	981.1	1.83
S6	903	1.65	0.0478	428	317	761	6.81	61.7	952.5	1.26
S7	857	1.58	0.0472	367	356	832	7.24	57.6	982.9	1.77
S8	872	1.61	0.0504	352	348	815	7.45	60.5	943.6	1.27
S9	914	1.63	0.0525	435	272	724	7.26	58.3	991.9	1.11
S10	897	1.52	0.0499	356	331	898	8.51	62.2	937.7	1.90

Table 9: Comparing Marvdasht sugar Factory Effluents with Waste Discharge Quality Standard Sourced by DoE in 2002:

			Marvdasht Sugar Factory Effluents				
Parameter	Unit	Standard	MIN.	MAX.	Average.	STDEV.	Comparison
Na^+	$Mg.L^{-1}$	6.3	16.7	18.2	17.45	.048	Not Standard
K^+	$Mg.L^{-1}$	2.3	56.8	65.9	61.26	3.22	Much Greater from Standard
Mg^{2+}	$Mg.L^{-1}$	4.1	46.1	54.3	50.26	2.97	Much Greater From Standard
Ca^{21}	$Mg.L^{-1}$	1S	108	124	117.1	5.19	Much Greater from Standard
Cl^-	$Mg.L^{-1}$	7.8	17.9	20.8	19.08	0.94	Not Standard
HCO_3	$Mg.L^{-1}$	58.4	274.59	298.33	285.55	7.96	Much greater from Standard
SO_4^{2-}	$Mg.L^{-1}$	11.2	12.9	15.1	13.93	0.70	Not Standard
NO_3^-	$Mg.L^{-1}$	10	4.7	5.5	5.05	0.33	Standard

			Marvdasht Sugar Factory Effluents				
Parameter	Unit	Standard	MIN.	MAX.	Average.	STDEV.	Comparison
PH	---------	6-9	6.81	8.51	7.48	0.5	Standard
TDS	$Mg.L^{-1}$	2100	724	898	800.1	48.5	Standard
EC	$Mg.L^{-1}$	1200	857	914	885.7	19.95	Not Standard
BOD	$Mg.L^{-1}$	50	57.6	63.9	60.35	2.12	Not Standard
COD	$Mg.L^{-1}$	20	912.3	1111.8	975.26	57.40	Much greater from Standard

III. RESULTS

As the data shows,Tabriz et al. (2011)also measured the good adaptability between sewerage water from North Bengal Sugar Mill (NBSM) for irrigation and its effect on soil characteristics.[11] They measured the quality parameters of wastewater in several places which is located in the drainage canal and a hand tube well of the NBSM complex and then by the main physicochemical properties and hydraulic characteristics of the wastewater they realized which problems caused by that sugar mill. [12] In the following,to examine the adverse effect of the sugar factory in Marvdasht, the physiochemical properties and quality parameters of groundwater obtained from this area brought for better evaluation and comparison. Because of metal leaching and mass of pollutants in our food chain, wastewater can also create impurity in groundwater with the undesirable factors which effect on health and hygiene of vegetation and animals, including humans' life. [13]Usage of treated sewerage for irrigation canalso influence the physicochemical properties of soils.

Fig 4: Environmental problem of the study area.

The hydro-physical characteristics of the soil are dramatically derived by soil type and quality of water irrigation. [14]In the study area, the soil hydraulic attributes like saturated hydraulic conductivity show a negative relevance with both soil organic C and electrical conductivity, while a positive relevance with Na in irrigation water is significant. Regarding to the analysis of untreated effluents of Marvdasht

sugar factory, some parameters like pH, EC, TDS, TSS, BOD5, COD show greater value in their degrees while they have very lower limits of DO than their standard range defined for them. Hence, these are unsuitable and should not use for drainage systems and irrigation purposes. Otherwise, because of their contaminant they are decreasing and dying the water creatures.

Fig 5: Some environmental problem in the study area.

As the standard research considered the effluents per ton of sugarcane should be about 500 liters but recently it has been reported that sugar factory processed an average of 20,000 - 30,000 liters of sewage per ton. The results also suggest that till now none of the organization or institutions had enough attention to prevent nature infection from sugar mill and they didn't do any action for the excessive discharge. This study shows a vast population of Marvdast city near the sewage of this sugar manufactory consumes the ground water for drinking and agricultural aims without enough remediation which results in health jeopardy every day. Last news indicates that recently hundreds of the citizens have forced to change their area to another placedue to this offensive and suffocating chemical smell which comes from the sewage of sugar. The outcomes of this study also show this reality that whenever contamination of effluents from sugarcane factory enter into the surrounding ground water, the water will be unsuitable for drinking and this squalid water can also change the quality of soil completely unfit for usage and cultivation. [15]

Even if the chemical parameters of water like pH, Total dissolved solids, chloride content, potassium, iron and zinc are in good range within their limits the extra values of sodium, magnesium, biochemical oxygen demand and chemical oxygen demand combined with the inappropriate value of dissolved oxygen degree show the extremely uncleaned water quality. If this impure water applies for drinking,it can cause the main problem for the people using it and suffering from skin diseases and other illness such as asthma, eye infection etc. Since this menace plays an important role in human life while it exists, it is necessary to look after specific measurement to eschew from more water deterioration. Due to this reason and if we want to achieve sustainable development in the future, we should check and evaluate the ground water pollution around the industry factories regularly. Above figure is an evidence for soils degradation near the environs of the sugar factory in Marvdasht whichrefer to the undesirable factors of sugar factory sewages and other waste materials. According to this study, the sewages of Marvdasht sugar factory not only has a risk for the health of the people of this city but also it would be the main problem for killing the ecosystem of the freshwater lakes like aquatic fauna of this city. Also regarding to this study, it was found that some of the animals like cows, horses, sheep, and goats bear different illnesses and all of these owes to the usage of sugar mill contamination and local sugar industry effluents.

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