Assessment of Brewery Industry Wastewater Quality for Irrigation and Its Impacts on Selected Soil Properties

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Abstract

Waste water contains a variety of inorganic substances from domestic and industrial sources, including a number of potentially toxic elements. Traditionally, the amount of water needed to brew beer is several times the volume actually brewed. The current study was designed to determine and characterize the physicochemical quality parameters of waste water from brewery industry for irrigation purpose. The BOD and COD values in the present study were 50.00 mg/L and 148.44 to 197.92 mg/L (mean value = 173.18 mg/L) respectively. Total Hardness as $CaCO_3$ value ranges from 81.38 to 86.63mg/L, total suspended solid value ranges from 260 to 185mg/L and dissolved solid sample valve ranges from 940 to 1005mg/L. These results highlighted that the final effluent produced from Dashen brewery factory waste water treatment plant (WWTP) did not meet the Standards set by WHO. Therefore, it is recommended that brewery WWTP has to be improved by correcting their treatment process. Hence, the sustainable use of treated waste water in agriculture can be beneficial to the environment in such a way that minimizes the side effects on the quality of downstream water resources. Furthermore, these results indicated that proper management of waste water irrigation and periodic monitoring of quality parameters are required to ensure successful, safe and long-term reuse of waste water for irrigation. It is recommended that waste water treatment has to be a high priority that is considered in the future and made a reliable alternative source in water resources management. Agricultural waste water reuse can effectively contribute to fill the increasing gap between water demand and water availability particularly in water stressed areas.

Keywords*:* BOD, Brewery industry, effluent, heavy metals, TSS,

Introduction

Advanced industrialization processes have provided comforts to human beings on one hand, and on the other, it has resulted in indiscriminate release of gasses and liquids, which polluted the environment of biological system (Lone, *et al.*, 2003). Industrial waste effluents are discharged into the surrounding environment with multiple effects and changes the physicochemical parameters of environment (Nebel and Wright, 1998). Pollution has adverse effects on land, water or air and its biotic and abiotic components. Water pollution may result from municipal, agricultural or industrial wastes containing organic and inorganic chemical substances, dissolved or suspended solids (Terry, 1996; Nebel and Wright, 1998; Moeller, 2004).

The world's supply of fresh water is limited and threatened by pollution from various human activities. Rising demands of water to supply agriculture, industry and cities are leading to competition over the allocation of the limited fresh water resources (Bartram and Balance>-159926(a)4(ti8 64.24

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special hazard to animals grazing sludge or effluent treated sites. Therefore humans directly or indirectly consume the plant and animal significantly affected by the toxic metal.

Waste water contains a variety of inorganic substances from domestic and industrial sources, including a number of potentially toxic elements such as Boron (B), Zinc (Zn), Cadmium (Cd), Cobalt (Co), Chromium (Cr), Copper (Cu), mercury (Hg), Nickel (Ni), Lead (Pb), Manganese (Mn), Zink (Zn), Arsenic (As).

High levels of pollutants in waste water systems causes to disturb the biological, chemical and physical characterize of irrigation water. For instance, from biological characters an increase in biological oxygen demand (BOD), from the chemical characters increasing chemical oxygen demand (COD), toxic metals such as Pb, Zn, Cd, Mn, Fe, Cu, Ni, Co, As, Hg and from the physical characters total dissolved solids (TDS), total suspended solids (TSS), properties such as colour, order, test, hardness, etc. make such water unsuitable for drinking, irrigation and aquatic life (Kanu and Achi, 2011). Even if toxic materials are not present in concentrations likely to affect humans, they might well be at phytotoxic levels, which would limit their agricultural use of waste water (Wilcox, 1948).

Beer is the fifth most consumed beverage in the world behind tea, carbonates, milk and coffee and it continues to be a popular drink with an average consumption of 23 liters/person per year (Levinson, 2002 and Ciancia S, 2000). Production of beer includes blending and fermentation of maize, malt and sorghum grits using yeast, which requires large volumes of water as the primary raw material. Traditionally, the amount of water needed to brew beer is several times the volume actually brewed. For instance, an average water consumption of 6.0 hectoliters is required to produce one hectoliter of clear beer (South African Breweries plc., 2001). Large volumes of water are being used by the industry for production of beer for two distinct purposes; as the main ingredient of the beer itself and as part of the brewing process for steam raising, cooling, and washing of floors, packaging, cleaning of the brew house during and after the end of each batch operation. The amount of wastewater that is being discharged from the industry after the production of beer, also contributes to this large volume of water (Simate G., *et al.*, 2011). With the competing demand on water resources and water reuse, discharge of industrial effluents into the aquatic environment has become an important issue (Kovoor, *et al.*, 2012)

The ever-increasing demand on irrigation water supply to farmlands are frequently faced with utilization of poor-quality irrigation water. In many parts of Ethiopia, waste water, which are disposed to wells, ponds, streams and treatment plants, are used as a source of irrigation water as well as for drinking (Alemtsehaye, 2002). In some locality's sludge water and human faces and other are also dumped to these rivers. One surprising aspect is communities use the polluted/waste water from these rivers for irrigation (Waltainformation 2004). Some studies indicated that 40% of the vegetable supplied to Addis Ababa city and animal feed comes from the suburb directly irrigated by these water or fields flushed from waste water during the heavy rainy season or during the dry season. But, the continued application of poor-quality irrigation water can reduce the yield of farmlands. This is due to the fact that the accumulation of heavy metals in the soil has an adverse effect on the growth and development of the wide variety of plant species (Nwajei, *et al.,* 2012).

This study was therefore conduct to characterize physical and chemical quality parameters of waste water from brewery industry for irrigation purpose and assess the effects of wastewater on Selected soil properties.

Material and method

Description of the study area

Debre Birhan town is located in North Shewa Zone of the Amhara Region, about 130 kilometres north east of Addis Ababa on the paved highway to Dessie, The town is at a latitude and longitude of 9°41′N, 39°32′E and at an elevation of 2,840 meters above sea level. The brewery industry is located at about 5 km south east from the Debre Birhan town on the road to Addis Ababa.

Bebre Birhan is one of the few towns in Ethiopia with a newly developing and having relative greater number of large-scale manufacturing plants including Dashen-Brewery Factory, Habesha-Brewery Factory, Mineral Water Bottling Factory's, Blanket factory and Flour Factory. On top of this, the town is selected to be an industrial town by Amhara National Regional State of Ethiopia, which indicates the industrial development and its associated pollution risk will increase in the future. The existing industries have been discharging their wastes into the surrounding environment.

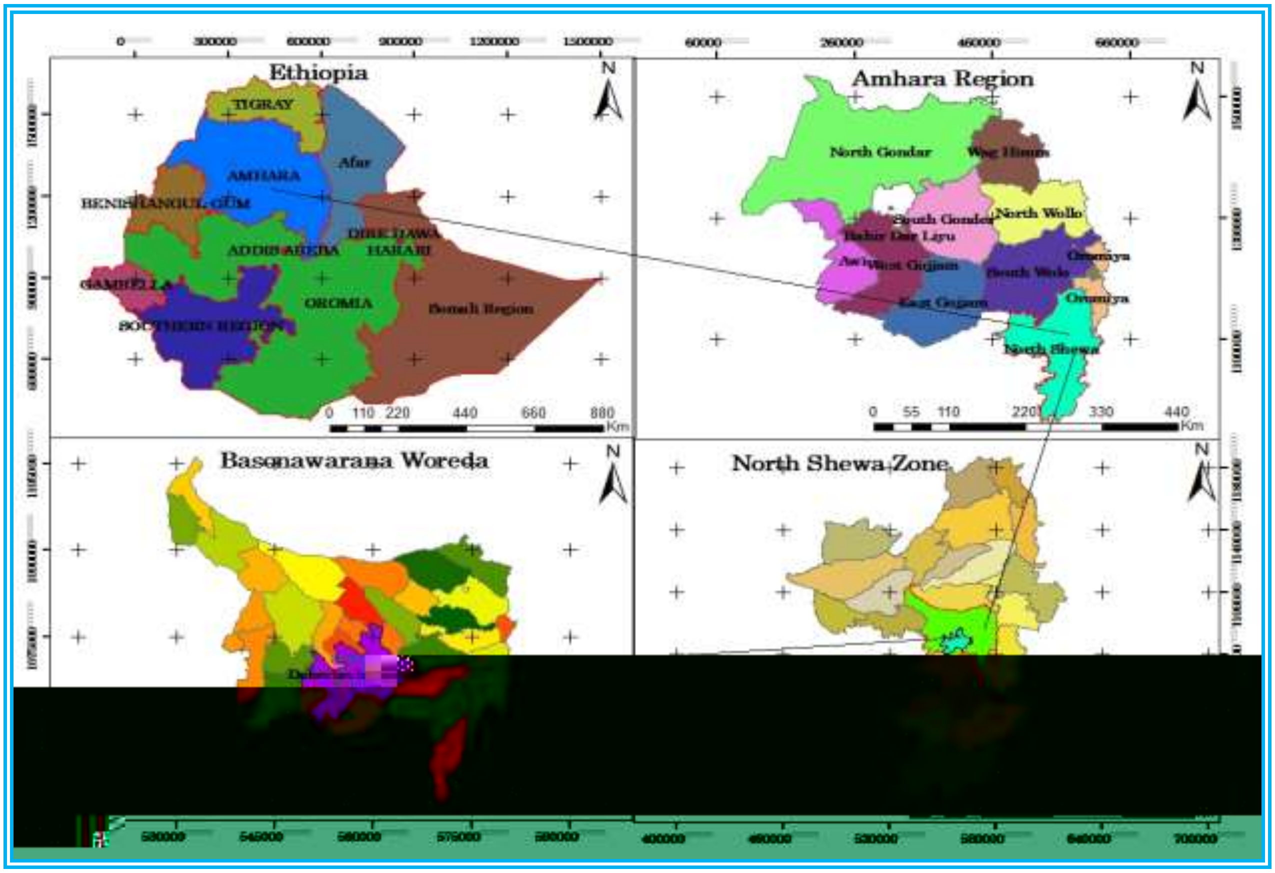

Figure 12. Map of the study area

Sampling Methods

Purposive sampling was used to collect waste water and soil samples. Treated and untreated waste water samples were collected in stopper fitted polyethylene bottles which were prewashed with dilute hydrochloric acid and then rinsed several times with the effluent sample before filling to the required capacity. Four sampling sites/stations were selected for water sample collection: Station-1from the Borehole site just before intering to the factory, Station-2 from the factory after treating the water for beer production, Station-3 just at the upper part of the command area, Station-4 just at the lower command area.

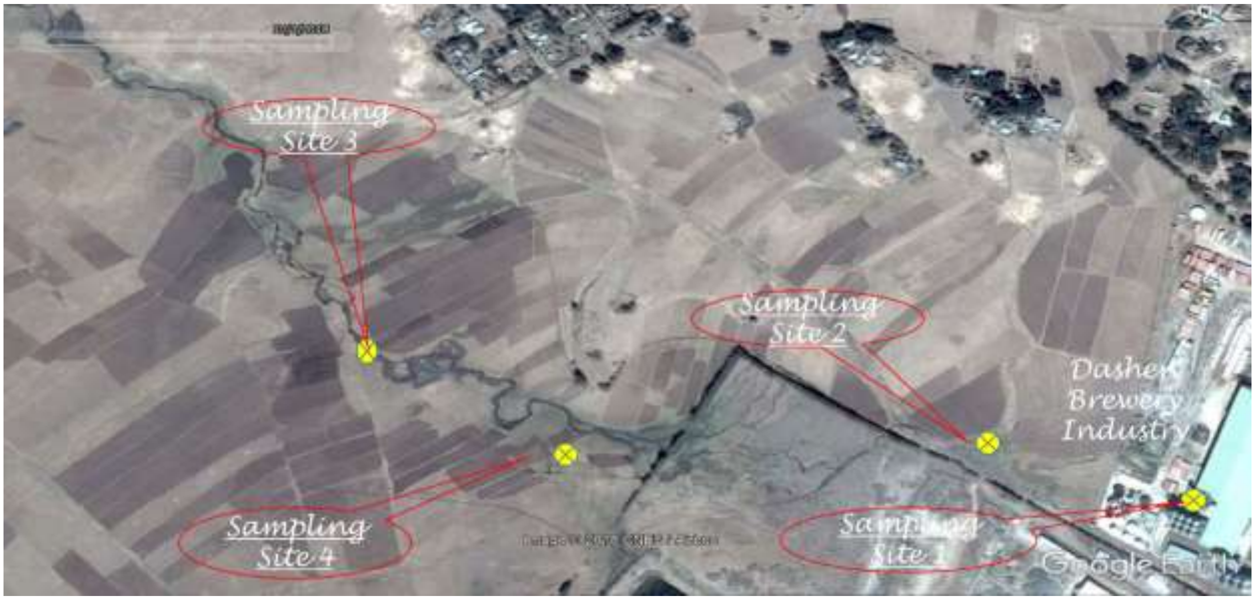

Figure 0. Location of the study site

The method of sample collection at each sampling point/station was done according to the WHO Guidelines (WHO, 1989) for waste water quality assessment and standard methods for the examination of waste water and the water laboratory manual (APHA, 1998). The Collected samples were stored at dry, cool and dark box and deliver the sample within 6 hr. to the laboratory for analysis.

Waste water Sample was filtered with laboratory Whatman Grade 52 filter paper in to wash and rinsed Erlenmeyer flasks. The clear filtered sample was transferred to ICP test tube. The solutions were analyzed for Na, Mg, Ca, K, S, Fe, Mn, Zi, Cu, Co, Cd, Pb, As, Cr and Ni with ICP-OES which was calibrated previously with standard series of all element stock solutions. The standard series uses to draw calibration curve of intensity verses concentration which is used to calculate the unknown sample. The correlation coefficient (R2) for the determination of the sample concentration of respective elements is always between 0.996-1.00. The other parameters also were analyzed with Colorimetric for Nitrate, with Titration for Bicarbonate and with Mohar Method for Chloride.

The sample is injecting with the auto sampler to the plasma by the help of peristaltic pump and the intensity of the light counts on the optic and calculate the Concentration on the Leaner calibration curve by the help of smart analyzer software. Biological Oxygen Demand (BOD) was determined by the 5 Day BOD test while Chemical Oxygen Demand (COD) was determined in the laboratory by the standard Open Reflux Method.

Similarly, the soil sample were collected from the field based on the standard. The Collected samples were stored at dry, cool and dark box and deliver the sample within 6 hr. to the laboratory for analysis. Soil samples were air dried and sieved under 2 mm diameter sieve for analysis. All elements were determined by ICP-OES using IRIS INTREPID (Thermo Elemental, Madison, USA). The calibration curves were linear in the whole concentration range.

Mehlich-3 estimates plant availability of most macronutrients and micronutrients in soils from acid to neutral pH using a dilute Acid-Fluoride-EDTA solution of pH 2.5. Due to the corrosive nature of Chloride in the Mehlich-2 extractant (Mehlich, 1978) and its inability to extract micronutrients on a wide range of soils, particularly copper on organic soils, Mehlich-3 was adopted.

In the process of extraction, phosphorus is solubilized under different mechanisms. Acidity of the two acids, Nitric and Acetic, increases the solubility of Iron and aluminum phosphates and extracts a portion of calcium phosphates if present. Fluoride serves to complex aluminum cations that potentially bind with phosphates thereby increasing the quantity of Orthophosphate in the solution. A benefit of Acetic Acid is to keep the solution buffered below pH 2.9 to prevent calcium fluoride from precipitating. Ammonium exchanges with potassium, calcium and magnesium and EDTA chelates iron, manganese, zinc, and copper. Phosphorus and cations were determined by ICP-AES instrumentation simultaneously. Phosphorus content in solution was determined spectrophotometrically at an acidity of 0.20 M H2SO4 by reacting with ammonium molybdate using ascorbic acid as a reductant in the presence of Antimony (Murphy and Riley, 1962). Carbonate (CO32-) and Bicarbonate (HCO3-) were determined by titration with HCl.

SAR is an important parameter for the determination of the suitability of irrigation

$$\mathrm{SAR} = \frac{\mathbf{Na^{+}}}{\sqrt{\frac{\mathbf{Ca^{+2} + Mg^{+2}}}{\mathbf{2}}}}$$

The Soluble Sodium Percentage (SSP) was calculated by the following equation:

$$\mathbf{SSP} = \frac{(\mathbf{Na^+}) * \mathbf{100}}{\mathbf{Ca^{+2}} + \mathbf{Mg^{+2}} + \mathbf{Na^+} + \mathbf{K^+}}$$

The ratio of the exchangeable Na+ to total exchangeable cations (ESP) is a good indicator for soil structure deterioration.

$$\mathbf{Esp} = \frac{\mathbf{100\ (-0.0120 + 0.01475\ SAR)}}{\mathbf{1 + (-0.0120 + 0.01475\ SAR)}}$$

Another indicator that was used to specify the Magnesium Hazard (MH) for irrigation water as in the following formula:

$$\mathbf{MH} = \frac{\mathbf{Mg^{2+}}}{\mathbf{Mg^{2+}} + \mathbf{Ca^{2+}}} * \mathbf{100}$$

If the value of MH is less than 50, then the water is safe and suitable for irrigation.

The excess sum of CO32- and HCO3- in wastewater over the sum of Ca2+ and Mg2+ influences the unsuitability of waste water for irrigation.

To qualify this effect, an experimental parameter termed as residual sodium carbonate (RSC) will be used. It will be calculated as follows:

RSC = (CO32- + HCO3-) – (Ca2+ + Mg2+)

According to the Uinited States Salinity Laboratory (USSL), RSC value less than 1.25 meq/L is safe for irrigation, a value between 1.25 and 2.5 meq/L is of permissible quality and a value more than 2.5 meq/L is unsuitable for irrigation.

The calculated RSC value show that all samples have RSC less than zero and are good suitable for irrigation purposes.

Results and discussion

To evaluate the pollution load in the brewery industrial effluents, the samples were analyzed for various physico-chemical parameters and the results were compared with values of National Environmental Quality Standards (NEQS, 2000) for industrial effluents. Similarly, values of ground water were compared with the standards of World Health Organization (WHO, 1981).

Table15. Wastewater and raw water chemical characteristics with respect to standard

Parameter	Unit	Symbol	Raw water	Treated water	Effluent mean at site 1	2	3	standard
Cadmium	mg/L	Cd	0.01	<0.069	<0.069	0.02	0.089	0.005
Arsenic	mg/L	As	0.15	0.41	0.32	0.31	0.63	0.05
Chromium	mg/L	Cr	0.13	<0.088	<0.088	0.04	0.128	0.05
Cobalt	mg/L	Co	0.068	0.06	0.00	0.02	0.02	0.05
Copper	mg/L	Cu	0.04	0.04	<0.033	<0.001	0.034	1
Iron	mg/L	Fe	0.11	0.15	1.76	1.92	3.68	0.3
Lead	mg/L	Pb	0.63	0.4	0.30	0.21	0.51	0.05
Manganese	mg/L	Mn	0.02	0.03	0.34	0.36	0.7	0.1
Mercury	mg/L	Hg	0.79	0.9	0.40	0.34	0.74	1
Nickel	mg/L	Ni	0.02	0.02	<0.01	<0.02	0.0	0.5
Zinc	mg/L	Zn	<0.026	<0.027	<0.028	<0.029	0.057	2
Calcium	mg/L	Ca^{2+}	21.52	21.31	22.81	18.52	41.33	200
Magnesium	mg/L	Mg^{2+}	4.43	4.4	6.93	5.36	12.29	150
Potassium	mg/L	K^{+}	3.6	3.45	19.18	46.41	65.59	-
Sodium	mg/L	Na^{+}	11.8	11.54	450.46	404.02	854.48	200
Phosphorus	mg/L	P	20.78	21.03	31.01	23.50	54.51	-
Ammonium	mg/L	NH_4^{+}	0.23	0.53	61.88	67.83	129.71	20
Bicarbonate	mg/L	HCO_3^{-}	8.45	6.56	19.31	16.26	35.57	-
Carbonate	mg/L	CO_3^{2-}	ND	ND	11.26	10.96	22.22	-
Nitrate	mg/L	NO_3^{-}	2.9	2.01	9.45	9.07	18.52	10
Chloride	mg/L	Cl^{-}	<0.1	<0.1	49.55	38.53	88.08	250

Note: - ND is not detected by the reading laboratory instrument

< the concentration is lower than the lower limit of the instrument.

The results obtained on heavy metal contents (Cd, As, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni and Zn) in brewery industrial effluents are presented in Table 1. Results showed that the levels of Cd, As, Cr Fe, Mn and Pb were above the permissible limits compared with standards. These results confirmed the early work of Banaras (1994). While the level of Co, Cu, Hg, Ni and Zn with in the limit. The main source of Mn in the effluents appeared to be aluminum industries which reduced the pH and thus Mn was released in the waste water.

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Table 2. Electrical conductivity and acidity of effluent

Parameter	Unit	Symbol	Raw water	Treated water	Effluent @ site 1	Effluent @ site 2	standard
Acidity	Pt. Co scale	pH-H_20	6.08	7.63	8.15	7.87	6.5-8.5
Conductivity	dS/m	EC	0.15	0.16	1.68	1.46	0.80 - 2.50
Temperature	^{0}C	T^0	20	21.5	27.33	22.17	25

The pH of the waste water collected from different stations was ranging from 6.3 to 8.15, and the result was shown in Table 2. The pH of raw, treated and waste water slightly increase and goes from slightly acidic to slightly alkaline, but not out of the range of the standard. The pH of the water is known to influence the availability of micronutrients as well as trace metals (Kirkham M. B., 2006). The principal component regulating ion pH in natural waters is the carbonate, which comprises CO_2, H_2CO_3, and HCO_3 (APHA, 1995). Electrical conductivity also shows slightly increment, but not out of the standard. Electrical conductivity is mainly attributed to the dissolved ions liberated from the decomposed plant matter (Sarwar and Majid, 1997) and input of inorganic and organic wastes (Wright, 1982). High EC values indicate the presence of high amount of dissolved inorganic substances in ionized form and the fluctuations in EC depends on the fluctuation in TDSs and salinity (Pandey *et, al*., 2003).

Temperature is an important indicator of water quality with regards to survival of aquatic organisms. The effluents temperature depends on the process of production in the industry. The temperature values of various industrial effluents ranged from 22.17–27.33 ^{0}C. However, the temperature of the effluent is warmer at the initial point from the factory and declined when going down.

Table 3. Wastewater physicochemical characteristics

	Analytical Result			
Parameter	symbol	*@site 1*	*@site 2*	*Unit*
Total Hardness as CaCO3	TH	86.63	81.38	mg/L
Total Suspended Solid	TSS	185	260	mg/L
Total Dissolved Solid	TDS	1005	940	mg/L
Carbonate	CO	ND	10.71	mg/L
Chemical Oxygen Demand	COD	148.44	197.92	mg/L
Biological Oxygen Demand	BOD	50	50	mg/L

Note: - ND is not detected by the reading laboratory instrument

As shows in Table 3 the concentration of TTS, TDS, CO and COD were higher and decrease from upstream to downstream, however total hardness increase in to downstream slightly and BOD remains constant in the irrigation scheme. In waste water, TDSs are composed mainly of bicarbonates, chlorides, carbonates, phosphates, and nitrates of calcium, magnesium, sodium, and potassium, manganese, salt and other particles (Mahananda., *et, al.*, 2010). The higher values of TDS may be due to the discharge of waste from effluents from various small-scale industries (Kataria., *et, al.*, 1996). BOD increases due to biodegradation of organic materials that exerts oxygen tension in a water body (Abida and Harikrishna, 2008). Increases in BOD can be due to heavy discharge of industrial waste water effluent, animal and crop wastes, and domestic sewage. BOD value has been widely adopted as a measure of pollution in the particular environment. It indicates the amount of organic matter present in water (Lokhande., *et, al.*, 2011). All organic compounds with few exceptions can be oxidized by the action of strong oxidizing agents under acidic condition. The COD determination is a measure of the oxygen equivalent of that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. While determining COD, oxygen demand value is useful in specifying toxic condition and presence of biologically resistant substances. The COD and BOD values are a measure of the relative oxygen-depletion effect of a waste contaminant. Both have been widely adopted as a measure of pollution effect. COD is also one of the most common measures of pollutant organic material in water. COD is similar in function to BOD, in which both measure the amount of organic compounds in water (Lokhande., *et, al.*, 2011).

Table 4. Contaminated and pure soil physicochemical characteristics

Parameter		*Pure soil @ site1*	*Pure soil @ site2*	*Contaminated soil @ site1*	*Contaminated soil @ site2*
Silicon	Si	433.57	410.32	622.68	456.38
Iron	Fe	288.86	291.16	308.28	338.44
Manganese	Mn	137.83	106.78	214.18	117.98
Zinc	Zn	3.41	3.67	2.99	3.97
Boron	B	0.22	0.23	0.90	0.51
Copper	Cu	1.68	2.49	1.71	1.35
Molybdenum	Mo	0.49	0.45	0.41	0.42
Cobalt	Co	1.23	0.83	2.43	0.93
Phosphorus	P	6.47	6.22	40.03	35.15
Potassium	K^+	36.26	32.46	172.98	156.64
Calcium	Ca^{2+}	3307.16	2326.81	3972.82	3636.10
Sodium	Na^+	48.66	21.78	1130.00	1294.28
Magnesium	Mg^{2+}	613.03	292.61	772.33	633.56
Sulphate	S	26.95	20.58	36.40	40.08
Acidity	PH	5.3	5.5	7.73	7.63
Conductivity	EC (µ	12.9	18.8	31.03	30.70
Organic Carbon	OC (%)	1.6	2	2.30	2.37
Organic Matter	OM (%)	2.8	3.5	4.13	3.93
T. Nitrogen	TN (%)	0.2	0.2	0.20	0.20

The result of pure soil and irrigated soil with waste water is shown in the Table 4. The concentration of heavy metal Si, Mn, Fe, P, S, Co and B and ions Na^+, Ca^{2+}, Mg^{2+} and K^+ increase as compared to the pure soil from adjacent land not irrigated with industrial waste water especially Na^+ increase seriously. However, Mo, Zn and Cu concentration decline in the pure soil than the contaminated soil. The concentration of PH, OM (%), OC (%), EC (µ s/cm) also increase in contaminated soil, except total nitrogen as it remains constant in both pure and contaminated soil.

Table 5. Soil texture and Bulk density of the study site

Parameter		Pure soil @site 1	Pure soil @site 2	Contaminated soil @site 1	Contaminated soil @site 2
Bulk density(g/cm^3)	Bd	1.37	1.42	1.37	1.24
Texture	%sand	44	52	44	22
	%clay	28	22	28	46
	%silt	28	26	28	26
	Tex. class	Clay loam	Sandy Clay loam	Clay loam	Clay

As show in Table 5 texture of the site ranges from clay to clay loam and is highly reactive and suitable for chemical reaction. Even if the concentration of sodium and other cations are slightly higher than the standared, the bulk density is similar in pure and contaminated soil. Na^+ broke down the edge of the clay particle and fill the pore space and block the infiltration of water and increase bulk density of soil.

Excessive sodium leads to development of an alkaline soil that can cause soil physical problems and reducing soil permeability. The water can be used for irrigation when the concentration of sodium is about 184.00 mg/L. Sodium hazard is usually expressed in terms of Sodium Adsorption Ratio (SAR) and it can be calculated from the ratio of sodium to calcium and magnesium. SAR is an important parameter for the determination of the suitability of irrigation water because it is responsible for the sodium hazard, since it is more closely related to exchangeable sodium percentages in the soil than the simpler sodium percentage. Sodium that replacing adsorbed calcium and magnesium is a hazard as it causes damage to the soil structure.

Water with SSP greater than 60 % may result in sodium accumulations that will cause breakdown of the soil's physical properties. The ratio of the exchangeable Na^+ to total exchangeable cations (Exchangeable Sodium Percentage, ESP) is a good indicator for soil structure deterioration. Although, the ESP of 10 to 15 % is generally accepted as a critical level, an ESP of 25 % may have little effect on soil structure in a sandy soil, whereas an ESP of 5 % is considered high particularly in soils containing 2:1 clay mineral like montmorillonite.

The excess sum of CO_3^{2-} and HCO_3^- in waste water over the sum of Ca^{2+} and Mg^{2+} influences the unsuitability of waste water for irrigation. In water having high concentration of CO_3^{2-} and HCO_3, there is tendency for Ca^{2+} and Mg^{2+} to precipitate as carbonates. To qualify this effect, an experimental parameter termed as RSC will be used.

According to the USSL, RSC value less than 1.25 meq/L is safe for irrigation, a value between 1.25 and 2.5 meq/L is of permissible quality and a value more than 2.5 meq/L is unsuitable for irrigation. The calculated RSC value show that all samples have RSC less than zero and are suitable for irrigation purposes.

The most common toxicity is from chloride (Cl^-) in the irrigation water. Cl^- is not adsorbed or held back by soils, therefore it moves readily with the soil-water, taken up by the crop, moves in the transpiration stream, and accumulates in the leaves. If the Cl^- concentration in the leaves exceeds the tolerance of the crop, injury symptoms develop such as leaf burn or drying of leaf tissue.

High concentration of Ca^{2+} and Mg^{2+} ions in irrigation water will increase soil pH, resulting in reducing of the availability of phosphorous. Water containing Ca^{2+} and Mg^{2+} higher than 10 meq/L (200 mg/L) cannot be used in agriculture. Another indicator that will be used to specify the Magnesium Hazard (MH) for irrigation water is less than 50, then the water is safe and suitable for irrigation.

Conclusion and recommendation

Interpretation of physical and chemical analysis revealed that the treated waste water of Dashen Brewery Factory is slightly alkaline. Among heavy metals Co, Cu, Hg, Ni and Zn, were within the permissible limits in all sites but Cd, As, Cr, Fe, Mn and Pb beyond the permissible limits in the effluents. The level of Ca^{2+}, Mg^{2+}, K^+, P, HCO_3^-, CO_3^{2-}, NO_3^- and Cl^- ionic concentration is within the permissible limit of the standard. However, the concentration of Na^+ and $NH4^+$ were higher than the standard. Therefore, it is recommended that Brewery WWTP has to be improved by correcting their treatment process. Otherwise use this water for agricultural purpose is dangerous. Therefore, the sustainable use of treated waste water in agriculture can be beneficial to the environment in such a way that minimizes the side effects on the quality of downstream water resources. Similarly, BOD and COD was above the permissible limit in almost all of the effluents. Chloride values are increasing intensively which is not recommended by the WHO standards and other standard agencies; hence which are not recommended for irrigation purpose. Based on these results, it is recommended that proper management of waste water irrigation and periodic monitoring of quality parameters are required to ensure successful, safe and long-term reuse of waste water for irrigation. Therefore, in the future high priority should been given for waste water treatment . This is because treated waste water is considered and made a reliable alternative source in water resources management. Agricultural waste water reuse can effectively contribute to fill the increasing gap between water demand and water availability particularly in water stressed areas.

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