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Wastewater Analysis of Assalaya Sugar Factory

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Abstract: Sugar industry is one of the most important food industries which many other industries relies on it. However, the waste products of sugar industry have environmental hazardous. This study was conducted in White Nile State-Assalaya sugar factory to investigate the environmental impact of the sugar waste in the region.

Thus, the experiments were conducted during the production and maintenance periods. The results obtained from the analysis of the liquid wastes, show that the values of physical and chemical properties (PH, Electrical Conductivity, Chemical oxygen demand and Biochemical oxygen demand) are higher than the permissible limits of the Sudanese standard specifications. Therefore, the disposal of the liquid waste in the surrounding environment is dangerous.

Keywords: *Environmental impact, liquid waste, PH, Chemical oxygen demand, Biochemical oxygen demand.*

I. INTRODUCTION

In Sudan the problem of wastewater was considered as the one most challenging issue which seriously affects the environment and people health. In White Nile State there is no doubt that factories play a large positive role in the national economy. In addition, they advance the development and process on all different sectors of life that would affect human, animals, and all various components of the environment. The trend may negatively affect both human and other lives as the result of environmental pollution. Because pollutions from manufacturing waste will most often be harmful if they are not well treated. In general, several pollutant parameters of oily wastewater were measured in order to identify the characteristics and Ingredients of wastewater.

The organic waste waters discharged by the sugar mills cause more pollution to river water. This reassure presents results of the organic waste water from cane sugar industry treated by other method process. The purpose of this study was to establish the kinetic model of organic removal, to determine the treatment parameters defining the oxygen demand and sludge yield. Furthermore, it will allow optimizing the operating conditions of the canesugar industrial wastewater treated by multi method process.

Environmental pollution defined as the contamination of air, water, or food in such a manner as to cause real or potential harm to human health, or to damage or harm nonhuman nature without justification.

II. GENERAL OBJECTIVE

This research attempts are to study and assess the current environmental impact of wastes product from sugar cane industry, and in specific the assessment of the environmental impact of wastes from Assalaya Sugar Factory.

III. MATERIALS AND METHODS

Sampling Location:

Locations were taken from wastewater in Assalaya Sugar Factory. Wastewater samples were collected from out section of the process composite sample from final drain carrying wastewater of all sections and going to outside the plant premises.

The apparatus were used throughout this study include:

1. EC214 Conductivity Meter (Portugal)
2. PH211 Microprocessor pH-Meter (Portugal)
3. Electronic Digital balance (O512) (China)
4. Microscope Olympus Model (X21FS1- mode in Philippines
5. Water Bath – Mumbai – 400 013 (India)
6. Close Electric Stove ART. NO. ES2615 (China)
7. Incubation 06287 AKyoet (Turkey)
8. Autoclave H.T30psi (Turkey) .
9. Turbidmeter IS021 (Turkey)
10. Viscometer TS018 (India)
11. Laboratory glass ware Equipment’s burette – pipette – graduate cylinder Test tube – Thermometer – etc.
12. Laboratory consumptions (gloves - facemask – Cotton – soap – etc.)
13. Lovebird Tintometer (ModelE) (18) Thermometer

IV. DATA ANALYSIS

Data were analyzed using a multiple variance analysis using ANOVA – Means were separated by range test of ($P \leq 0.05$).

(1) Total dissolved solids (TDS):

Total dissolved solids were determined by evaporating the water samples to dryness following AOAC, (1984).

Procedure:

20ml of each samples were transferred to weighed evaporating dish(petri dish)and evaporated to dryness by heating for (1-2hr) at l00ºC to constant weight

Calculation: $\text{mg/l of TDS} = \frac{\text{mg residue} \times 1000}{\text{ml sample}}$

(2) Electrical conductivity (EC):

Kent ETL model 214 conductivity meter was used with specific conductance cell (Platinum electrode cell) has cell constant 1.00.

Reagents:

- Deionized water
- KCL solution (0.0IM)

Procedure:

745.8mg of AR KCL was dissolved and diluted to one Liter with deionized water, make standard reference solution. The conductivities of the samples were determined in the same manner (as described by OAC, 1984).

(3) PH determination:

PH-value measured by Kent EIL model 211 Microprocessor pH-meter3.7 - 3.1reagent.Three standards buffer solutions were prepared using buffer tablets.The buffer tablets are (4, 7, and 9). Each tablet was dissolved in 100ml distilled water to form the buffer solutions specified.

Procedure:

The pH-meter was calibrated by the buffer solutions of pH 4, 7 and 9 at 25Cº. The pH values of the samples were then by recorded as described by Salem (2006).

(4) Determination of Chemical Oxygen Demand (COD):

$KMnO_4$ titrimetric method was used as described in standard method by EEA (2001).

Reagents:

- Sulphuric acid (conc.)
- Copper Sulphate (1g)
- Potassium Permanganate (0.025N).
- Sodium Oxalate (0.025N).

Procedure:

10 ml of the sample was taken in 100 ml bottle, then 5 ml of concentration.H_2SO_4 was added and 1g of copper sulphate ($CuSO_4$) also was added. Then 3ml of the prepared (0.025 N $KMnO_4$) solution was added and immersed the bottle in boiling water for 30min, while keeping the surface of the boiling water at the higher level than the surface of the sample . Three mills were then prepared 0.025N Sodium Oxalate ($Na_2 C_2 O_4$) was added and immediately titrated with 0.025 N Potassium Permanganate ($KMnO_4$) violet color appeared ,then repeated for the blank separately under the same condition using 10mls of distilled water instead of 10mls of samples.

Calculation: COD as mg/L = $\frac{(sample of ml B\ )\ (A\ 8000 \times 0.025)}{ml\ of sample}$

Where:

A= ml of $KMnO_4$ used for sample;
B= ml of $KMnO_4$ used for blank;
0.025(1/40) = Normality of $KMnO_4$
8000 = ml-equivalent weight of oxygen in 1000ml/l.

(5) Determination of Biochemical Oxygen Demand (BOD_5):

Winkler titrimetric method was used as described by EEA (2001).

Reagents:

- Sulphuric acid (H_2SO_4).
- Starch indicator.
- Iodide sodium.
- Manganese sulphate.

Procedure:

Two bottles of each 100 ml were obtained with lid and cleaned well. Twenty-five mills sample was taken in each bottle and 75ml of the sample was added to each of the two bottles. Then the two bottles closed well. One bottle was kept in the incubator (06287 AKyurty) at (20-22 ºC) for 5days .Then 10ml of manganese sulphate solution and 2ml of alkali-iodide solution was added to the other bottle below the surface of the liquid by using a syringe. Then the bottle closed and mixed by inverting it several times. When the precipitate settles leaving a clear supernatant above the precipitate, shaken again slowly by inverting the bottle and when the setting has produced at least 50mls supernatant 8mls of concentration. $H_2SO_4$was added. Then the bottle was closed and mixed by gentle inversion until dissolution was completed. One-hundred mills of the sample was titratedwith 0.05M $Na_2S_2O_3$ solution until a pale yellow solution reached. Then 2ml of freshly prepared starch solution was added and titration was continued until a blue color appeared. The procedure was then repeated using 100mls distilled water (blank). Then, repeated for incubated sample after 5days.

Calculations:

The BOD_5 was calculated as follows
BOD_5 as mg/l = $16(V_1-V_2)$

Where:

V_1 = ml of $Na_2S_2O_3$ used for the sample before incubation.
V_2 = ml of $Na_2S_2O_3$ used for the sample before incubation.

The total solids of the samples were determined by Punmia and Ashok (1998).

V. RESULTS AND DISCUSSIONS

In this section, the results obtained for Biochemical oxygen demand, Chemical oxygen demand, Electrical conductivity and PH will be demonstrated and discussed in details.

Table 1: Result analysis of wastewater samples before and after treatment

	Season point		Maintenance point		
Parameter	IN-1	OUT-1	Zero	IN-2	OUT-2
PH	4	4.4	6.5	4.4	5.3
T(◦C)	27.9	25.9	26	28.3	25
EC(μs/m)	2.4	1.8	0.4	2.1	1.1
TDS(mg/L)	1538	1232	238	1396	1305
BOD_5(mg/L)	1865	1250	890	1280	968
COD(mg/L)	7715	8217	9240	10422	9405

IN-1: Wastewater before treatment during production season.
OUT-1: Wastewater after treatment during production season.
ZERO: sumpoint in the factor.
IN-2: Wastewater before treatment during maintenance period.
OUT-2: Wastewater after treatment during maintenance period.

Table (2) Result of analysis of Assalaya wastewater samples after and before treatment compared with Sudanese standard values.

Parameter	**IN-1**	**OUT-1**	**ZERO**	**IN-2**	**OUT-2**	**Standard**
PH	4	4.4	6.5	4.4	5.3	06-Sep
T(◦C)	27.9	25.9	26	28.3	25	25
EC(μs/m)	2.4	1.8	0.4	2.1	1.1	1.5
BOD_5(mg/L)	1865	1250	890	1280	968	50
COD(mg/L)	7715	8217	9240	10422	9405	150

1) Biochemical oxygen demand

The chemical oxygen demand (COD) values divided by biochemical oxygen demand (BOD) values (COD/BOD) is equal or exceed (5). Figure (1) and table(3) show that the value of BOD$_5$ of the experiment result of analyzing the wastewater before (1865mg/L) , and after (1250mg/L) treatment during the production season. At the same time the values of BOD of pool point (890mg/L), before (1280mg/L) and after (968mg/L) treatment, showed higher concentration than the standard (600mg/L).

Table (3) Result of determination of biochemical oxygen demand (BOD)

Places	BOD(mg/L)
IN-1	1865
OUT-1	1250
ZERO	968
IN-2	1286
OUT-2	968

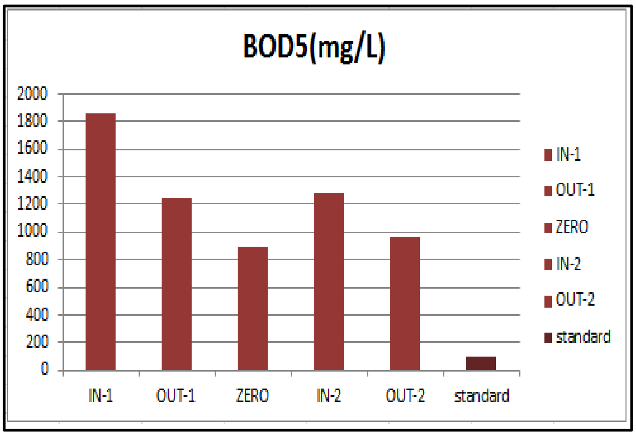

Figure (1) Relation betweenbiochemical oxygen demand and Time with values of Sudanese standards

2) Chemical oxygen demand:

The result of experimental analysis of COD was (8217mg/L) after treatment and (7715mg/L) before treatment which both have taken during the production season. These values of the concentration are higher than the Sudanese standard value (1100 mg/L). However, at the same time the COD concentration is also higher than Sudanese standard value during the maintenance period. In pool point it exceeds (9240mg/L) after water treatment, and (10422mg/L) before treatment, which are higher than the standard concentration of (1100mg/L). These results are shown in table (4) and figure (2) respectively.

Table 4: Result of Chemical oxygen demand (COD)

Place	COD(mg/L)
IN-1	7715
OUT-1	8217
ZREO	9240
IN-2	10422
OUT-2	9405

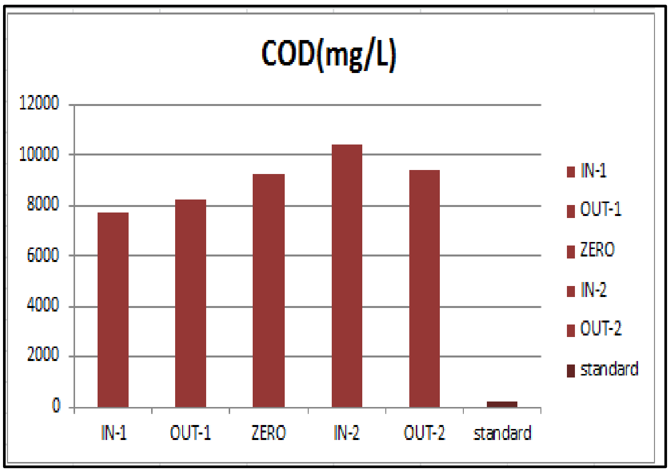

Figure (2) Relation between biochemical oxygen demand and Time with values of Sudanese standards

3) Electrical conductivity

From table (5) and figure (3)It can be revealed that the value of Electrical conductivity (EC) before treatment is (2.4µs/m), and after treatment is (1.8µs/m) where both readings were taken during the production season. These valuesare a lower than the Sudanese standard of (1.5µs/m). However, the EC value during the main tenance period is (0.4µs/m) in pool point of (2.1µs/m) before treatment, when a limit concentration is (1.5µs/m). After treatment, the value of EC is (1.1µs/m), which is high in comparison with the Sudanese standard. The higher ratio of EC concentration indicates that the elements and the compound decomposed completely to give rich positive and negative charges, which is a sign of high concentration of EC.

Table (5) Result of Electrical conductivity (EC)

Place	EC(µs/m)
IN-1	2.4
OUT-1	1.8
ZREO	0.4
IN-2	2.1
OUT-2	1.1

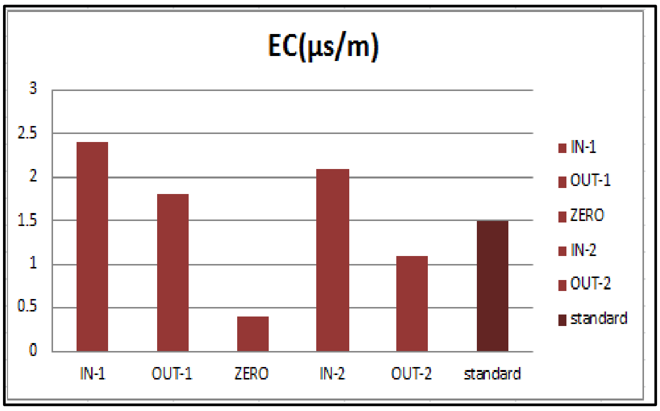

Figure (3) Relation between Electrical conductivity (EC) and Sudanese standard Time

4) PH value

Table (6) and figure (4) show that the values of pH which is (4.0) before treatment, and (4.4) after treatment during production season. These values are lower than the Sudanese standard of (6.0). At the same time, the measured PH value during the maintenance period is (6.5) in pool point and it's higher than the standard. The PH of waste water in this period before treatment is (4.4) , and it exceed (5.8) after treatment. However the pH is lower than the value of Sudanese standard (6.0). The influent pH has significant impact on wastewater treatment, is possible to treat organic wastewaters over a wide pH range. However the optimum pH for microbial growth is between 6.0 and 7.5.

Table 6: Result of PH analyzing in chosen places

Place	PH
IN-1	4
OUT-1	4.4
ZREO	6.5
IN-2	4.4
OUT-2	5.3

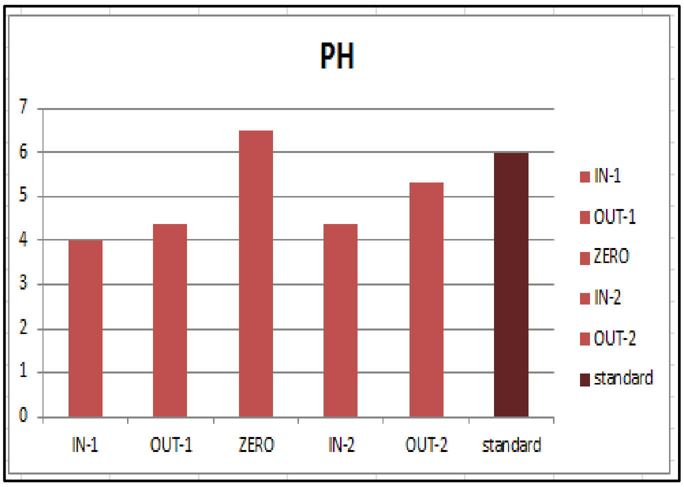

Figure (4) Relation between PH and Time with (standard)

CONCLUSION

This study was conducted in order to investigate the environmental impact of Assalaya sugar factory in the region. The season and maintenance production periods of 2016-2017 were chosen for collecting the data. The results from this study revealed that the values of BOD , COD, EC and pH are very high. It exceeded the tolerable limits of Sudanese standard. In addition, the wastewater from the Assalaya sugar factory causes a threat to the agricultural environment and the superiority of animals. Generally, the factory waste water poisoning Aljasser water south of the Aba island, which have a deleterious effect onagricultural and animals.Therefore, it is highly recommended to subject the wastewater of sugar factory to very serious treatment before its disposal.

Recommendations

1. Safety equipment should be provided to workers in the treatment plant so as not affect their health in the long term.
2. Study the effect of wastewater on a specific species of anmial living in that area.
3. Some chemical additives must be used in the treatment plant, which proves their efficiency in reducing values BOD_5 example for this chemical.
4. Introduction of treatment ponds to treat the wastewater before it is discharged into the White Nile.

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