Characteristics of effluent of sugar factory with reference to trace metals

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Abstract – Metal concentration in waste water has threat to atmosphere during the 21st century due to its toxicity and non- biodegradable in nature. Heavy metals are strictly regulated and must be treated before being discharged in the environment. Any metals having density greater than 5 g/cm^3 is generally considered as heavy metals .Heavy metal concentration in effluent of a sugar industry plays important role in maintaining the ecological balance of the natural streams ,rivers etc .However the sugar mill have a great environmental impact upon the surrounding environment .Many countries in the world are affected by presence of heavy metal in water. Among the various metal arsenic, lead, chromium and zink are found normally available in waste water hence it is necessary to remove it by using proper technology however the treatment process efficiency depends upon time of contaminant and parameter like p^H , current density, treatment and etc. This paper illustrates the characteristics of waste water of sugar effluent with respect to trace metals .For this experimentation the samples of effluent were collected before the effluent reaches the effluent treatment plant and after leaving the treatment plant

Key words – biodegradable, Effluent, pollutants

I-INTRODUCTION

The sugar industry usages sugar cane as raw material along with various chemicals are added during the process to produce the final product. During the process the large amount of water is used which results in waste water on larger amount. Sugarcane itself contains 70% of water and same an be used for manufacturing of sugar .(Sonage N. P. ,Kulkarni A A 2015) . The waste water generated from different processes of a sugar factory can be classified as follows-

(1) *Mill House waste* — This consists of the water used for cleaning purpose and contains some portion of cane juice,oil as well as grease .The cleaning is required frequentlty to prevent the growth of bacterias on the floor .As well as some quantity of water is used for cooling purpose .Which ultimately results in major quantity of waste water .

(2) Boiling house waste —This water generates from the various leakages like ,leakage through the pumps ,leakages from the pipelines and waste water by washing of the various units of the factory like evaporators , juice heaters ,clarification and centrifugation sections .

(3) Boiler waste water— The water used in boilers ultimately result in concentration of salts of various metals. Hence this salty water shall be removed frequently and when it mixed with the other source of water it becomes salty in nature .

(4) Condensed water-- The water used for condensation unit of a sugar factory is pollutant free and can be used for washing and the similar purpose .But when it pollutes by any means it should be discharged into the waste water mains and must be treated before its final disposal

1.1Quantity of effluent generation in various units of a sugar factory:--

The quantity of waste generated by each unit depends on the purpose of the use of water .Some units requires large quantity of water hence the large quantity of water appears as a waste water and vice versa .The following table shows the range of water used by the various units of a sugar factory .

SR NO	PROCESS	EFFLUENT m^3/day
01	Mill House	50--80
02	Boiling House	150--200
03	Boiler house (blow down)	40--50
04	Pump cooling water	80--100
05	Sulphur furnaces	14--20
06	Lime Hydrator	14--16
07	Excess condensate	20--30
08	Final effluent	400--500
09	Spray pond overflow	400--500

Table 1:--Range of water used by the various units of a sugar factory

1.2 Analysis of samples for heavy metals

Heavy metal treatment is important before disposal of effluent on land or in water bodies, with possibility of metals getting dissolved or formation of complex. Since all the waste water from the sources discussed above initially treated by giving a

suitable treatment in Effluent Treatment Plant and then discharged into the near by natural streams or water bodies .There is a risk of contamination of such water bodies due to the presence of trace metals into the waste water.

Materials and methods

1.Site selection:--The site selected for the experimentation was Shri Sant Tukaram Sahakari Sakhar Karkhana Ltd , Kasarsai near Pune –Mumbai Express way. The cane crushing capacity of the factory is 3000 MT /day . The factory has its own effluent treatment plant located at the tail end of all processes .

2.Effluent collection :--The waste water sample were collected in pre cleaned plastic containers before it reaches to the effluent treatment plant and after leaving the plant .The sample of waste water was collected from two different locations and experimentation is done for trace metals . For the analysis the samples were preserved to maintain its original characteristics by storing the sample of 5^0c temperature .

3.Methodology used -- The samples were analyzed by using standard methods referring the IS:3025 Part –02 (2004).
The laboratory instrument used for the testing was the UV spectrophotometer .

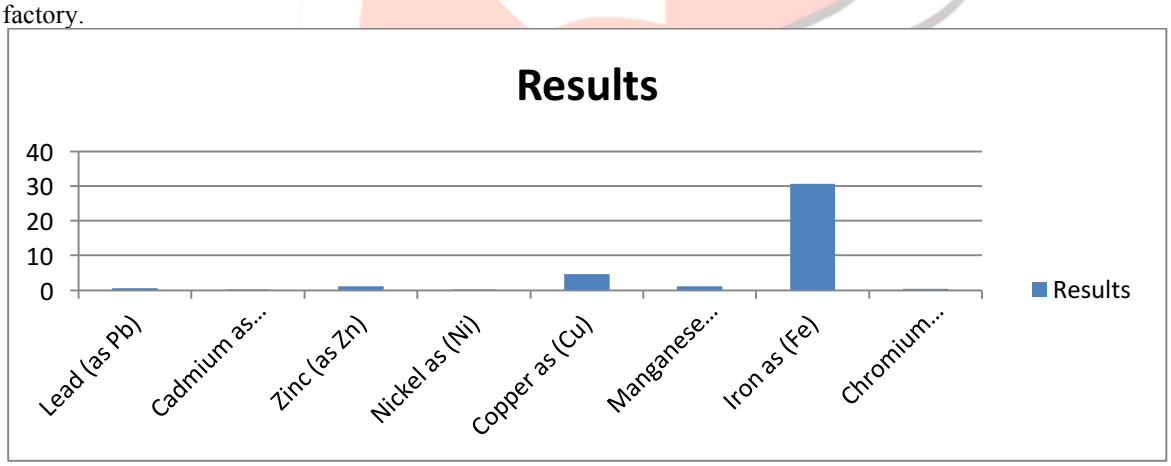
Results and discussion

Sample N0. –1
Site :-- Shri Sant Tukaram Sakhar Karkhana Pune.
Source of waste water --- Effluent Treatment Plant inlet.
Date / Time of sample collection –23/02/2019 2.30 pm
The following results were obtained

Sr No	Parameter	Unit	Result	Standard Method
01	Lead (as Pb)	mg/lit	0.52	IS:3025 Part –02 (2004)
02	Cadmium as (Cd)	mg/lit	0.06	IS:3025 Part –02 (2004)
03	Zinc (as Zn)	mg/lit	1.10	IS:3025 Part –02 (2004)
04	Nickel as (Ni)	mg/lit	0.03	IS:3025 Part –02 (2004)
05	Copper as (Cu)	mg/lit	4.65	IS:3025 Part –02 (2004)
06	Manganese as (Mn)	mg/lit	1.09	IS:3025 Part –02 (2004)
07	Iron as (Fe)	mg/lit	30.58	IS:3025 Part –02 (2004)
08	Chromium (as Cr)	mg/lit	0.39	IS:3025 Part –02 (2004)

Table 2:Waste water analysis

The following graph shows the concentration of trace metals present in waste water from the inlet of effluent treatment plant of sugar factory.



Graph 1:Graph showing concentrations of heavy metals in the waste water .

After analysing the sample of waste water before entering the ETP it is found that iron content is more than any other trace metals .A little rise in copper level was also considerable for the analysis.It is expected that while processing the waste through ETP the concentrations of iron and copper will arrive in the permissible level .For this purpose the waste water from the outlet of ETP was also tested.

Sample N0. –2
Site :-- Shri Sant Tukaram Sakhar Karkhana Pune.
Source of waste water --- Effluent Treatment Plant outlet.
Date / Time of sample collection –23/02/2019 2.30 pm
The following results were obtained

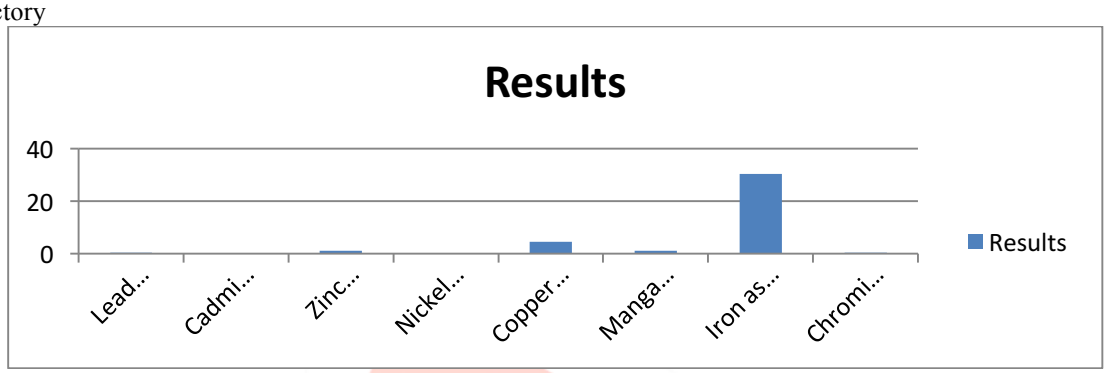
Sr No	Parameter	Unit	Result	Standard Method
01	Lead (as Pb)	mg/lit	0.52	IS:3025 Part –02 (2004)
02	Cadmium as (Cd)	mg/lit	0.006	IS:3025 Part –02 (2004)
03	Zinc (as Zn)	mg/lit	1.41	IS:3025 Part –02 (2004)

04	Nickel as (Ni)	mg/lit	0.16	IS:3025 Part –02 (2004)
05	Copper as (Cu)	mg/lit	4.48	IS:3025 Part –02 (2004)
06	Manganese as (Mn)	mg/lit	0.88	IS:3025 Part –02 (2004)
07	Iron as (Fe)	mg/lit	23.13	IS:3025 Part –02 (2004)
08	Chromium (as Cr)	mg/lit	0.45	IS:3025 Part –02 (2004)

Table 3:Waste water analysis

After analysing the sample of waste water After leaving the ETP it is found that iron content is still more than its permissible limit than any other trace metals .Copper level was remain constant There is a little rise in concentrations of zink and Nickel level. Since the waste water after giving the necessary treatment by the factory the next step is to discharge this water into the natural water bodies or the natural streams .The excess concentrations of these metals than the permissible limits prescribed by the pollution control board It is necessary to remove the metals by using some suitable mechanism .

The following graph shows the concentration of trace metals present in waste water from the outlet of effluent treatment plant of sugar factory

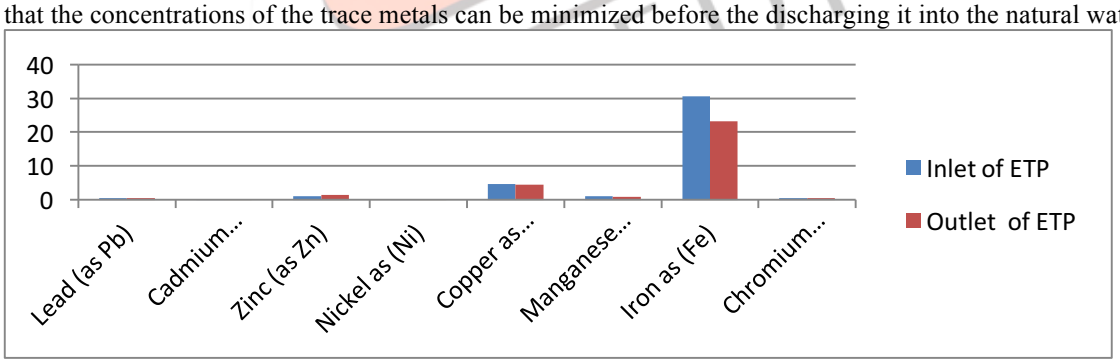


Graph 2: Concentrations of heavy metals in the waste water

Sr No	Parameter	Unit	Inlet of ETP	Outlet of ETP
01	Lead (as Pb)	mg/lit	0.52	0.52
02	Cadmium as (Cd)	mg/lit	0.06	0.006
03	Zinc (as Zn)	mg/lit	1.10	1.41
04	Nickel as (Ni)	mg/lit	0.03	0.16
05	Copper as (Cu)	mg/lit	4.65	4.48
06	Manganese as (Mn)	mg/lit	1.09	0.88
07	Iron as (Fe)	mg/lit	30.58	23.13
08	Chromium (as Cr)	mg/lit	0.39	0.45

Table 4 : Comparative overlook of ETP inlet and outlet parameters .

Following graph shows comparative concentration of heavy metals present in the waste water at inlet and outlet of effluent treatment plant of sugar factory which can be utilized for the improvement in the treatment to be given to the waste water in the ETP so that the concentrations of the trace metals can be minimized before the discharging it into the natural water bodies.



Graph 3: Comparative concentrations of heavy metals in the waste water

General comments on heavy metal analysis

After performing heavy metal analysis it is found that the concentrations of lead(0.52 /0.52 mg/lit),Zinc(1.10/1.41 mg/lit), Copper(4.65/4.48 mg/lit) , Manganese(1.09/0.88 mg/lit) and but the presence of heavy metals in waste water even after giving treatment by ETP .Some metals still present in the outlet of ETP waste .So it is necessary to remove these metals before the waste enters into the natural water bodies .The following table shows the concentration of metals which are being received by the water bodes even after giving treatment in ETP.

SR NO	Parameter	Unit	Result	Standards
01	lead	mg/lit	0.52	0.01
02	Zinc	mg/lit	1.41	05
03	Copper	mg/lit	4.48	03

04	Mangenese	mg/lit)	0.88	01
05	Iron	mg/lit	23.13	05

Table –6 Heavy metal concentrations and its standards

Conclusion

Since the even though the effluent of sugar industry is not reaching to the natural streams directly but after giving suitable treatment in the effluent treatment plant , it contains excess concentration of iron and copper ,creates bad effect on the human being and the natural environment . Iron above 0.3 mg/l can affect appearance affecting domestic water supplies, promotes iron bacteria, The first indication of iron poisoning by ingestion is stomach pain, as iron is corrosive to the lining of the gastrointestinal tract, including the stomach. Nausea and vomiting are also common symptoms and bloody omitting may occur. Excess concentration of copper causes abdominal pain, headache, nausea, dizziness, vomiting and diarrhea, respiratory .So it is necessary to lower the concentration of these metals and bring them to required level before releasing into the natural streams .

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