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A CASE STUDY ON CHARACTERIZATION, TREATMENT AND UTILIZATION OF DEOBAND SUGAR MILL EFFLUENT

ANJALI GOEL, MANU AND RICHA TYAGI

Department of Chemistry, Kanya Gurukul Mahavidyalaya,
Gurukul Kangri University, Haridwar 249 407, India

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ABSTRACT

The present study deals with physico-chemical analysis, treatment and utilization of Deoband sugar mill effluent. The effluent is treated with alkaline solution of hexacyanoferrate (III). The results show high values of alkalinity,TDS, hardness, BOD and COD indicating a high degree of organic pollution. These high values get reduces to a good extent with HCF (III) ions in an aquoues alkaline medium. The use of both treated and untreated effluent for irrigation purpose has been studied in two ways. Firstly by studying physico-chemical characteristics like pH, conductivity, sulphtaes, chlorides, TDS, % Na and SAR values and secondly by studying the effect of sugar mill effluent on % seed germination and early seedling growth of *Triticum aestivum*. Results show that both treated and untreated effluent are sutaible for all types of crops and all types of soil except those which are very sensitive to sodium. From data it can also be concluded that the lower concentration of effluent up to 10 -20% are be beneficial for seed germination and growth of *Triticum aestium* but its higher concentrations have adverse effects.

INTRODUCTION

Deoband is an old historical town of district Saharanpur (U.P.) and about 20 km. from Muzaffernagar (U.P.) city. Deoband sugar mill is near the railway

station occupying an area about 50 acres. The factory is discharging large amount of watse water in the surrounding which contains cane debris, organic and inorganic waste, oil and grease and variety of microbes etc.

The process of sugar cane dose not involve production of any effluent like other chemical industries but produces large volume of effluent led out with a biochemical oxygen demand load up to 1500 ppm. The variation in the physico-chemical charateristics of soil and geo chemicalcharacteristics of ground water are studied under the stress of sugar mill effluent by several workers (Prasad and Kumar, 1999).

Many methods being employed from time to time for the treatment of sugar mill waste water. These methods are mainly based on coagulation, biodegradation filtration and activated sludge process, reverse osmosis and nanofiltration (Kumar, 1999). But these techniques are not in use due to involvement of prohibitive cost implication. Hence, in the present study an attempt has been made to work out the newer methods for the treatment of sugar mill effluent up to the permissible limits for safe disposal and utilization in irrigation.

Experimental

The samples of untreated effluent for analysis were collected directly from the discharging channel in 5 liter plastic canes. Some of the physico-chemical characteristics were analysed at the site and for rest the cane were transported immediately to the laboratory for detailed analysis. All the effluent samples were analysed for their physico-chemical analysis within 6 to 7 hrs after collection. In case of delay the neccessary attempt were taken to ensure the check of biological activity. Methods prescribed by APHA (1995) were used for physico-chemical analysis.

Treatment methods

In the present study HCF (III) in alkaline medium has been used to reduce the pollution load of sugar mill effluent. HCF(III) in alkaline medium acts a mild oxidising agent. Singh and Joshi, (1999) and Goel *et al.* (1999) have reported that HCF (III) oxidises alcohols, sugar, amino acids etc. in aqueous alkaline medium in to simple acids. The treatment process was adopted on the laboratory scale in the glass trough of 4 liter capacity. The samples were kept over night with 0.328g / L and 0.004 g / L of HCF (III) and sodium hydroxide respectively. The colour of HCF (III) was removed by using activated charcoal.

Utilization

For Utilization purpose the effect of various concentrations (10% to 80%) of both treated and untretaed sugar mill effluent on seed germination and early seedling growth of *Triticum aestivum* has been studied. But before study, certain characteristics of water like pH, coductivity, sulphates, chlorides, total dissolved solids, percentage sodium and SAR value (sodium absorption value) have been determined which are accepted as sufficient to assess its suitability for irrigation.

To study the effect of effluent on seed germination and early seedling growth

the parameters like % seed germination, vigour index, root lenth, shoot length and biomass are determined. To carry out this study, thirty healthy seeds, sterlized with 1% mercuric chloride were sown in erthern pots of 66.00 cm circum ference containing 750gm of garden soil. The triplicate sets of pots were maintained with uniform conditions of light and water. During whole analysis all the chemicals used were of AR grade and double distilled water was used for reagent preparation.

RESULTS AND DISCUSSION

The results for the analysis of Deoband sugar mill effluent both before treatment and after treatment for some of its physico-chemical characteristics are presented in Table 1. The results show an increase in pH value from 8.38±0.28 to 9.47±0.44 and conductivity from 455.00±23.45 to 668.33±47.08 mS cm^{-1} but the values are within the permissible limits for industrial efluent discharge values prescribed by IS, 2490, 1974. These high values may be due to the presence of OH. The mean values of TDS, COD, BOD, hardness and alkalinity are very high indicating a high degree of organic pollutin which causes nuisance in the environment. It is observed that during treatment process, there is 8.04 to 67 .84%, 12.12 to 51.01% and 30.00 to 51.6% reduction in TDS, COD and BOD (Fig. 1) values respectively in 24 to 74 hrs duration.

The values of hardnessalkalinity, chlorides, sulphates, turbidity, CO_2, also decreases after treatment up to the permissible limit of IS 2490, 1974. Thus the above results show that organic pollution load of Deoband sugar mill effluent reduces to good extent by the treatment with alkaline HCF (III) solution.

The suitability of sugar mill waste water for irrigation has been studied in two ways. Firstly by studying physico-chemical characteristics like pH, con-

Table 1
Summarized results of some physico-chemical characteristics of Deoband sugar mill effluent

S.N.	Parameters	Unit	Before Treatment Mean ± STDEV	After Treatment Mean ± STDEV
1.	pH		8.38±0.28	9.47±0.44
2.	Conductivity	mS cm^{-1}	455.0±23.45	668.33±47.08
3.	Turbidity	NTU	54.65±2.34	0.00±0.00
4.	Carbon dioxide	mg/L	63.18±3.36	33.25±7.16
5.	Alkalinity	mg/L	295.55±37.39	164.44±36.43
6.	Hardness	mg/L	657.11±33.43	308.00±118.92
7.	Chlorides	mg/L	67.53±6.44	55.54±8.40
8.	Sulphites	mg/L	2.00±0.00	1.00±0.00
9.	Sulphates	mg/L	47.00±3.90	30.00±4.34
10.	TDS	mg/L	858.33±21.37	400.00±27.39
11.	DO	mg/L	0.00±0.00	0.00±0.00
12.	BOD	mg/L	2635.0±325.13	1860.00±277.27
13.	COD	mg/L	6510.0±824.19	4572.89±812.54
14.	% NA	mg/L	0.990±0.811	1.020±0.007
15.	SAR	mg/L	0.034±0.018	0.033±0.016

Table 2

Results to show effect of untreated effluent of deoband Sugar mill on % seed germination, vigour index and biomass of *Triticum aestivum*

S.N.	Conc. of % effluent	seed germination	Root length (cm)	Shoot length (cm)	RL/SL	Total length	Vigour index	Biomass (g/plant)
1.	Control	86.67	9.54±3.14	28.28 ± 12.10	0.3373	37.82	3277.86	0.2166±0.0216
2.	10%	86.67	14.59±6.39	20.27±4.80	0.7200	34.86	3021.32	0.3311±0.0900
3.	20%	93.33	12.51±3.75	23.05±11.07	0.5430	35.86	3318.81	0.3554±0.0317
4.	40%	86.67	11.60±6.23	20.14±5.86	0.5759	31.74	2750.91	0.3075±0.0551
5.	60%	63.33	10.95±5.99	17.99±5.69	0.6086	28.94	1832.77	0.2466±0.0779
6.	80%	60.00	10.39±5.16	15.91±4.57	0.6530	26.30	1578.00	0.2191±0.0625

Table 3

Results to show effect of treated effluent of Deoband Sugar mill on % seed germination vigou index and biomass of *Triticum aestivum*

S.N.	Conc. of effluent	%seed germination	Root length (cm)	Shoot length (cm)	RL/SL	Total length	Vigour index	Biomass (g/plant)
1.	Control	86.67	9.54±3.14	28.28 ± 12.10	0.3373	37.82	3277.86	0.2166±0.0216
2.	10%	100.00	16.47±4.95	22.37±8.84	0.7362	38.84	2848.14	0.3591±0.0345
3.	20%	100.00	13.06±3.84	21.61±4.45	0.6043	34.67	3120.30	0.3388±0.0734
4.	40%	83.33	12.32±7.70	21.03±6.27	0.5858	33.35	2445.55	0.2697±0.0942
5.	60%	63.33	10.91±3.90	19.77±6.71	0.5518	30.68	1942.96	0.2595±0.0403
6.	80%	60.00	10.43±3.57	17.93±6.48	0.5817	28.36	1701.60	0.1686±0.0200

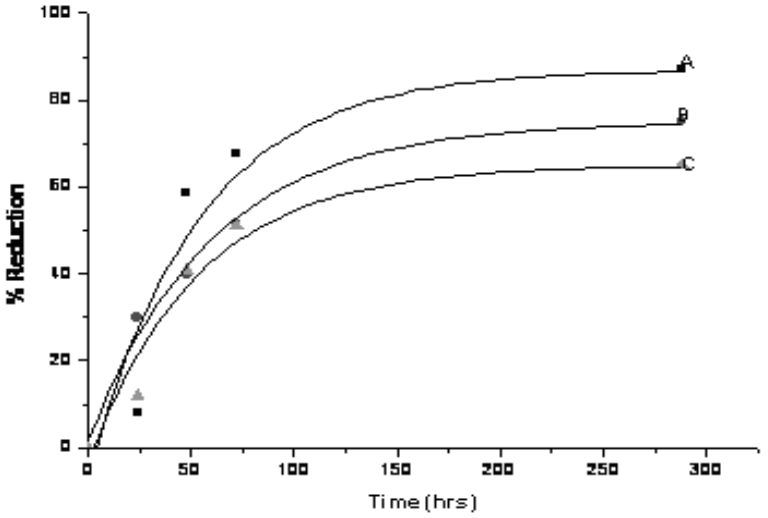

Fig. 1 %reduction in TDS (A),BOD (B) and COD (C) after treatment

ductivity, sulphates, chlorides, TDS, % Na and SAR values which have been compared with the standard values prescribed by IS for irrigation. The highest prescribed value of pH and conductivity are 9.00 and 1000 mScm-1 respectiely. For all types of crops the IS prescribed value of TDS, % Na and SAR are 700mg / L, 0-60 and 0-10 respectively. The values reported in Table 1 for treated and untreated effluent clearly reveals that both treated and untreated effulent are suitable for all types of crops and all types of soils except for those crops which are very sensitivive to sodium.

Secondly the suitability of sugar mill efluent waste water for irrigation has been checked by studying the actual impact of sugar mill effluent on crops. The effect of treated and untreated effluents is studied on seed germination and seedling growth of *Triticum aestivum*. Results are shown in terms of % seed germination and some growth parameters such as root length, shoot length and Vigour index. Biomass is also determined to study their effecvt on productivity. Results presented in Table 2 suggest that maximum % germination (86.67-93.33%) was recorded with 10-20% effluent concentration. The % seed germination with treated effluent is more than the untreated effluent. The effect of effluent conc. on growth parameters indicates that up to 20% concentration of effluent the value of root length, shoot length, vigour index and biomass increases with effluent conc. But above 20% effluent conc, these values goes on decreasing. From the comparison of data of treated and untreated effluent, it is clear that % seed germination and growth of the seedlings improves with treated effluent.

Thus it can be concluded that the proposed treatment processes has no ill effect on seed germination and seedling growth of Triticam aestivum. It can also be concluded from the above results that the sugar mill effluent has adverse effect over the growth of Triticum aestivum at its higher concentration.

The lower concentrations 10 - 20% proved to be beneficial for germination and growth. Hence sugar mill effluent can be utilized by the near by farmers after proper dilution (20% level) as a substitute for chemical fertilizers. Similar recommendation was also made by Chandrashekhar *et al.* (1998).

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