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Comparative study of natural decolourizing agents for degradation of melanoidin present in biomethanated molasses spent wash

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Abstract : Molasses Spent Wash (MSW) is pollution intensive waste water generated by ethanol distilleries. It retains very dark brown colour and severe pungent smell due to the presence of water soluble recalcitrant melanoidin pigment. In present laboratory scale study, removal of melanoidin from MSW was investigated using different cost effective decolorizing agents. The effect of various molasses concentration (10-100% v/v) along with different combination of soil, bagasse, jagerry and fly ash was studied to estimate the removal efficiency. Results indicate that maximal reduction of colour removal of 85% was achieved by using combination of soil and bagasse at molasses concentration of 100% and contact time of 24 days.
Key words : Spent Wash; Soil, Bagasse, Fly Ash, Colour.

Introduction

A distilled beverage containing ethanol is produced by distillation of fermented grain, fruit, or vegetables. In Indian distillery sector ethanol is primarily produced by fermentation of molasses, a by-product of sugar industry which contain about 40-50% sugar. There are about 295 distilleries in India which contribute for 2.7 billion litres of alcohol and generate 40 billion litres of wastewater annually[1]. Waste water which majorly consists of bottoms of distillation is known as spent wash (SW), it is nearly 15 times the alcohol produced[2]. Spent wash should be treated before disposal and should possess the standards notified by Ministry of Environment and Forest (MoEF), Government of India vide GSR 176(E), April 2, 1996. SW should have pH between 5.5-9; suspended solids 100 mg/L, and maximum BOD level of 30 mg/L for disposal into water courses and 100 -120 mg/L for disposal on land. Many distilleries follow biological treatment via microbial activity for the mineralization and decolourization of spentwash[3] as they are easy to operate, environment friendly and cost competitive alternative to chemical decomposition process[4-8]. Diverse microorganisms involved in decolourisation of spentwash are mentioned in Table 1. Even after this treatment the pollution potential of the SW is marginally reduced but the colour is still persistent. The colour is due to presence of brown polymers called melanoidins formed by the nonenzymatic browning reactions called Maillard amino-carbonyl reaction[9]. These compounds are highly recalcitrant and even toxic to many microorganisms used for

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wastewater treatment processes [10]. Due to dark colour, offensive odor and high COD these pose serious threat to soil and aquatic ecosystem[11-12]. Several authors have reported physico-chemical methods like coagulation and flocculation, oxidation, ultrafiltration, sonication *etc*. for treatment, but these methods require high reagent dosages and generate large amount of sludge[11]. Further to this, strict regulation of CPCB directs the distillery sector for zero-discharge, thereforemodern distilleries are adopting thermal incineration of SW. All these alternatives are not cost effective. Presently there is no sustainable solution for this problem. Through this paper we are reporting the possibility of decolourisation under static condition.

Table 1 Microorganisms capable of decolourizing distillery spent wash

Microorganism		Extent of decolourization (%)	Reference
A. Bacteria			
1.	Lactic acid bacteria	70	13
2.	*P. fluorescens*	76	14
3.	*Acetogenic bacterium N0BP103*	70	15
4.	*P. aeruginosa*	67.00	16
5.	*Pseudomonas sp.*	56.00	17
6.	*Citrobacter sp*.	19	*18*
7.	*Lactobacillus plantarum*	44	*19*
8.	*Pseudomonas aeruginosa*	92	*20*
9.	*Paracoccuspantotrophus*	81.2 ± 2.43%	*21*
B. Fungi			
10	*Aspergillus niger*	80	22
11	*Aspergillus niveus*	37	23
12	*Penicillium pinophilum*TERI DB1	86	*24*
13	*Cladosporium cladosporioides*	52	25

Materials and Methods

The molassesspent wash (MSW) after biomethanation was collected from Unnao Distilleries And Breweries Limited located near Kanpur city (Uttar Pradesh), India.The colour intensity of MSW was determined by UV- Visible spectrophotometer at wavelength of 475nm (λ_{max} of Melanoidin). MSW of different strength (10-100% v/v diluted using sterile distilled water of pH 7, temperature 37^{0}C) was subjected to decolourisation using soil, bagasse, fly ash. All the samples were kept at room temperature under static condition for 24 days. Aliquots were withdrawn from each sample and centrifuged at 12,000rpm for 12 minutes. The supernatant obtained after the centrifugation was checked for absorbance. The extent of decolourisation was calculated by checking the difference in absorbance of the spentwash before and after treatment. The percentage of colour degradation is measured by:

% colour degradation = [(Ci – Cf)*100]/Ci

Where, C0 and Cf are the initial absorbance and final absorbance of the spent wash [26-27].

Result and Discussion

The untreated MSW (100%) showed the optical density of 1.26 (after 50X dilution) .The considerable colour reduction was observed when MSW was treated with soil, bagasse and fly ash (Table 2).

Colour removal of 64% was achieved for 20 % MSW using soil alone (Figure1). Almost 69% (Using soil and Fly Ash) and 46% (Using soil and Jagerry) decolourization was obtained for 100% MSW and 50% MSW respectively (Figure 3 and 4). In comparison with other carriers, maximum decolourization of 89% was measured for 100% MSW using soil with bagasse (Figure 2). Adikane H.V.[28] reported decolourization of 69% using 10% (w/v) soil and 12.5% (v/v) MSW after 7 days incubation. Optimized parameters including days – 6 days, pH – 6, MSW – 12.5% and soil concentration – 40% were obtained for maximum decolourization. In another study where Fahy [29] reporteddecolourization above 85% after 10 days incubation using 6.25% MSW supplemented with 2.5% glucose.

Table 2- Decolourization (%) of MSW treated with different natural carriers

Concentration	**1gm Soil+10ml Effluent**	**1gm Soil+ 10ml Effluent+.5gm Bagasse**	**1gm Soil+ 10ml Effluent+.1gm Jaggery**	**1gm Soil+ 10ml Effluent+1gm Flyash**
Effluent Dilution (%)	**Soil**	**Baggase + Soil**	**Jaggery+ Soil**	**Flyash+ Soil**
10	53.23	66.94	0.81	55.65
20	64.02	75.40	23.81	50.79
30	25.97	74.55	24.68	18.96
40	41.58	76.67	36.71	57.40
50	37.36	85.16	46.15	53.02
60	55.10	82.37	42.70	61.43
70	38.46	82.47	29.13	62.30
80	10.86	88.71	22.26	60.80
90	7.20	85.60	14.96	57.82
100	32.81	89.54	38.11	69.41

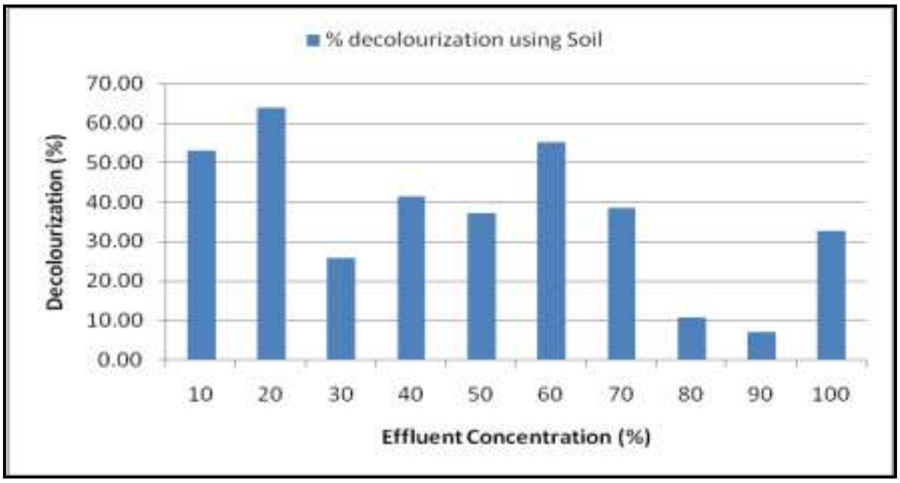

Figure 1.Decolourization pattern of MSW obtained after treatment with soil.

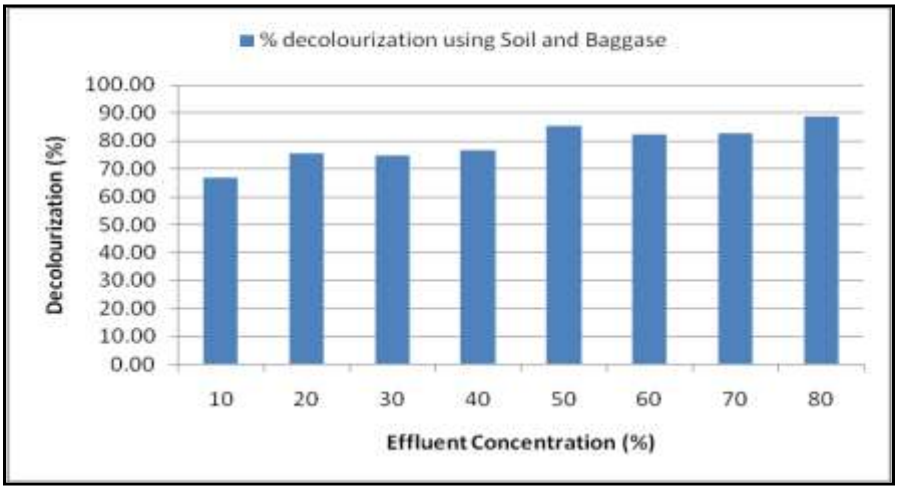

Figure 2.Decolourization pattern of MSW obtained after treatment with soil and Bagasse

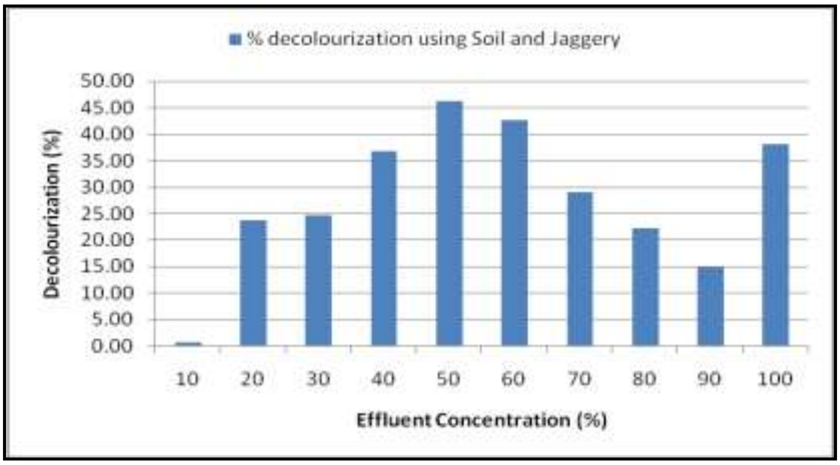

Figure 3.Decolourization pattern of MSW obtained after treatment with soil and Jaggery

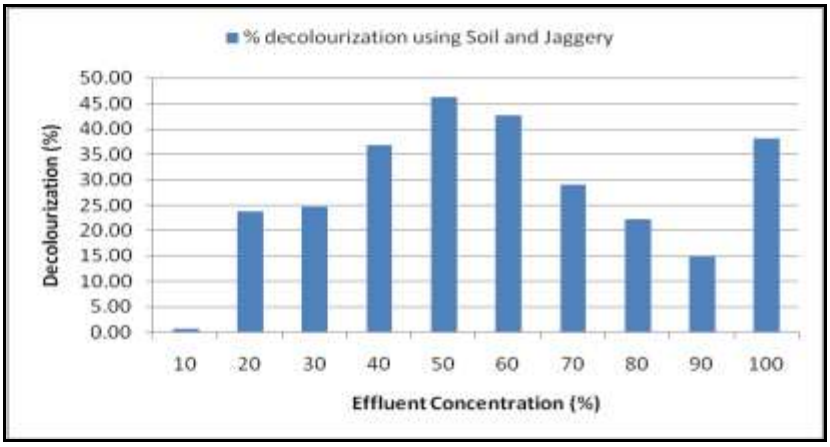

Figure 4.Decolourization pattern of MSW obtained after treatment with soil and Fly Ash.

Conclusion

On the basis of experimental result it can be concluded that treatment of MSW using soil with bagasse is one of the best combination than fly ash and jaggery as it resulted out the maximum decolourization of 89% after 24 days of incubation under static condition.

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