



Removal of colour from Biomethanated Distillery waste by treatment with Activated Sawdust

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Abstract: The aim of this work is to see the role of activated carbon (wood sawdust) and *A. niger* in the removal of colour from the anaerobically digested molasses spent wash. Various operation parameters like pH, contact time, adsorbent dosage, concentration of phosphate and carbon source, were considered and their effect on decolourization of anaerobically digested MSW by activated carbon and *A. niger* in batch mode was investigated.

Keywords: Distillery, Colour, Spent Wash, Industrial Effluent, Melanoidin, Activated Carbon.

1. Introduction

Biological methods involve anaerobic or aerobic treatment by microorganism. After anaerobic digestion, effluent still has high COD and dark brown colour. In order to remove further colour and COD from anaerobically digested MSW, aerobic treatment has been attempted. A large number of microorganisms such as bacteria, cyanobacteria, yeast and fungi etc. have been isolated in recent years that are capable of degrading melanoidins and thus decolorizing the waste. Microbial species, such as *Bacillus megaterium*, *B. cereus* (Jain *et al.*, 2005), *Pseudomonas fluorescens* (Dahiya *et al.*, 2001), *Geotrichum candidum* (Kim and Shoda, 1999), *Corioliolus hirsutus* (Miyata *et al.*, 2000), *A. fumigatus*, *Mycelia sterilia*, *Flavodon flavus*, *Corioliolus versicolor* have been employed for biodecolourization of distillery effluent. Fungi are recognized by their superior aptitude to produce a large variety of extracellular proteins, organic acids and other metabolites and for their capacity to adapt to severe environmental constraints. The aim of this work is to see the role of activated carbon (wood sawdust) and *A. niger* in the removal of colour from the anaerobically digested molasses spent wash.

2. Materials and Methods

2.1 Procurement of raw material

Mixed wood sawdust of *Shorea robusta* (Sal) and *Dalbergia sissoo* (Sesham) was collected from local sawmill of Patiala.

2.2 Preparation of activated carbon

2.2.1 Acid Activation

Sawdust was dried and sieved. Then wood sawdust was mixed with concentrated sulphuric acid, in the ratio of 4:1.5. The acidified carbon mixture was kept in an oven at 150°C for 12 hrs. Then char was obtained and washed with distilled water and soaked in 1% sodium carbonate overnight to remove residual acid. Next day, the char was washed with distilled water and dried at 1050°C for 24 hrs.

2.2.2 Batch sorption experiment

The activated carbon sample was evaluated for decolourization efficiency with biomethanated distillery spent wash. Adsorbent experiment was carried out in batch mode using 100ml of 1:1 diluted effluent with activated carbon dosage from 2-5g/100ml of the effluent. The adsorbent effluent mixture was agitated on a shaker at 140 rpm for 30 minutes. Effluent samples

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were withdrawn at regular interval of time for colour analysis. The samples were analyzed after removal of suspended activated carbon by centrifugation at 5000 rpm for 15 minutes. In each experiment, biomethanated distillery spent wash with the same dilution (1:1) but without activating carbon served as control. The filtrate colour was measured directly at 475nm and percentage colour removal was calculated.

3. Results and Discussion

3.1 Initial characterization of distillery effluent for various parameters

To see the presence of organic pollutants in the anaerobically digested MSW, characterization for various parameters colour dark brown, pH 7.7, TDS 58000, TSS 2000, TS 60,000, Hardness 8000, BOD 4800, COD 6400mg/l was found (APHA, 1996). To see the effect of process parameters on decolourization of effluent, various operational parameters were considered like dosage of adsorbent, contact time, agitation speed, pH and effect of shaking and stationary conditions.

3.2 Effect of adsorbent dosages (g/100ml)

To observe the effect of adsorbent dosage on decolourization of the distillery effluent, various adsorbent dosages (2g, 3g, 4g and 5g) were considered, during the experiment for a fixed time period (40 min). It was observed maximum decolourization of 99% was achieved at the dosage 5g/100ml of effluent (Fig. 1).

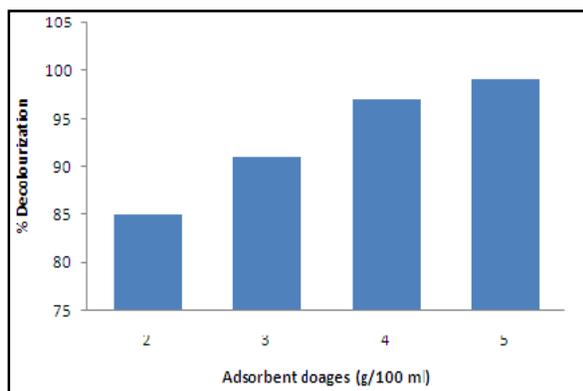


Fig. 1. Effect of adsorbent dosages (g/100ml) on % decolourization of effluent.

Operating conditions: Contact time-40 minutes, conc. of effluent-50%, Agitation speed-140 rpm, pH-7.

3.3 Effect of contact time (shaking condition)

To investigate the effect of contact time on decolourization of the distillery effluent, at an adsorbent dosage of 5g/100ml, was mixed with the 50% diluted distillery effluent. After a regular time interval (10 min, 20 min, 30 min and 40 min) decolourization assay was performed. It was found that after 30 minutes,

maximum decolourization was achieved i.e. 99% (Fig. 2). By increasing the contact time beyond 30 min, the percent decolourization was observed to be constant.

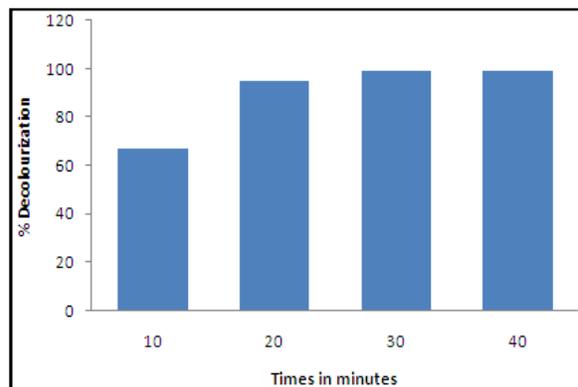


Fig. 2. Effect of contact time on % decolourization of effluent.

Operating conditions: Concentration of effluent-50%, agitation speed-140 rpm, adsorbent dosage-5g/100ml, pH-7.

3.4 Effect of stationary vs shaking condition

To see the colour removal during stationary and shaking conditions, the experiment was run both in the shaking condition and in the stationary condition, at a fixed adsorbent dosage of 5g/100ml of the effluent. After 30 minutes, it was found that in shaking condition maximum decolourization was achieved up to 99%, whereas in stationary condition it was 85%.

3.5 Effect of Ph

To determine the effect of pH on decolourization of the effluent, the experiment was run, with adsorbent dosage 5g/100ml of effluent, in different pH (3, 5, 7 and 9) ranges. It was observed that the prepared activated carbon can show decolourization activity of approx. 99% in wide range of pH (3-9).

3.6 Decolourization of anaerobically digested molasses spent wash by *A. niger* (281)

The extent of decolourization was also determined by measuring the absorbance of the sample after fungal treatment i.e. *A. niger*. *A. niger* showed its ability to decolourise anaerobically digested up to 72% when effluent was diluted at the rate of 50% and supplemented with external carbon (3%) and phosphate source (0.1% K_2HPO_4). Various operating parameters were considered and their effect on decolourization of anaerobically digested MSW by *A. niger* in batch mode was investigated.

3.7 Effect of K_2HPO_4 on decolourization ability of *A. niger*

It was observed that by providing an external phosphate source to the *A. niger*, the extent of decolourization was increased. To see the effect of K_2HPO_4 , 100ml of effluent was taken in two

Erlenmeyer conical flasks. One of the flasks was supplemented with an external phosphate source (0.1% K_2HPO_4) and another one was without any phosphate source. After 3 days, the decolonization assay was performed and found that the flask which was supplemented with an external phosphate source showed more decolonization than the other flask under operating conditions of concentration of effluent-50%, agitation speed-160 rpm, inoculums size-5% and contact time of 4 days.

3.8 Effect of external carbon source

In attempting the decolonization of anaerobically digested MSW, glucose and sucrose were provided as carbon source (3g/100ml) and also supplemented with 0.1% K_2HPO_4 . It was observed that 71% decolonization was achieved when glucose was used as carbon source and 63% decolonization was achieved when sucrose was used as a carbon source (Fig. 3). So from the present study, it has been observed that effect of glucose on decolonization of effluent was more prominent as compared to sucrose.

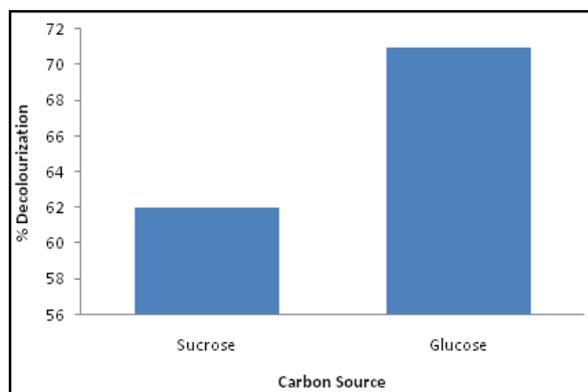


Fig. 3. Effect of external carbon source on % decolonization.

Operating conditions: Concentration of effluent-50%, agitation speed-160 rpm, inoculums size-5%, pH 5.5, contact time- 4 days.

3.9 Effect of concentration of carbon source

Decolonization activity of *A. niger* was observed at different concentrations of glucose. It was seen that decolonization activity of *A. niger* was increased, when we increased concentration from 1-3g and above 3g the decolonization activity was not effectively increased (Table 1).

Table 1. Effect of concentration of carbon source on % decolonization.

S. No	Conc. of glucose (g/100ml)	% Decolonization
1.	1	54
2.	2	65
3.	3	71
4.	4	72

Operating conditions: Conc. of effluent-50%, agitation speed-160 rpm, inoculums size-5%, pH 5.5, contact time-4 days.

3.10 Effect of dilution of distillery effluent on decolonization

Decolonization activity of *A. niger* was affected by the concentration of distillery effluent. This was determined by providing different concentrations (30%, 50%, 70% and 90%) of the effluent to the *A. niger*. It was observed that maximum decolonization was achieved up to 81.26%, at 30% concentration of the effluent (Fig. 4).

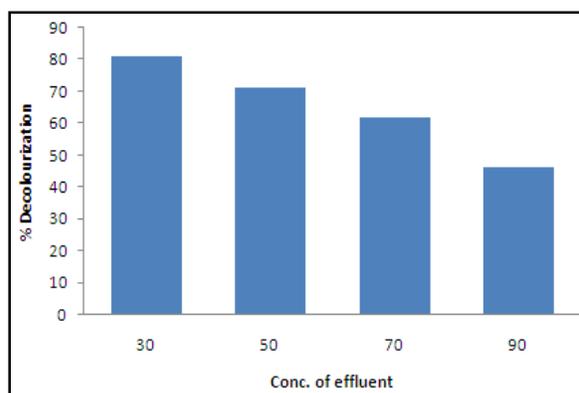


Fig. 4. Effect of dilution of distillery effluent on % decolonization.

Operating conditions: Agitation speed-160 rpm, inoculums size-5%, pH 5.5, contact time-4 days, glucose-3%, K_2HPO_4 -0.1%.

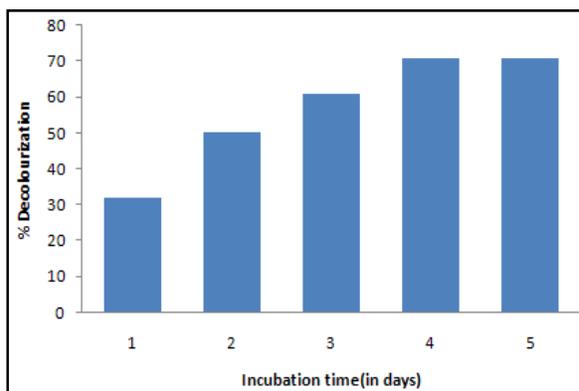


Fig. 5. Effect of incubation time on % decolonization of effluent.

Operating conditions: Agitation speed-160 rpm, inoculums size-5%, pH 5.5, glucose-3%, K_2HPO_4 -0.1%.

3.11 Effect of incubation time on decolonization

Anaerobically digested MSW was supplemented with carbon and phosphate source and inoculated with biomass of *A. niger*. After a regular interval of time samples were withdrawn from the experimental flask

and decolourization assay was performed. It was found that maximum decolourization up to 71% was achieved on the fourth day of incubation. After that on increasing the incubation time, percent decolourization became constant (Fig. 5).

4. Conclusion

Acid activated sawdust and fungal culture *Aspergillus niger* have been successfully employed for decolourization of biomethanated distillery waste for development of an integrated treatment technology.

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