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Aerobic Biodegradation of Vinegar Containing Waste Water by Mixed Culture Bacteria from Soil in Fluidised Bed Reactor

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ABSTRACT
The present study is focussed on biodegradation of the vinegar effluents by mixed culture bacteria isolated from the soil. The presence of acetic acid in the vinegar plant effluent contaminates the water and soil erodes if the effluent is released into the soil, ultimately contaminate the ground water table. It is necessary to remove acetic acid from the vinegar plant effluents. The technique used in this study in order to remove biodegradable matter is Aerobic Biodegradation. Varying initial concentrations of vinegar is synthetically prepared in the laboratory, which resembled the effluent released from the vinegar plant by adding the vinegar of 1%, 4%, 7% to 1250 ml water respectively. The mixed culture bacteria from the soil grown on standard Lysogeny Broth medium and introduced into the aerobic fluidized bed reactor after 24 hours and the bacteria (Bacilli, Cocci)biodegraded the organic matter i.e., acetic acid present in the sample. Samples analysed for vinegar concentration, DO and salinity, electrical conductivity for every 24hr, 48hr, and 72hr by volumetric analysis. The pH, DO, salinity, electrical conductivity and concentrations of the each samples measured for every 24hr, 48hr, and 72hr respectively. The pH of 1%, 4% & 7% samples varied from 6 to 9, 5 to 8.5 & 3 to 7 respectively from day1 to day3. The dissolved oxygen altered from 4ppm to 1ppm for 1% sample from day1 to day3 and from 5ppm to 2ppm for 4% vinegar sample for day1 o day3. Electrical conductivity of 1% vinegar sample increased from 52 to 58 from day1 to day3.
***Key words**:* Fluidised bed reactor, pH, Electrical Conductivity, Dissolved Oxygen, Aerobic Biodegradation.

I. INTRODUCTION

The effluvium released from vinegar plant contains organic compound such as acetic acid [1, 2]. The untreated effluent from vinegar process industries damages the soil characteristics if they are discharged on to the land. The effluents if discharged directly to surface waters like rivers and lakes will deplete the dissolved oxygen present in the surface waters [3, 4]. It is necessary to degrade waste water by aerobic process which is emanated from food industries and vinegar plants. The bacteria collected from the soil will degrade the vinegar aerobically by supplying the air [7]. Aerobic treatment of waste water is evolving one of the best pre-treatment options to reduce BOD, COD and odour problem [5, 8]. The goal of this experiment is to study concentration, electrical conductivity, and salinity of vinegar from vinegar synthetic wastewater by using Aerobic Biodegradation.

II. MATERIALS & METHODS

Three rectors of each 2000ml capacity filled with 1250ml of distilled water.1% of vinegar is added to the reactor. Prepared sample is fed into a fluidized bed reactor. The fluidized bed reactor is run for 3 consecutive days continually. Each reactor was fitted with aerator and air control knob &blower. The initial concentration of the sample is measured by titrating against the 0.1N of NaOH.

2.1. Reactor dimensions

Top section:
Volume = $1.470*10^{-3}$ m^3, Length = 0.165 m, Inner diameter = 0.1065 m
Bottom section:
Volume = $0.8*10^{-3}$ m^3, Length = 0.50 m, Inner diameter = 0.002 m,
Total volume = $2.27*10^{-3}$ m^3, Total height = 0.665 m

2.2. Culturing of bacteria

The sample for mixed culture bacteria soil collected from JNTU College premises and mixed culture bacteria is isolated by using serial dilution techniques and culture is propagated by using LB medium. The medium is autoclaved at 15psig for 30 minutes. After autoclaving it is inoculated and kept in the incubator at 35.4ºC for 24 hr.

2.2.1. Lysogeny Broth Medium Preparation

The materials used for this preparation are Yeast extract: 5g, peptone: 10g, NaOH: 10g, NaCl: 10g. Lysogeny Broth is prepared by adding 5g of yeast extract,10g of peptone, and 10g of NaCl in one litre beaker. The pH of Lysogeny Broth maintained in the range of 7.2 -7.4 by adding 1N Sodium Hydroxide (which is a strong base). However, we prepared 1litre Lysogeny Broth in four 250ml conical flasks by adding 1.25g of yeast extract, 2.5g of peptone, and 2.5g of NaCl in each flask. The flasks closed with

cotton and covered with aluminium foils with the help of a rubber band. Lysogeny Broth is autoclaved at 15psig for 20 minutes at 120ºC. Then the bottles are cooled to room temperature. After this the medium is sterilized and placed in the incubator (Remi) at a temperature of 37ºC for aerobic reaction to be carried out.

2.2 Bacteria Culture Preparation

The sample soil is sieved with 72 number meshes for 1g. The1g of soil is transferred into a one litre flask containing distilled water (Millipore), and stirred for uniform mixing (200ml distilled water + 22.2ml water containing soil). 222.2ml water containing soil transferred into 4 flasks i.e., 55.5ml of water each. Now, the bacterium (Bacilli, Cocci) is grown in the Lysogeny Broth. In the Lysogeny Broth, the function of NaCl is transportation and for osmotic balance. Yeast extract is used for breaking the proteins supplied by peptones into amino acids.

2.3 Placing Bacteria into the Reactor

After 24 hours broths from three flasks are placed in an Incubator and further 250 ml broth (which contains bacteria) each is added to the reactor. And these samples are measured for vinegar The concentration versus time plots shows that the concentration decreases with respect to time. The pH concentrations after 24hr, 48hr, and 72hr, by using volumetric analysis.

Fig: *Fluidised Bed Reactor*

Measuring of Parameters **.**pH, Dissolved Oxygen, salinity, conductivity and Concentration of the samples are measured at regular intervals. pH is measured for every two hours (10:35am, 12:35pm, 2:35pm, 4:35pm). Dissolved Oxygen is calculated once in a day (12.00pm).The dissolved oxygen is measured by using Winkler's Method (standard methods for testing water and waste water, American water works association) [7, 8]. Bacteria are identified by using laboratory experiments. Bacteria used in this experiment found are Bacilli and cocci.

III. RESULTS AND DISCUSSION

versus time plots shows that the pH is increasing with respect to time.

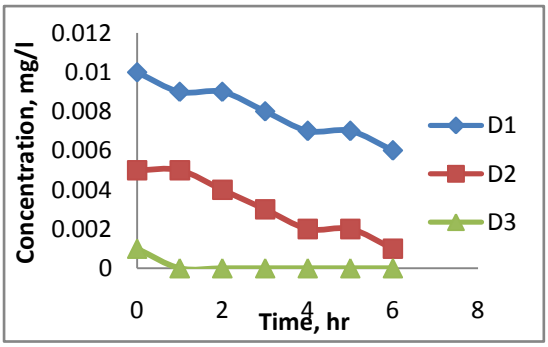

Fig1: Concentration vs time for 1% vinegar

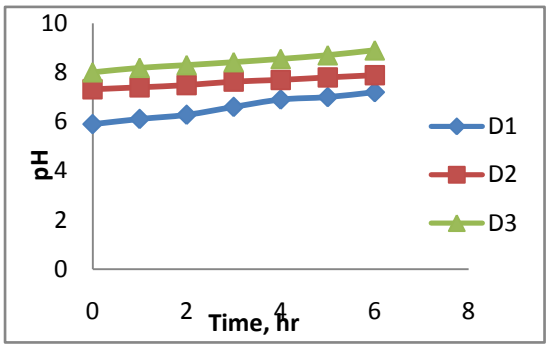

Fig2: pH vs time for 1% vinegar

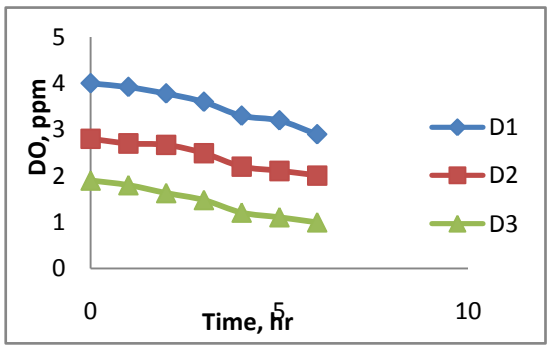

Fig3: DO vs time for 1% vinegar

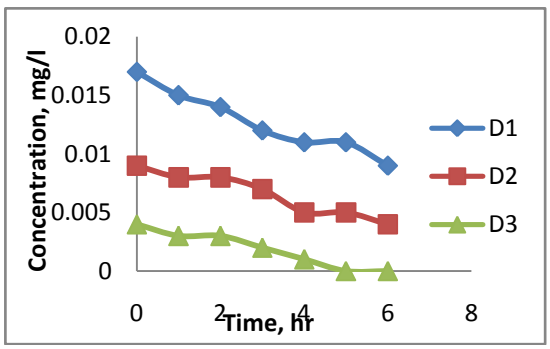

Fig4: Concentration vs time for 4% vinegar

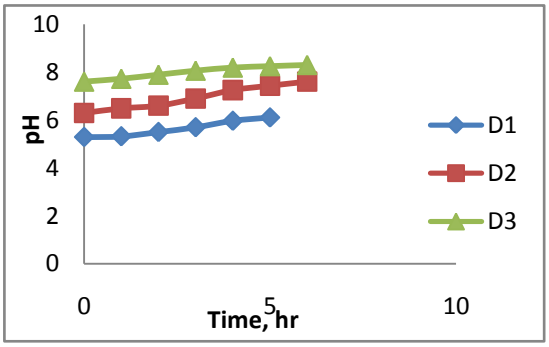

Fig5: pH vs time for 4% vinegar

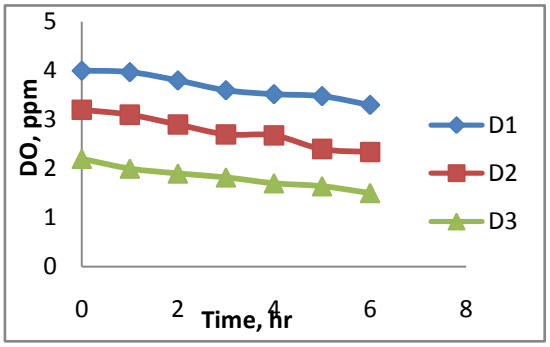

Fig6: DO vs time for 4% vinegar

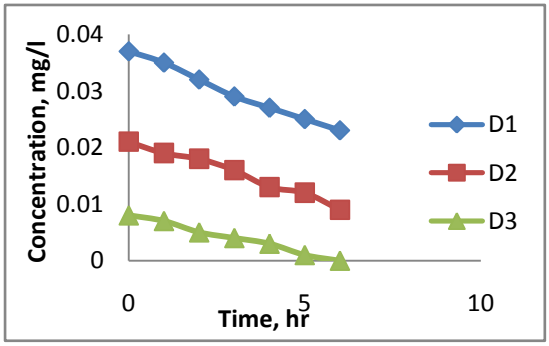

Fig7: Concentration vs time for 7% vinegar

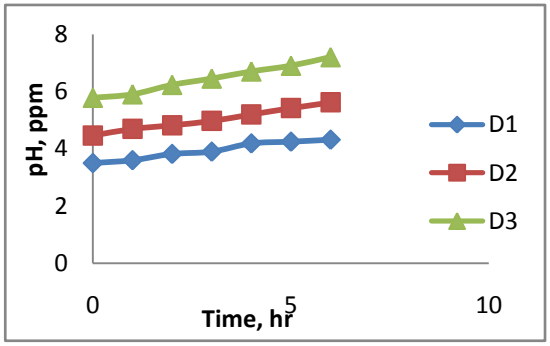

Fig8: pH vs time for 7% vinegar

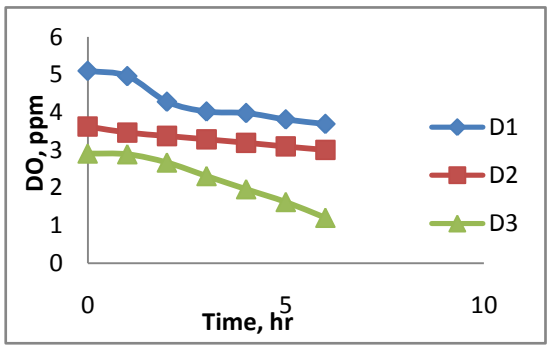

Fig9: DO vs time for 7% vinegar

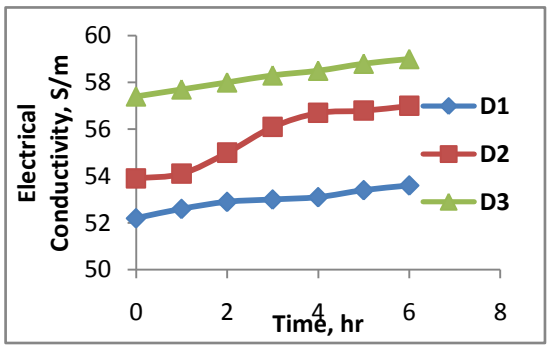

Fig10: EC vs time for 1% vinegar

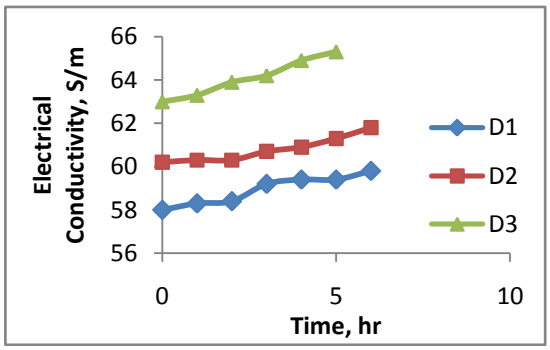

Fig11: EC vs time for 4% vinegar

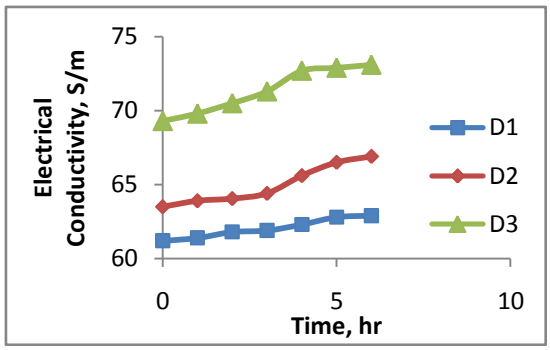

Fig12: EC vs time for 7% vinegar

In the above plots D1, D2, & D3 represents Day1, Day2 & Day3 respectively. The figures 1, 4, 7 shows removal of vinegar in 1% vinegar sample reached from 0.01 to 0.007 in day1 and ultimately reached to zero in day3. Similarly in 4% & 7% samples also 100% vinegar removal happened. The pH of 1%, 4% & 7% samples varied from 6 to 9, 5 to 8.5 & 3 to 7 respectively from day1 to day3. The dissolved oxygen altered from 4ppm to 1ppm for 1% sample from day1 to day3 and from 5ppm to 2ppm for 4% vinegar sample for day1 o day3. Electrical conductivity of 1% vinegar sample increased from 52

to 58 from day1 to day3 and for 4% vinegar sample EC varied from 58 to 65 & for 7% vinegar sample EC altered from 65 to 73.

IV. Conclusion

The present study of aerobic biodegradation in fluidised bed reactor indicates that the concentration of vinegar in 1%, 4% & 7% becomes to zero in 72 hours, whereas pH of the sample approximately increased from 3 to 9.5 in all the three samples. The aerobic biodegradation by using fluidised bed reactor seems to be an appropriate approach to treat vinegar effluents.

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