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APPROACH OF AGRO BASED MIXED CULTURE FOR POTENTIAL TREATMENT OF INDUSTRIAL WASTE WATER

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ABSTRACT

Industrial Effluents are mainly composed of suspended solids, high levels of organic pollutants, fats, oil and grease and are often being classified as ‘high strength’. High strength effluents cannot be discharged into natural water bodies as they deplete the dissolved oxygen of the natural water body and thus render a potential threat to aquatic flora and fauna. Hence these industrial effluents must be treated before discharging, by effective methods. The conventional methods require the use of chemicals and are of high cost. Thus there is a need to develop new intensive biotechnological methods for the treatment of wastewater. A laboratory-scaled experiment was conducted to test the bioremediation potential of agro based mixed culture (ABMC) for industrial effluents. Different variables like temperature and concentration of ABMC (%v/v) were tested for 13 days of treatment. The results were compared with the wastewater sample without adding ABMC as control. The water quality parameters analyzed were pH, Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). All parameters showed significant difference, improving the water quality, compared to the untreated sample. The study revealed that the ABMC could remove 75.46% BOD and 76% COD. The pH turned acidic due to the production of weak organic acids produced by the decomposition of the organic matter. This study indicated that ABMC has bioremediation potential of improving the water quality of industrial effluents. The biological treatment using ABMC is effective and the agricultural waste being cheap and easily available makes this method economical in practice.

Keywords: Agro Based Mixed Culture, Bioremediation, Industrial effluent.

1. INTRODUCTION

Industrial effluents contain various organic and inorganic pollutants. Organic pollutants impart the effluent with high COD, BOD values. Such effluents cannot be discharged into natural water bodies as they deplete the dissolved oxygen of the natural water body and thus render a potential threat to aquatic flora and fauna. Thus these effluents should be treated before discharging to reduce the organic matter. Adequate dissolved oxygen is necessary for good water quality. Oxygen is a necessary element to all forms of life. Natural stream purification processes require adequate oxygen levels in order to provide for aerobic life forms. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. The lower the concentration, the greater the stress. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills. Numerous scientific studies suggest that 4-5 parts per million (ppm) of DO is the minimum amount that will support a large, diverse fish population. The DO level in good fishing waters generally averages about 9.0 parts per million (ppm). [1][8]

The parameter used as a measure of the amount of oxygen required by microorganisms is Biochemical Oxygen Demand (BOD). This parameter also measures the strength of any given wastewater. The BOD is an empirical biological test in which the water condition such as temperature, oxygen concentration or type of bacteria plays a decisive role. These and other factors cause the reproducibility to be much less than that of pure chemical tests. In spite of the disadvantage, the BOD is of special importance in the assessment of pollution in wastewater. The Chemical Oxygen Demand (COD) is used to measure the oxygen equivalent required to oxidize the organic matter using a strong chemical oxidizing agent in an acidic medium. The COD of a waste is in general higher than the BOD because more components can be chemically oxidized than can be biologically. (Ademoroti, 1984) A high DO is an indication of a high state of purity of water and a low DO is an indication of pollution. Conversely, a high BOD and COD is an indication that the water is polluted whereas a low BOD and COD indicate high quality. [8]

Agricultural residues includes all leaves, straw and husks left in the field after harvest, hulls and shells removed during processing of crop at the mills, as well as animal dung. The types of crop residues which play a significant role as biomass fuels are relatively few. Crop residue accumulates in the fields and in factories. The waste from the agro processing industries accumulates at the mills where the crop is prepared. [8]

Bioremediation as defined by the American Academy of Microbiology is "the use of living organisms to reduce or eliminate environmental hazards resulting from accumulations of toxic chemicals or other hazardous wastes". [1]

Microorganisms can breakdown most of the compounds for their growth and/or energy requirements. This biodegradation process may or may not require air. In some cases, metabolic pathways which organisms normally use for growth and energy supply may also be used to break down pollutant molecules. A complete biodegradation results in detoxification by mineralizing pollutants to carbon dioxide, water and harmless inorganic salts. Incomplete biodegradation will yield break down products which may or may not be less toxic than the original pollutant. [10]

Biodegradation may occur spontaneously, in which case the term "intrinsic bioremediation" or natural attenuation" are often used. In most of cases natural conditions are not favorable enough for complete bioremediation to take place. In such cases can be improved by providing one or more prerequisites, as nutrients or oxygen. [8]

Studies have shown that the utilization of micro-biotic consortiums offers considerable advantages over the use of pure cultures in the degradation of pollutants. It could be attributed to the synergistic interactions among members of the association (***Mukredet al.,2008).*** Studies show that it is possible that one species removes the toxic metabolites, that otherwise may hinder microbial activities of the species preceding it. It is also possible that the second species are able to degrade compounds that the first are able to only partially. Theories that each member in a microbial community has a significant role and may need to depend on the presence of other species or strains to be able to survive. I has been found out that the individual strains of mixed cultures may attack the molecule of pollutants at different positions or may use decomposition products produced by another strain for further decomposition. [5]

Microorganisms need nutrients for their growth. In creating bionutrients, the materials are fermented by adding molasses, making nutrient more available and easily broken as well as improving the population of microorganisms. Most organisms that contaminate are harmless when ingested by humans but play a significant role in spoilage of the product. Microorganisms are natural and normal flora in or on fruits, and serve as reservoir to contaminate fruit products when they processed. [3] To study a safe and effective method to treat industrial effluent, by using ABMC in varying concentration, at different temperature and for varying time period.

Methodology

Preparation of Agro based mixed culture

Agro-waste was collected from potential sources, in a random manner. The material was chopped, unwashed and unpeeled. Agricultural waste material was taken and was allowed to degrade by addition of sugar cane juice and baggasse. Then molasses and water was added to the material for further degradation in the ratio of 10:3: 1 of water, agricultural waste and molasses.

After one week degradation, the material was filtered through a normal sieve.

The filtrate contains variety of microorganisms which have potential to bioremediate the industrial effluent. This filtrate is known as ABMC.

Optimization Experiment

Industrial wastewaters from different sources were taken for the study. Studies were carried out by adding ABMC and it was compared with the effluent without addition of ABMC (0% ABMC).

The variables taken for the study were: Various concentrations of ABMC, Various types of effluents, different temperature conditions and varying time period.

- Agro Based Mixed Culture Concentration – Different concentration of ABMC was added to each effluent of 0, 20, 60 and 100% v/v prepared by mixing with 20ml distilled water and transferred to flasks containing 250ml of wastewater sample.
- Wastewater samples- wastewater from Sugar, dairy and textile industries were taken for the study.
- Temperature variation – the prepared sets were kept at 28^0C and 37^0C.
- Time period – the wastewater samples were then checked for various parameters at the interval of 0, 4,7,10 and 13 days of treatment.
- Parameters –pH, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

RESULTS

Characterization of wastes

Parameters	Sample A		Sample B	
	A1	A2	B1	B2
pH	6.9	6.5	7.3	7.3
BOD (mg/L)	230	200	4725	841
COD (mg/L)	520	500	10486	1866

The permissible limit for the discharge water is pH should be in the range of 6.5-7.5, Biochemical Oxygen Demand (BOD) should not be more than 100mg/L and Chemical Oxygen Demand should not be more than 250mg/L.

The values of these parameters of the collected wastewaters, except for pH showed quite higher values, so before discharging they should be treated first. If discharged otherwise, it can cause detrimental effects on the ecosystem.

Variations in wastewater quality on addition of agro based mixed culture (ABMC):

The variation in the wastewater quality was studied and the results were as follows:

Variations in pH:

The first graph shown here is of variations of pH of sample A, treated at 37^0 C. on the addition of ABMC, the pH of the sample increases a bit, and then due to the degradation of organic material, the pH starts decreasing. The similar pattern is seen in all the samples.

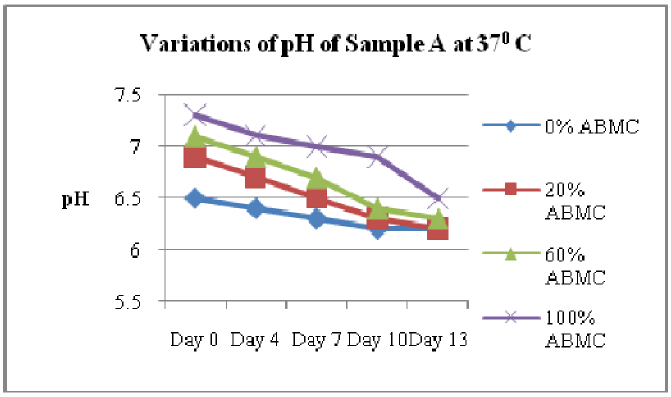

Figure 4.1 ***Variations in pH of Sample A treated at 37^{0}C***

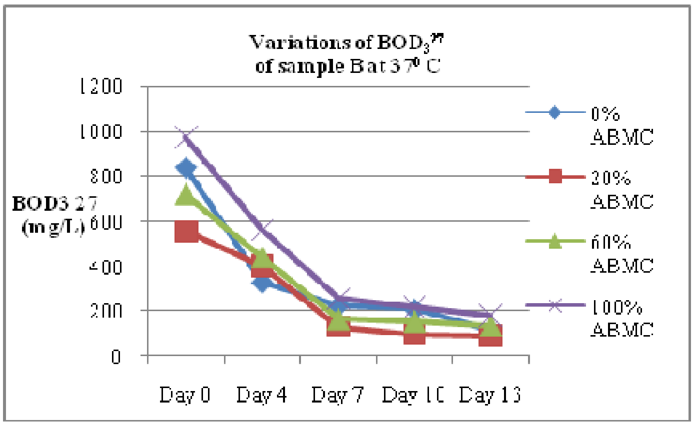

Figure 4.2 ***Variations of BOD_3^{27} of Sample B treated at 37^{0} C***

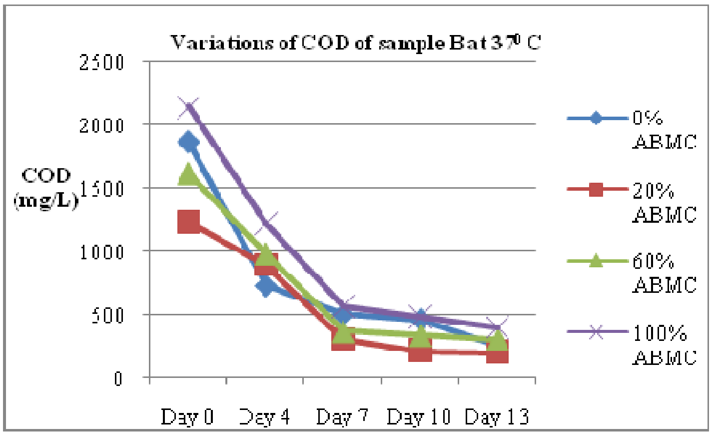

Figure 4.3 ***Variations of COD of sample B treated at 37^{0} C***

Variations in Biochemical Oxygen Demand (BOD):

The graph here shown is of the variations of BOD values of sample B, treated at 28^{0} C without and with the addition of ABMC. In this sample maximum reduction of BOD values were observed of 89.06% with 20% ABMC at day 13. The other concentrations of ABMC gave in sample B gave nearly 80% reduction at both the test temperatures. In the other samples too the reduction by 20% ABMC was maximum compared to other ABMC concentrations. The sample with 0% ABMC showed reduction in BOD values but the percentage reduction was lesser than as shown by 20% ABMC, and also was slower as compared to the latter.

Variations in Chemical Oxygen Demand (COD):

Normally COD values are higher than that of BOD values COD measures the amount of oxygen that is consumed by water for the decomposition of organic matter. [4]

The graph shown here is of sample B, treated at 37^0 C. The maximum reduction of COD was observed with this sample, with 20% ABMC set, of 89.28% reduction at the day 13. The other concentrations of ABMC gave the reduction of nearly 80%. The 0% ABMC also showed good reduction, but it was much slower and quite lesser than that of with the 20% ABMC. In other two samples the reduction with 20% ABMC was more than that of the other ABMC concentrations.

5. CONCLUSION

Agro Based Mixed Culture was found to improve the quality of wastewater efficiently. All the parameters analyzed showed significant difference compared to the sample with 0% ABMC. 20% ABMC showed the best results among the different concentrations of ABMC used for the experiment. The results showed that better results were obtained when more biodegradable organic matter was present in the sample.

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