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Treatment of Industrial Wastewater by Nonviable Biomass –A Review

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ABSTRACT
The present paper is a review paper on use of viable biomass of Industrial waste water treatment. there are many industry that use that latest technology such as the use of synthetic dyes for textile. However, a variety of synthetic dyestuff released by the textile industry has been posing a threat to the safety of the environment due the presence of a large number of toxic contaminants such as organic waste, acids, bases and organic pollutants. Therefore, the government began to control the pollution created by the industry to tighten the re gulation and enforcement by forcing the industry to treat waste before discharge to the environment. There are many methods have been used to treat this waste. However, it requires a treatment that really works not only at low cost with require minimal or no pre-treatment at all, but it must also be environmentally friendly, minimum sludge production and cleaner. This study used biological method to explore the usability of the microorganisms i.e. bacteria, Lactobacil lusde lbruckii for the removal of dyes from aqueous solutions. The ability of microorganism to decolorize and metabolise dyes has long been also the use of bioremediation based technology for treating textile waste water has attracted interest. The effects of different parameters such as pH, temperature and initial dye concentration were studied and the effectiveness of this method to remove the dye solution was determined by measuring the percentage of color removal

Keywords *Aspergillus, fumigates*, decolourization, textile effluent

I. INTRODUCTION

Contamination of water sources by many organic pollutants is a major factor of global Environmental pollution for number of years.

Two major sources of dye pollution are the textile and dye stuff manufacturing industries. Effluents of these industries are highly colored and very difficult to treat since the dyes used are synthetic complex molecules that are resistant to aerobic digestion and stable to light, heat and oxidizing agents different dyes and pigments are used in dyeing and printing industries. It is estimated that 2,80,000 tons of textile dyes are discharged in such industrial effluents every year worldwide .Improper textile dye effluent disposal in aqueous ecosystems leads to the reduction in sunlight penetration which in turn decreases the photo synthetic activity, dissolved oxygen concentration, water quality and depicts acute toxic effects on aquatic flora and fauna, causing severe environmental problems world-wide Several physicochemical methods such as absorption, membrane filtration, photo catalytic degradation, ion exchange, precipitation, flocculation, floatation and ozonation are quite effective in decolorization of dyes, have some disadvantages such as high cost unit volume of waste water treated, unfriendly for nature or unreliability in operation . Therefore, there is a need to develop alternative and cost effective treatment process for colored effluents.

Color is the most visible pollutant that can be easily recognized in wastewater and it should be treated properly before discharging into water bodies or on land. The presence of color in wastewater either in industrial or domestics needs is considered as the most undesirable. Besides, the occurrence of various coloring agents like dyes, inorganic pigments, tannins and lignin which usually impart color become among the main contributor for these environmental matter with dyes wastes are predominant. Dyes are widely used in many Industries such as textile dyeing, food, cosmetics, paper printing, leather and plastics, with textiles industry is the major consumer. The number of synthetic dyes presently utilizes in textile industry is about 10 000, representing an annual consumption of around $7x10^{5}$ tones worldwide. Synthetic dyes were classified based on their chromophores and it can be divided into several groups such as azo, anthraquinone, sculpture, indigo, triphenymehyl and phthalocyanine derivatives. Moreover, azo dyes are the most important class of commercial dye and versatile colorants which have been used excessively in industries worldwide due to their wide variety of color shades, high wet fastness profiles, ease and cost effectiveness compared to natural dyes.[1]

There is a need to develop alternative and cost effective treatment process for colored effluents. The microbial de colorization and degradation has been of considerable interest since it is inexpensive, eco-friendly and produces a less amount of sludge. Both living and dead biomass can be used to remove the hazardous organics. Dead cells are obviously preferable for waste water treatment since they are not affected by toxic waste and chemicals and do not pollute the environment by releasing toxins .Dead and dried biomass can be stored for longer periods at room temperature with little risk of putrefaction. This makes it easier to use and transport. Dead biomass is also generated as waste product from established industrial process. Rhizopus arrhizus, Aspergillus niger, Neurospora crass , Penicillumchrysosporium and Aspergillusfumigat are some of low cost fungal materials which have been used as biosorbent for dyes. Hence, in present study, the feasibility of using dead biomass of A. fumigatusfor colour removal from textile dye effluent was examined.[6]

The physical and chemical techniques were numerous including anion excheneger, flotation, electro flotation, electrochemical destruction, irradiation , ozonation , adsorption and use of activated carbon etc. some of physical and chemical treatment techniques are effective of colour removal but use more energy and chemical than biological process. They also concentrate the pollution into solids or liquid side stream requiring additional treatment. Number of study have focus on some microorganisms which are to biodegrade and biosorb dye in wastewater. [3]

Type of solid material has the capacity to adsorb pollutants to some degree, a number of industrial inorganic wastes, such as ash, or natural inorganic materials like clay, synthetic materials like zeolite, as well as, living or nonliving biomass/biomaterials, have been investigated as cheap adsorbents capable of replacing the well-known, but more expressive ones. Considering their cost and efficiency, biomass-based adsorbents or biosorbents as they are commonly called, are the most attractive alternatives to ionexchange resins and activated carbon. The use of biosorbents for the removal of toxic pollutants or for the recovery of valuable resources from aqueous waste waters , is one of the most recent developments in environmental or bioresource technology. The major advantages of this technology over conventional ones include not only its low cost, but also its high efficiency, the minimization of chemical or biological sludges, the ability to regenerate biosorbents, and the possibility of metal recovery following adsorption .As opposed to a much more complex phenomenon of bioaccumulation based on active metabolic transport, biosorption by dead biomass is passive and occurs primarily due to the ‘affinity’ between the biosorbent and adsorbate .[9]
Adsorptive pollutants like metals and dyes can be removed by living microorganisms, but can also be removed by dead biological material. Feasibility studies for large-scale applications have demonstrated that biosorptive processes using non-living biomass are in fact more applicable than the bioaccumulative processes that use living microorganisms, since the latter require a nutrient supply and complicated bioreactor systems . In addition, maintenance of a healthy microbial population is difficult due to toxicity of the pollutants being extracted, and other unsuitable environmental factors like temperature and pH of the solution being treated. Recovery of valuable metals is also limited in living cells since these may be bound intracellularly. For these reasons, attention has been focused on the use of non-living biomass as biosorbents .Dead biomass has advantages over living microorganisms. However, many attributes of living microorganisms remain unexploited in an industrial context and are all worthy of further attention since they may be of use for specific applications. This type of approach may lead to simultaneous removal of toxic metals, organic pollutants, and other inorganic impurities. To control the size of the current review, however, we have chosen to focus on single biosorption processes in this review and to avoid discussion of hybrid processes combined with biosorption. The first major challenge faced by biosorption researchers was to select the most promising types of biomass from an extremely large pool of readily available and inexpensive biomaterials. When choosing biomass, for large-scale industrial uses, the main factor to be taken into account is its availability and cheapness. Considering these factors, native biomass can come from (i) industrial wastes, which should be available free of charge; (ii) organisms easily obtainable in large amounts in nature; and (iii) organisms that can be grown quickly or specially cultivated or propagated for biosorption purposes . A broad range of biomass types have been tested for their biosorptive capacities under various conditions at this point in time, but there are no limits to exploration of new biomass types having low cost and high efficiency. In some cases, the uptake of heavy metals by biomass reached as high as 50% of its dry weight.[6]

The use of immobilized biomass, rather than native biomass, has been recommended for large-scale application of biosorption process. Immobilization techniques increase the overall cost of biosorbents, and decrease their biosorptive rates and capacities. Thus, more attention needs to be paid to this point. In addition, more work needs to be done to understand the effect of various immobilization techniques on the rate and equilibrium uptake of pollutant by immobilized biomass. Biosorption processes are still at the stage of laboratoryscale Study in spite of unquestionable progress. Thus, much work in this area is necessary to demonstrate its possibilitieson an industrial scale.[7]

Decolourization of textile dye effluent by different fungal strains:[11]

Fungal isolates	**Rate of decolourization (%)**
Rhizopus sp.	25
Penicillium sp.	30
Cladosporium sp.	35
Aspergillus sp.	**67**
Trichoderma sp.	39
Fusarium sp.	23
Flavodon sp.	15

II. MATERIALS AND METHODS

2.1Micro organisms and growth conditions:

Fungus Aspergillus flavus was isolate from soil. Aspergillus flavus was grown and maintaine on GPYA (Glucose Peptone Yeast Extract Agar) medium [composition (g/L): glucose- 40; peptone- 5; yeast extract- 5; agar- 30; pH-5.6] incubate at room temperature for 48hrs. To obtain fungal biomass, Aspergillus flavus was inoculate in same liquid medium and incubate at RT, 150rpm for 20 days. The biomass was autoclave at 1210 C, for 15min at 15lbs. Then it was filtere through Whattman filter paper No.1, dried at 550 C for one week and then crushed in mortar and pestle. This dri dead powdered biomass was use for biosorption study. SEM analysis of dried fungi was study.[9]

2.2 Fungus isolation and bio sorbent preparation

Fungus Aspergillus niger was isolated from soil. Aspergillus niger was grown and maintaine on GPYA (Glucose Peptone Yeast Extract Agar) medium [composition (g/L): glucose- 40; peptone- 5; yeast extract- 5; agar- 30; pH-5.6] incubate at room temperature for 48hrs. To obtain fungal biomass, Aspergillus flavus was inoculated in same liquid medium and incubate at RT, 150rpm for 20 days. The biomass was autoclave at 1210 C, for 15min at 15lbs. Then it was filtere through Whattman filter paper No.1, dry at 550 C for one week and then crushe in mortar and pestle. This drie dead powdere biomass was used for biosorption study. SEM analysis of dry fungi was study.[11]

2.3 Calculation of % Biosorption by dead biomass

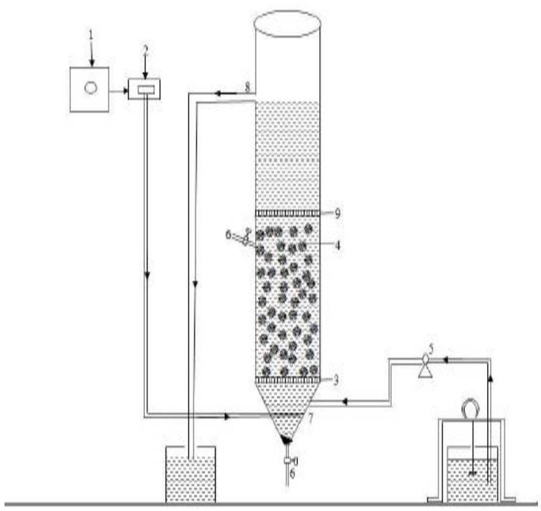
Biosorption efficiency of biosorbent was calculated by using following formula:
% Biosorption = Initial Absorbance – Final Absorbance X100/ Initial absorbance [11]

III. Experimental Set Up

The experimental setup consists of a fixed film aerobic Fluidized bed reactor having an effective volume of 0.02 m^3.[5]

S.No	Specifications	Details
1	volume of reactor	0.03m3
2	Effective volume of reactor	0.02m3
3	Diameter of reactor	0.15m
4	Height of reactor	1.17m
5	Height of packed bed before fluidization	0.25m
6	Flow Distributer	2nos
7	Pump used for the influent feed	peristaltic pump
8	Media Packed	fujino spirals
9	Specific area of Filling media	500m2/m3
10	Void ratio of the media	87%
11	Expansion of bed restricted by the top flow distributor	50%
12	Air blower	270 L/min
13	Air supply	0.025m/s
14	Sample Port	2No.

Table 1: Physical features and process parameters



1.Air blower 2.Flow meter 3.Bottom Flow Diatributer 4.Spirel media 5.Miclis pump 6.Sample port 7.Inlet 8.Out let 9.Top flow distribution [5]

Figure 1: Experiment setup

3.1 Microorganism and Culture medium

Fungus Aspergillus flavus was isolate from soil. Aspergillus flavus was grown and maintaine on GPYA (Glucose Peptone Yeast Extract Agar) medium [composition (g/L): glucose- 40; peptone- 5; yeast extract- 5; agar- 30; pH-5.6] incubate at room temperature for 48hrs. To obtain fungal biomass, Aspergillus flavus was inoculate in same liquid medium and incubate at RT, 150rpm for 20 days. The biomass was autoclave at 1210 C, for 15min at 15lbs. Then it was filtered through Whattman filter paper No.1, dried at 550 C for one week and then crushed in mortar and pestle. This dry dead powdered biomass was use for biosorption study. SEM analysis of dried fungi was study.

The reactor was fed with 5% inoculums of the above fungal species to the effective volume of the reactor.

3.2 Preparation of Synthetic wastewater

The synthetic wastewater was simulated towards the characteristics of a real textile dying effluent. Three different reactive dyes namely Drimarene Red X 6BN, Drimarene Blue X 3LR CDG and Drimarene Yellow X4RN were purchased from Colour Chemicals Pvt. Ltd. (Erode, India). Dyes were mixed in equal proportions with various chemicals like sodium chloride, sodium carbonate, soap oil, wetting agent, acids, alkalis and hydrogen peroxide.

3.3 Start up Process

Initially, 5% inoculums was fed into the reactor and operated continuously with the sufficient nutrient of COD: N: P as (100:5:1) ratio.
Waste water was fed into the reactor. Once the steady state condition was achieved within 5 days, the experiment was run for the evaluation. HRT and OLR were taken as the operational parameters for the varying COD concentrations.

3.4 Experimental Run

The experiment was run for different COD Concentrations of 750 mg/L to 2000 mg/L. The operational parameters HRT were varied as 10 hrs to 30 hr for each COD concentration subsequently. With respect to the COD concentrations .Samples were collected regularly according to the HRT varying period from inlet and outlet for the analysis. The evaluation is based on the % COD removal and % colour removal. The experiment was run under the room temperature of 30^{o}C.

3.5 Analytical Methods

Samples were collected from the inlet and outlet of the reactor at contect time 10 hr to 30 hr for different COD concentrations of 750 mg/L to 2000 mg/L for the analysis. COD was measured by the closed reflux method and colour was determined by measuring the absorbance using spectrophotometer by standard methods. The % Colour removal is obtained from the following equation,

% Colour Removal = A – B*100/A

Where, A = Inlet OD; B = Outlet OD

IV. CONCLUSION

The Aerobic Fluidized bed Reactor acclimatized with the specific colour removing fungal biomass consortium can be employed for treating the textile dyeing wastewater in achieving higher efficiency of colour removal and biodegradation. This Aerobic Fluidized bed Reactor acclimatized with the fungal biomass. The dead biomass of Asppergillius niger to remove the reactive dye from textile dye effluent. The results obtained from this work showed that the fungal biomass possessed high decolourization efficiency. The findings offer potential for the development of a cost effective and robust technology for biosorption of reactive dye effluents.

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