JOURNAL OF PURE AND APPLIED MICROBIOLOGY, April 2010. Vol. 4(1), p. 183-187

A Study on Mycoremediation as a Novel Treatment for Textile Mill Effluent

H. Mangalam[1]*, P.U. Mahalingam[2] and D. Raja[3]

[1]Department of Microbiology, Meenakshi Mission Hospital and Research Centre, Madurai - 625 107, India
[2]Department of Biology, Gandhigram Rural University, Gandhigram - 624 302, India.
[3]Sanat Products Limited, Kodairoad, India.

(Received: 02 October 2009; accepted: 03 November 2009)

The present study aims to isolate the five fungal strains (*Aspergillus niger*, *Penicillium* spp, *Rhizopus* spp, *Trichoderma* spp, *Pleurotus* spp) from the polluted soil of textile mill dyeing industry and these strains were used for decolourization of textile mill effluent. The various physico-chemical parameters of effluent such as temperature, pH, color, odour, clarity, electrical conductivity, hardness, alkalinity, chloride, sulphate, total solid, total dissolved solid and total suspended solid were analysed and the effluent was found to be highly polluted. Dye decolourization using the above fungal culture were studied under various conditions, Such as sterilized, unsterilized, effluent without any nutrients, effluent with 'N' source and effluent with minimal media (Free of Carbon source). Among the five isolates *Pleurotus spp* showed an effective decolourization than other four fungal cultures in all the conditions. Decolorization was effective in the condition of using minimal media.

Key words: Textile mill effluent, Dye decolourization, Fungal strains.

The textile industry is a major user of the water starting from washing raw wool or manmade fibre production upto garment manufacturing. Wastewaters from these industries are highly colored and can cause imbalance in the ecological system (Dutta, 1994). Strong color is one of the most notorious characteristic of textile mill effluent.

* To whom all correspondence should be addressed.
Mob.: +91-9245629639
E-mail: mangalhari86@yahoo.co.in, mangalhari86@gmail.com

The color if not properly dealt with, would have strongly negative impact on the aquatic environment caused by its turbidity and high polluting strength. The removal of color from wastewater was often more important than the removal of the soluble colorless organic substance, which usually contribute the major fraction of the biochemical oxygen demand (Chen *et al.,* 2003). Color was the first contaminant to be recognized in wastewater (Yuxing and Jain, 1999) and has to be removed before discharging into water bodies or on land.

Treatment of the effluent by microbial degradation is an innovative method. It converts or degrades the pollutants into water, carbondioxide and various salts of inorganic nature. The isolation of potent microbial species and degradation was one of the interests in biological aspect of effluents treatment (Banat *et*

al 1996). Fungi thrive well in inhospitable habitats with environmental extremes because of their enzyme system. Fungi were involved in the bio degradation of undesirable materials or compounds and convert them into harmless, tolerable or useful products. This study was conducted to use the fungal strains for the decolorization of textile mill effluent.

MATERIAL AND METHODS

Collection of sample

The effluent was collected from the outlet of textile mill dyeing industry at Chinnalapatti, Dindigul District, TamilNadu. Macroscopic features of the sample was observed and recorded. Color and consistency of the sample were noted. Sample was collected in a container and taken to laboratory.

Analysis of physico-chemcial parameters in Textile Mill effluent

The physico chemical characteristics of the textile effluent such as temperature, pH, color, odour, clarity, electrical conductivity, hardness, alkalinity, chloride, sulphate, total solids, total dissolved solids, and total suspended solids were examined by the following standard methods (Apha, 1998).

Isolation and Identification of fungus from textile mill effluent

The polluted soil from the textile mill dyeing industry was used for the isolation of fungus. The fungal colonies were isolated using Mortin's Rose Bengal agar, enumerated and results were expressed as CFU. The fungal isolates were identified using colony characteristics on agar medium and lactophenol cotton blue staining features. Pure culture was maintained under refrigerator condition for further use.

A study of decolorization of textile mill effluents using fungal isolates

The fungal inoculant was prepared using Sabouraud dextrose broth. The uniform (homogenized) broth cultures of 48-72hrs were being used for dye decolorization activity.

Bottles were dried in the hot air oven and taken out, 100ml of the sample (effluent) was taken in each bottle. The decolourization activity was done in following six treatments with the five fungal isolates such as *Aspergillus niger, Penicillium* spp*, Rhizopus* spp*, Trichoderma* spp and *Pleurotus* spp.

The treatments were as follows

Unsterilized effluents

The raw effluent used as such for the test.

Sterilized effluent

Sterilized the effluent at 15lbs (121°C) for 15 minutes.

Unsterilized effluent with 'N' source

Mix ammonium nitrate (100mg) to unsterilized effluent as 'N' source.

Sterilized effluent with 'N' source

Mix ammonium nitrate (100mg) to sterilized effluent as 'N' source.

Unsterilized effluent with minimal media(all nutrients)

Prepared minimal media with unsterilized effluent (free of carbon source).

Sterilized effluent with minimal media(all nutrients)

Prepared minimal media with sterilized effluent (free of carbon source).

All the bottles were inoculated with respective fungal cultures and were incubated at room temperature to observe decolourization of dyes in effluent sample. The color changes were observed on the interval of 4^{th}, 8^{th}, 12^{th}, 16^{th}, and 20^{th} days. Decolourized effluent was centrifuged at 5000rpm for 15minutes to get cell free filtrates. The clear filtrates were analyzed in spectrophotometric method at the wavelength of 450nm. The measured optical density (OD) value denotes the absorption due to dye decolorization. Decolourization activity has been calculated by the following formula and the result was expressed in terms of percentage.

$$\text{Decolourization} = \frac{\text{Initial absorbance-final absorbance}}{\text{Initial absorbance}} \times 100$$

RESULTS AND DISCUSSION

Physico-chemical parameters

The physico-chemical parameters. Were analyzed and the results were given in the table 1 The pH and temperature range of effluent tested in this study was found to be 6.32 and 27°C respectively (Table 1). Federal Environmental Protection Agency was reported that the pH, range for wastewater is 6.0 to 9.0.

Chloride occurs naturally in all types of waters. Industries were also important sources of chlorides. It was harmless upto 1500mg/l concentration but produces a salty taste at 250-500mg/l level reported by Trivedi and Goel, (1986). In this study, the chloride concentration was 1917 mg/l which indicates the effluent may harmful to the environment (Table 1).

Table 1. Physico chemical parameters of textile mill effluent

S.No.	Parameters	Result
1.	pH	6.32
2.	Temperature	27°C
3.	Color	Brown
4.	Odour	Unpleasant
5.	Clarity	Turbid
6.	Electrical Conductivity	0.09×10^{2} (mho cm^{-1})
7.	Hardness (mg/l)	3000
8.	Alkalinity (mg/l)	200
9.	Chloride (mg/l)	1917
10.	Sulphate (mg/l)	70
11.	Total Solid (mg/l)	5200
12.	Total Dissolved Solid (mg/l)	5000
13.	Total Suspended Solid (mg/l)	200

Sulphate was naturally occurring anion in all kinds of natural waters. It was an important constituent of hardness with calcium and Magnesium. Trivedi and Goel (1986) reported that sulphate produces an objectionable taste at 300-400mg/l concentrations. Above 500mg/l a bitter taste was produced in the water. In this study, the sulphate concentration was found to be 70mg/l (Table 1).

As effluent sample used in this study contains all types of chemical pollutants in higher amount, it is needed to treat in proper way before disposal.

Microbiological analysis of textile mill effluent

The total fungal count on Rose Bengal agar was counted as 6.36×10^{3} CFU/gm .The predominant five fungal strains were selected on the basis of their abundance growth with distinct morphology (Table 2).

By microscopic observation and colony morphology, the isolated fungal cultures were identified as *Aspergillus niger, Penicillium* spp, *Rhizopus* spp, *Trichoderma* spp, and *Pleurotus* spp.

Mohamad *et al.,* (2006) isolated *Aspergillus fumigatus* has been found to be effective for decolourization of anaerobically treated distillery wastewater.

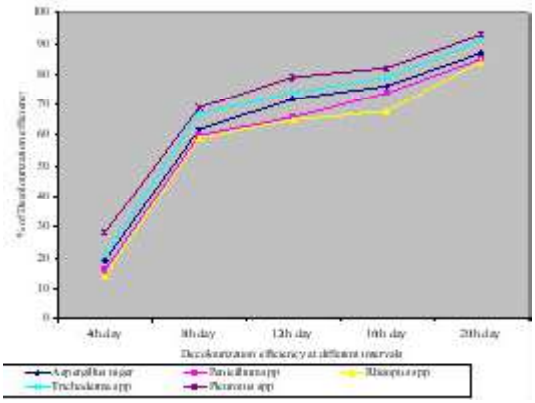
The results of the above conditions were revealed that sterilized effluent showed the maximium decolourization with higher percentage when compared to the unsterilized effluent. It was also noted that the effluent treatment of both sterilized/unsterilized with minimal media showed higher rate of decolourization. This fact coincides with studies of Stolz (2001) where he observed the nutrient content increases the adsorption capacity of dyes.

Table 2. Morphological characteristics of fungal isolates on Rose Bengal agar

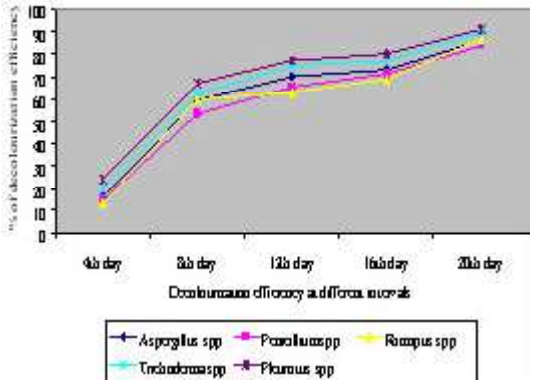
Isolates	Colony morphology
FI -1	Large echinulate jet black conidia in chains
FIS-2	Chains of conidia from phialides and arranged in brush-like appearance
FIS-3	Sporangiospores arised from spherical shaped. sporangia and rhizoids raised from the nodes
FIS-4	Chains of conidia from phialides and arranged in branches
FIS-5	Mycelial growth was observed

Note: FIS – Fungal Isolate.

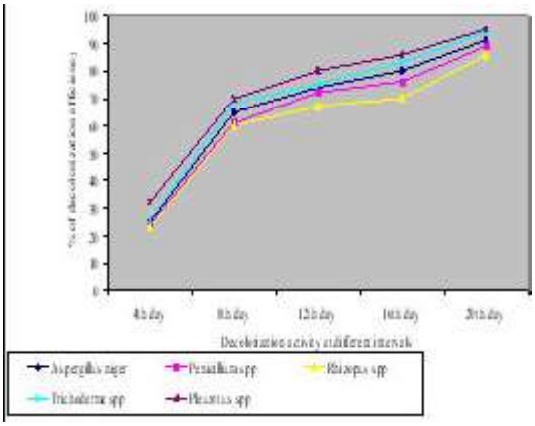
The *Pleurotus spp* showed the best result than other isolates. Decolourization of textile dye effluent by white rot fungi is well known to occur through dye adsorption biodegradation through an enzyme system, such as laccase, manganese peroxidase and lignin peroxidase (Robinson *et al*., 2001).



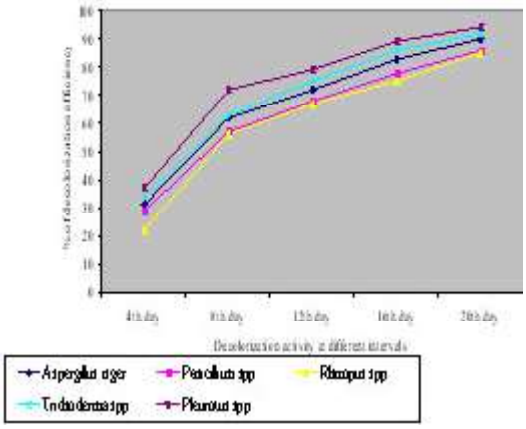
Fungal decolorization activity without any nutrients under sterilized conditions



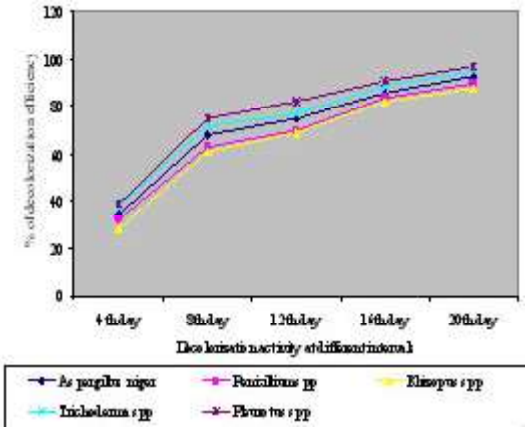
Fungal decolorization activity without any nutrients under unsterilized conditions



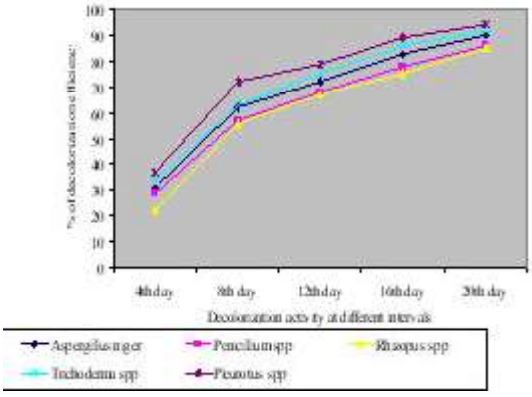
Fungal decolorization activity with N source under sterilized conditions



Fungal decolorization activity with N source under unsterilized conditions



Fungal decolorization activity with all nutrients under sterilized conditions



Fungal decolorization activity with all nutrients under unsterilized conditions

Fig. Fungal decolorization of textile mill effluent

REFERENCES

1. Dutta, P.K. An overview of textile pollution and it's remedy. *Indian Journal of Env. Protection*, 1994; **14**(6): 443-446.
2. Chen, K.C., Wu, J.Y., Liu, D.J., Hwang, S.C.J. Decolorization of the textile dyes by newly isolated bacterial strains. *J of Biotechnology*, 2003; **12**: 56-70.
3. Yuxing, W., Jian, Y. Decolorization of synthetic dyes and wastewater from textile. *Wat. Res*., 1999; **83**(16) K: 3512–3520.
4. Banat, I.M., Nigam, P.L., Singh, D., Marchant, R. Microbial decolorization of textile dyes containing effluents: *A review. Biores. Technol*., 1996; **58**: 217-227.
5. APHA. Standard methods of examination of water and waste water, 17th edn. American Public Health Association, Washington D.C. 1998; 11-13.
6. Trivedi R.K., Goel.P.K. Chemical and biological methods for water pollution studies. Environmental Publication, Karad (Inc), India. 1986.
7. Mohammad, P., Azarmiclokht, H., Fatollah, M., Mahboubed, B. Application of response surface methodology for optimization of important parameters in decolorizing treated distillery wastewater using *Aspergillus fumigatus* UB 60. International biodeterioration and biodegradation, 2006; **57**(4): 195-9.
8. Stolz, A. Basic and applied aspects in the microbial degradatiuon of azo dyes. *Appl. Microbiol. Biotechnol.,* 2001; **56**: 69-80.
9. Robinson, T., Mc Mullan, G., Marchant, R., Nigam, P. Remediation of dyes in textile effluent: Acritical review on current treatment technologies with a proposed alternative. *Biores. Technol.*, 2001; **77**: 247-255.