JOURNAL OF PURE AND APPLIED MICROBIOLOGY, October 2008. Vol. **2**(2), p. 497-500

Bioculture and Characteristic of Dye Decolorizing Bacteria Isolated from Textile Industry for Treatment of Wastewater

A.C. Sonawane and S.R. Thorat

School of Environmental and Earth Science,
North Maharashtra University, Jalgaon - 425 001, India.

(Received: 18 May 2008; accepted: 23 July 2008)

Biological treatment methods are comparatively cheap and considered to be the best alternative with proper analysis and environmental control. Treatment of dye house effluent is a difficult task because of its synthetic origin and complex molecular structure of the dyes present in it. Microbial treatment of dye house effluent is a good alternative compare to physical and chemical methods. In this context, an attempt was made to evaluate efficiency with mixed microbial culture for the decolourisation of dye wastewater in continuous mode of operation. The experiment were conducted for different organic loading rate parameters for the effluent were evaluated the removal efficiency of anaerobic process, activated sludge process for the parameters studied.

In this present investigation, the aim was to identify decolorizing potential of the bacteria isolated from dyeing unit sludge. The biochemical characteristics of the bacteria are also studied. Samples were collected for the study was a combined effluent from equalization tank in Common Effluent Treatment Plant (CETP). Jalgaon, Maharashtra.

Key words: Decolourization, bioculture, biochemical characteristic, textile industry & organic load.

Textile industries consumes a large amount of water, consequently generate and equally large quantity of effluent. Untreated effluent from dyestuff production and dyeing meals are highly colored and hence are objectionable for discharge into open water.

Colour removal from effluent of textile industries is one of the major environmental problems. When this colored effluent enters into natural streams or other surface water system, they may interfere with penetration, radiation and also can cause major health problem, like allergic, dermatitis, skin irritation, cancer and mutation to humans (Rajamohan *et. al.* 2004, Masselli and Burtord, 1956). Several dyes and heavy metals have been considered to be possible source of genotoxic activity in dyeing and textile effluent. Several dyes has been investigated and found to be carcinogenic (Khan, 1995, Suzuki *et. al*. 2001 & Shelby, 1991).

The dyestuff, textile, leather and paper industries along with dye producers produce effluents that are highly resistant to the biological treatment. It was investigated that between 10 and 15% of the total dye consumption in dyeing operation may be released in wastewaters (Jarosz-Wilkolazka *et.al.,* 2002). Bioremediation, the exploitation of microbial derivative processes, has become one method of dealing with colored textile dye wastewater. In this respect, the search for new, highly efficient microorganisms is focused on isolating and identifying bacterial strains from dye industrial sludge.

* To whom all correspondence should be addressed.
E-mail: acsonawane_22@rediffmail.com

Microbial bioremediation and decolourisation of dyes seen to be a cost effective method for removing the pollutants from the environment. On microbial decolourisation of textiles dyes, Groff and Kim tested a variety of bacterial cultures with a potential to carry out decolourisation and these cultures included *Rhodocules* sp., *Bacillus cereus*, *plesiomanas* sp. and *Achromobacter* sp. Also the mineralisation of sulphonated azodye mordant yellow by a bacterial consortium was reported by Meenambal *et.al*., 2006. A Change from anaerobic to aerobic condition was required to achieve complete degradation. Recently, Hu_5 isolated a bacterium *Pseudomonas luteola* from dyeing wastewater sludge, which removed the colour of reactive azodyes such as Red G (37.4 percent), RBB (93.2 percent), RB2B (92.4 percent) and V2RP (88 percent) under shaking condition for the first 48 hours followed by 2 days of static condition. *Klebseilla pneumonia* RS_{13} and Aceactar *liquefaciens* S_1 capable of decolorizing methyl red (MR) have been reported as suitable agents for future application in the treatment of azodyes. In azodye degradation, the main azobond cleavage needs the reductase enzymes, which are mainly functional under anaerobic condition. Among the fungal system white root fungi have revealed higher decolorizing ability as they have a secondary metabolic activity linked with lignin. This study was thus planned to investigate the biochemical characterization of dyes decolorizing bacteria and potential of dyes removed by bioculture in continous mode.

MATERIAL AND METHODS

Analysis of textile dyes sample were taken for the study was the combined effluent collection form equalization tank. APHA 1989, Buchanan and Gibbans, 1974, assessed the physico-chemical characterization. The composit sample of the wastewater collected from equalization tank of the common effluent treatment plant was analyzed to determine the general characteristics of textile dyes wastewater the result obtain from the data (Table 1).

Acclimatizing

The mixed microbial cultures

Initially 50g of bio-clean were activated by the addition of 2.5 liters of water and dye wastewater respectively. The content was aerated continuously for 5 days. The dosage was fixed by trial and error method. After 5 days, the aeration was stopped. Thus, the activated bio-clean was mixed with the dye effluent in the closed container and acclimatized the ratio of bio-clean and dye wastewater, which was fixed upto 1:1.

RESULTS AND DISCUSSION

The results of the study on decolourization of the textile dye wastewater for colour removal at different organic loading rates are given in Table 1. The dye house effluent used in this study was collected from a dyeing unit in Jalgaon region of Maharashtra, India.

The sludge collected from the dyeing unit was diluted using serial dilution technique. 2ml of this sludge was transferred to agar plates containing the growth medium with the following composition peptone 1.5g, yeast extract 0.75g, sodium chloride 0.75g, agar 20g and methyl red 0.005g, distilled water1 liter and pH 7.0 $\pm$ 0.1. Methyl red was used as an indicator for bacterial growth and decolourisation. The colonies, which decolorized the colour to the maximum level, were isolated. The isolated strains were further enriched

Table 1. Showing textile industrial dye wastewater characteristics

Sample	Colour wavelength	Colour abs	pH	BOD mg/l	COD mg/l	SS mg/l	TDS mg/l	Chlorides	Sulphates
1	505	0.5119	8.9	210	756	436	5732	2324	828
2	525	0.5290	9.2	204	734	482	5350	2108	882
3	545	0.5865	8.7	218	748	465	5408	2278	864
4	510	0.5811	8.6	224	738	426	5487	2054	836
5	525	0.5902	9.1	216	745	430	5625	2165	845

using the same medium. After enrichment, the biochemical characteristics of the four isolated strains were studied (Buchanan & Gibbons 1974) and tabulated in Table 2.

The performance of the treatment for various organic loading rates of 0.478, 0.650, 0.708, and 0.812 kg COD/cu.m/day were studied for 2.5, 1.33, 1.0, 0.8, and 0.65 day detention time are coated in Table 3.

These observations are in accordance with several studies that reported bioculture in continuous mode in a number of dyes (Garner and Nutman 1977; Venturini and Tamaro, 1979), related studies were observed by Wani and Thorat, 2007 in pulp and paper industries, Wani *et.al.* 2007. The presence of impurities in commercially available dyes has been reported to contribute in bioculture of these dyes (Prival *et.al.* 1984).

The significance of this study was the colour removal 86.05% of textile dye by the combined treatment process, activated sludge process as shown in Flow diagram No.1 with sand filter and mixed microbial culture the maximum efficiency of all the parameter occurs at the lower organic loading rate of 0.378 kg COD/cu.m/day which shown a still higher removal efficiency may be obtain by minimizing organic loading rate. The maximum removal efficiency of all parameters shows that high degree of treatment achieved, the detention time of process should be increased.

Bio-clean

Bio-clean contains mixed microbial cultures. The cultures grow in either the presence or absence of oxygen. Bio-clean even can perform efficiency in effluents having high total dissolved solids. The bio-clean consists of 76 different strains of bacteria and yeast. Among these different strains, the following microorganisms

Table 2. Biochemical characteristics of the isolated bacteria from effluent of textile industry

S.No	Characters studied	Isolated I	Isolated 2	Isolated 3	Isolated 4
1	Shape	Short rods	Mixed, seems	Gram variable rods	Cocci, seems mixed
2	Gram stain	- ive	+ive gram variable	Gram variable	-ive
3	Starch hydrolysis	-ive	+ive	-ive	-ive
4	Catalase	+ive	+ive	+ive	+ive
5	Acid hydrolysis				
	a) Sucrose	+ive	+ive	+ive	+ive
	b)Glucose	+ive	+ive	+ive	+ive
	c) Lactose	+ive	+ive	+ive	+ive
6	Gas production	+ive	+ive	-ive	-ive
7	Methyl red	+ive	+ive	+ive	+ive
8	H2S production	-ive	-ive	+ive	-ive
9	Citrate utilization	-ive	+ive	-ive	-ive
10	Triple Sugar Iron test	Acid butt Acid slope	Acid butt Acid slope	Acid butt Acid slope	Acid butt Acid slope

Table 3. Colour removal for different organic loading rate (OLR) from textile industries

S. No.	Organic loading rate KgCo D/m3/day	Influent Max. wave length	Influent Abs	Anaerobic treatment Abs	Anaerobic treatment percentage reduction	Aerobic treatment Abs	Aerobic treatment % reduction	Sand filter abs	Sand filter % reduc-tion	Overall % reduc-tion
1	0. 478	505	0.5119	0.2183	57.36	0.1161	46.82	0.0694	40.22	86.45
2	0.650	525	0.5290	0.2345	55.68	0.1323	43.59	0.0811	38.96	84.67
3	0.708	545	0.5865	0.2745	53.06	0.1646	40.24	0.1066	34.15	81.84
4	0.812	510	0.5811	0.2938	49.45	0.1902	35.27	0.1278	32.80	78.02

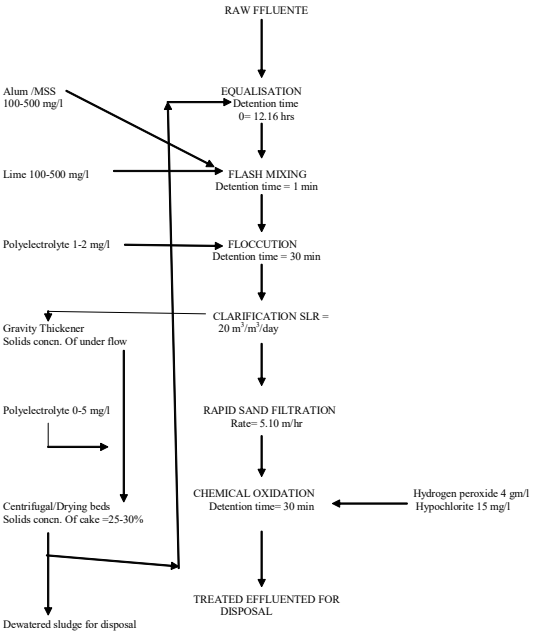

Fig. 1. Flow diagram

are predominant. *Bacillus* sp. *Cellulomonas, Aerobacter, Nitrobacter, Nitrosomonas, Saccharomyces* sp.

Activation of bio-clean

The bio-clean or the immobilized microbes are activated by the addition of water and oxygen. Under the favorable environment the microbial action is triggered and it begins to grow and multiply. After adding the water to the bio-clean in the container, the container was aerated by the application of compressed air through air diffuser stones for 5 days continuously, which is called as activated bio-clean.

The result of the present study could serve as an important base for developing economy as well as biological system using microorganism for providing recycled clean water for industrial and agricultural process.

REFERENCES

1. APHA, Standard methods for the Examination of water and wastewater, 17th Ed., *American Public Health Association*, Washington D.C 1989.
2. Buchanan, R. E. and Gibbons, N. E., Bergy's Mannual of determinative bacteriology, 8th Ed., *The Williams Wilkins Company*, Baltimore 1974.
3. Garner R. C. and C. A. Nutman., Testing of some Azo dyes and their reduction production for mutagenicity using Salmonella typhimurium TA 1538. *Mut. Res*., 1977; **44**: 9-19.
4. Khan, T. I., N. Kaur and P. C. Vyas., Effects of industrial effluents on physicochemical characteristics of Amani Shah Nallah- A case stud. *J. Env. Poll*., 1995; **2**(3): 147-150.
5. Jarosz-wilkolazka, Anna Janaina Kochmanska-Rdest, Etzbeita-Malarczyk, Wlasyslaw Wardas and Andrzej-leonowicz., Fungi and their ability to decolorize azo and anthraquinone dyes. *Enzymes and Microbial Technology*, 2002; **30**: 566-572.
6. Masselli J. W and M. G. Burford., Pollution reduction program for textile industry, *Sewage and Waste*, 1956; **28**: 1273.
7. Prival, M. J., S.J. Bell, V.D. Mitchell and V.L. Vaughan., Mutagenicity assessment of benzidine and benzidine congener dyes and selected monoazodyes in a modified Salmonella assay. *Mut. Res*., 1984; **136**: 33-47.
8. Shelby , M. D. and E. Zeiger., Activity of human carcinogens in the Salmonella and rodent bonemarrow cytogenetics tests. *Mut. Res*., 1990; **234**: 257-261.
9. Suzuki, T., S. Tinolei, L. Kurunczi, U. Dietze and G. Schuuirmann ., Correlation of aerobic biodegradability of sulfonated Azo dyes with the chemical structure. *Chemosphere*, 2001; **45**: 1-9.
10. T. Neenambal, Divya Devi, C and Nunirunissa Begum. H., Colour Removal from textile wastewater using Bioculture in continous Mode. *J. of Envi. sci. & Engg.* 2006; **48**(4): 247-252.
11. Venturnini, S and M. Tamaro., Mutagencity of anthraquinone and azo dyes in Ames Salmonella typhimurium test. *Mut. Res.,* 1972; **68**: 307-312.
12. Wani P.P.,and S.R.Thorat., Corelation study on physicochemical characteristics of untreated and treated effluents of pulp and paper industry. *J. Current World Environment* 2007; **2**(1): 21-26.
13. Wani P.P., Sonawane A.C. and S.R.Thorat., Reduction of chromium by microbial method: transmission electron microscopic study using electron energy loss spectroscopy in-situ environmental cells. *J. Pure and Applied Microbiology*, 2007; **1**(2): 331-334.