IISRC International Conference on Industrial Scientific Research Engineering
International Industrial Scientific Research Corporation
www.worldconferences.org

Biodegradation of Industrial Effluent

C. M. NOORJAHAN
Assistant Professor, PG & Research, Dept of Zoology, Justice Basheer Ahmed Sayeed College for Women (Autonomous), Chennai, Tamilnadu, India, E-mail: cmnoorjahan@gmail.com.

Abstract: An investigation was carried out to study the physicochemical parameters of industrial effluent and the degradation of the effluent using fungus, Asperigillus niger. The results of the study revealed that the parameter like EC, BOD, COD, TSS, TDS etc. were higher than the permissible limit for its disposal. Asperigillus niger degraded the effluent reducing the toxic substances present in the effluent indicating the efficiency of the fungus to degrade the effluent.

Keywords: Industrial Effluent, Physico Chemical Parameters, Biodegradation, Asperigillus Niger.

I. INTRODUCTION

Several kinds of natural and manmade activities (domestic, industrial, agricultural etc.) contribute to water pollution. The rivers, lakes and reservoirs are highly susceptible for pollutants due to natural and manmade activities. The routes for the entry of pollutants include sewage out falls, industrial out falls nuclear stations out falls etc. Industrial effluent wastes are ranked as high pollutants (Eye and Lawrence, 1971). Untreated effluent is acidic with an unpleasant odour and colour, has high BOD, COD, organic and inorganic matter (Kulkarni, 1992). Industrial effluent induces health hazards to human and other aquatic organisms. It also make the soil infertile, the ground and surface water turns to be unfit for irrigation and drinking.. (Aruna U. Kakde, 2012). Heavy metals in the effluent is one of the most hazardous environmental pollutants. Disposal of such waste with high pollution load into water courses or onto land, with or without prior treatment creates a great problem in the environment in the vicinity. So, it has become essential to treat the waste prior to its disposal. A wide of technologies had been developed for treatment of industial effluent which includes: Physical Treatment Method, Chemical Treatment Method and Biological Treatment Method. Biological treatment method ie.

Microbiological treatment of waste water is more efficient, environment friendly, cost effective and consumes no energy compared to physical and chemical methods of waste treatment (Sekar, 2011). Scientists are presently concentrating on the isolation of an organism and its degrading capacity of certain organic and inorganic compounds and also metals used in various industrial processes (Krishna Priya, 2010). Many research works on the degradation of contaminants using fungi has been carried out by various researchers. Taking a lead from all the above said investigations carried out by many researchers pertaining to degradation of wastewater using microbes especially fungus, an attempt has been made to degrade the industrial effluent using fungus, Aspergillus niger.

II. MATERIALS AND METHODS

Industrial effluent was selected as the material in this study. The sample was collected from an industry situated in Chennai, Tamil Nadu, India, in polythene containers (5 litres capacity). They were brought to the laboratory with due care and stored at 25°C for further analysis. The physico-chemical parameters such as Colour, Odour, pH, Electrical Conductivity (EC), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Heavy Metals-Chromium of industrial effluent were determined by following the Standard Methods outlined by APHA (1995). Aspergillus niger is a fungus was used for the degradation of the effluent. It was procured from a microbiological laboratory located in Chennai, India. I t was sub cultured on Potato Dextrose Agar (PDA) medium for 3 days separately. Then the culture was maintained in Malt Extract broth for a week at 30oC for substantial growth. Mycelial mats of fungus, Aspergillus niger. grown separately in liquid culture was recovered, washed with sterile distilled water and approximately 10 gms (fresh weight) mycelia of fungus was transferred to 100% effluent in a conical flask separately.

Conical flask with effluent and fungus Aspergillus niger (experimental) was incubated separately at 30 0.5oC for 96 hours on rotary shaker at 2000 rpm. After incubation the samples were centrifuged at 5000 rpm for 20 minutes. Control (conical flask with industrial effluent without fungus) was also run simultaneously. The procedure for degradation process was carried out by following the procedure of (Brightlin, 2012). The supernatant were analysed for physico chemical parameters like pH. EC, Total Suspended Solids, Total Dissolved Solids, Biological Oxygen Demand and Chemical Oxygen Demand and heavy metals - chromium. Physico chemical parameters of the effluent were analysed before bio treatment (control) and after bio treatment by following the Standard procedure of APHA (1995). Statstical analysis was also carried out for the above experiment.

III. RESULTS AND DISCUSSIONS

Copyright @ 2016 International Industrial Scientific Engineering Corporation (IISRC). All rights reserved.

The results of the analysis of physico-chemical parameters of industrial effluent collected are depicted in table 1. Colour of the effluent is brownish in colour. Odour of effluent is offensive. The pH of industrial effluent is 7.5. The conductivity of the effluent is 5,140 µmhos/cm, the value of EC are higher than the permissible limits (400 µmhos/cm) of CPCB (1995). TSS level of 172 mg/l which is higher than the permissible limits (100 mg/l) perscribed by CPCB (1995). TDS of Industrial effluent is 9,200 mg/l, the value of TDS was found to be higher than the permissible limits (2,100 mg/l) of CPCB (1995). BOD levels of effluent has a value of 900 mg/l which is higher than the permissible limits (30 mg/l) of CPCB (1995).COD level of the effluent is 3300 mg/l, the value is higher than the permissible limits (250 mg/l) of CPCB (1995).Chromium levels of the effluent is 0.019 mg/l. The results of the biodegradation of the effluent revealed that industrial sample is brownish in colour before degradation but after degradation for 96 hrs. using fungus, Aspergillus niger. there is a change in colour from brownish to almost colourless nature of the sample. The odour of the effluent is offensive in nature before degradation but after degrading the effluent for 96 hours using fungus, the sample shows odourless condition.

This may be due to the action of microbes - Aspergillus niger, which decomposed the toxic pollutants present in the effluent and changed the colour and odour of the effluent. This is supported by the work of Brightlin (2012). pH of the effluent before degradation is alkaline in nature but after degrading the sample using fungus, Aspergillus niger for 96 hrs. alkaline nature of pH has changed to the neutral state indicating the efficiency of the microbes to biodegrade the effluent. This is in agreement with the reports of Ramamurthy et al. (2011). EC of 100% industrial effluent before degradation is 10,372 mg/l ± 15.8 which is beyond the permissible level (400 mg/l) of CPCB (1995) for disposal, but after degradation, fungus Aspergillus niger degraded EC to 2829 ± 0.5 and the percentage change is 72.11%. TSS of 100% industrial effluent before degradation is 56 mg/l ± 3.31 which is beyond the permissible level (100 mg/l) of CPCB (1995) for disposal, but after degradation, fungus, Aspergillus niger degraded TSS to 20 mg/l ± 0.5 and the percentage change is 64.28%. TDS of 100% effluent before degradation is 7,273 mg/l ± 22.5 which is beyond the permissible level (2,100 mg/l) of CPCB (1995) for disposal, but after degradation, fungus , Aspergillus niger degraded TDS to 2024 mg/l ± 2 and the percentage change is 72.11% Since TSS and TDS are the major pollutants, the above degradation results are encouraging and scale up studies for continuous treatment of waste water at pilot scale is required.

The information generated would help to scale up the process and assess the economic feasibility of the technology. The results of the study are in accordance with reports of Sekar (2011). BOD of 100% industrial effluent before degradation is 750 mg/l ± 2.59 which is beyond the permissible level (30 mg/l) of CPCB (1995) for disposal, but after degradation, fungus Aspergillus niger degraded BOD to 130 mg/l ± 2 and the percentage change is (82.66%) there by indicating the degrading efficiency of fungus, Aspergillus niger . This is supported by the work of Kulkarni, 1992). COD of 100% effluent before degradation is 2,223 mg/l ± 15.8 which is beyond the permissible level (250 mg/l) of CPCB (1995) for disposal, but after degradation, fungus, Aspergillus niger degraded COD to 423 mg/l ± 2.5 and the percentage change is (80.92%) This is supported by the work of Nagarajan and Sasikumar (2002). Chromium of 100% industrial effluent before degradation is 0.019 ± 2 which is beyond the permissible level (0.05 mg/l) of CPCB (1995) for disposal, but after degradation, fungus Aspergillus niger degraded Chromium to 0.007 ± 0.000015 and the percentage change is 63.15%. Alkaline pH, high TSS, TDS, BOD and COD of the industrial effluent reveals that the effluent is highly polluted and it has to be treated before disposal. Hence it's imperative to adopt technologies to reduce or degrade the effluent using microbes. Thus from the foregoing discussion it is very clear that microbes play a important role in the biodegradation of organic and inorganic matter.

TABLE I: Physico - Chemical Parameters of 100% Industrial Effluent

S. No.	Parameters	CPCB (1995)	Industrial Effluent
1.	Colour	Colourless	Brownish
2.	Odour	Odourless	Offensive
3.	pH	5.5 - 9.0	7.5
4.	Electrical Conductivity (µmhos/cm)	400	5,140
5.	Total Suspended Solids (mg/l)	100	172
6.	Total Dissolved Solids (mg/l)	2100	9200
7.	Biochemical Oxygen Demand (mg/l)	30	900
8.	Chemical Oxygen Demand (mg/l)	250	3300
9.	Chromium (mg/l)	0.05	0.019

TABLE II: Analysis of Physico Chemical Parameters of 100% Industrial Effluent Before (Control) and After Degradation using Fungus, Aspergillus Niger

S. No.	Parameters	CPCB 1995	Control (Industrial effluent)	Biotreated (fungus, Aspergillus niger)
1.	Colour	Colourless	Brownish	Colourless
2.	Odour	Odourless	Offensive	Odourless
3.	pH	5.5 - 9.0	8.96 ± 3	7.54 ± 0.2
				(15.84%)
4.	Electrical Conductivity (µmhos/cm)	400	10,372 ± 1.58	2,829 ± 0.5
				(72.11%)
5.	Total Suspended Solids (mg/l)	100	56 ± 3.31	20 ± 0.5
				(64.28%)
6.	Total Dissolved Solids (mg/l)	2100	7,273 ± 22.5	2,024 ± 2
				(72.17%)
7.	Biochemical Oxygen Demand (mg/l)	30	750 ± 2.54	130 ± 2
				(82.66%)
8.	Chemical Oxygen Demand (mg/l)	250	2,223 ± 1.58	424 ± 2.5
				(80.92%)
9.	Chromium (mg/l)	0.05	0.019 ± 2	0.007 ± 0.0015
				(63.15%)

During biodegradation the key element is the micro-organisms. They have enzyme that allow them to use environmental contaminants as food and hence make them ideal for biodegradation. Besides their characteristics like rapid growth, metabolism and a remarkable ability to adjust to a variety of environments make them very useful in biodegradation. How successful are the microorganism in

degrading the environmental contaminants depends on the type of microbes, contaminants and on the nature of contaminated site. From the present study Aspergillus sp, showed efficient degrading capabilities by degrading the contaminants as they use it for their growth and reproduction. Organic compounds are a source of carbon which forms one of the basic building blocks of new cell contaminants. In addition to the carbon sources, they require nitrogen and phosphorus as primary nutrient and traces of in organic salts through a series of complex enzymatically catalysed reaction, the toxic organic contaminant is converted to innocuous chemical compound, obtain energy by catalysing energy producing chemical reactions and this energy in used in the production of new cells finally resulting in carbon - dioxide and water. The results of this study have shown that the biological treatment almost satisfied the irrigation water guidelines. Thus degradation by microbes seems to be most promising technique for 100% industrial effluent as evidenced in the present investigation. Thus it may be concluded from the above study that industrial effluent with high pollutants can be reduced by using fungus, Aspergillus niger and this treated water can be reused for agricultural purpose as evidenced in the present work.

IV. REFERENCES

[1]. APHA. 1995. Standard methods for the examination of water and waste water. American public Health Association, Washington, D.C. 17th ed.

[2]. Aruna U. Kakade. 2012. Biodegradation of tannery effluent by using tannery effluent isolate, International Multiple disciplinary Reasearch Journal, 2(3) : 2231 – 6302.

[3]. Brightlin. 2012. Biodegradation of tannery effluent using native fungi. B.Sc. Dissertation , University of Madras.

[4]. CPCB. 1995. Pollution control, acts, rules and modifications issued their under Central Pollution Control Board, New Delhi.

[5]. Eye, J.D. and Lawrence, L. 1971. Treatment of waste from sole leather tannery. J. Wat. Pollut. Cont. Fed, 43:2291-2303.

[6]. Krishna Priya. 2010. Degradation of industrial effluent using fungi. B.Sc. Dissertation, University of Madras.

[7]. Kulkarni, T.T. 1992. Source and characteristics of dairy wastes from a medium size effluent on microorganisms plant growth and their microbial change. Life science of Advance, 3: 26 - 28.

[8]. Nagarajan, K., and Sasikumar, R. 2002. Effect of Sago effluent on selected physiological aspects of the fresh water fish, Labeo rohita., J. Ecotoxicol., Environ. Monit., 12(3) : 233 - 238.

[9]. Ramamurthy, N., Balasarawathy, S., Sivasathivelan, P., 2011, Bio degradation and physico chemical changes of textile effluent by various fungal species, Journal of Biophysics, 112-123.

[10]. Sekar. P. 2011. Efficacy of microbes in Bioremediation of tannery effluent, International Journal Of Current Research, 3(4) : 324 - 326.