Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2012, 4(2):1061-1065

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Control of pharmaceutical effluent parameters through bioremediation

Merina Paul Das[1]*, Maharshi Bashwant[1], Kranthi Kumar[1], Jayabrata Das[2]

[1]Department of Industrial Biotechnology, Bharath University, Chennai
[2]Department of Biotechnology, SRM University, Chennai

ABSTRACT

Pharmaceutical industries are widely been used for the production of wide range of antibiotics, solvents and many by-products which are widely useful for both man-kind and in agriculture purpose. The waste materials may be in the form of solids, liquids and gases and are been released in streams, soils and many are been vaporised into air from centuries, which are causing many hazardous to the human life and effecting the environment. Pharmaceutical industries are employing various methods for the treatment of waste which includes physical, chemical and mechanical methods but failed to reduce the toxicity and there is limited reduction in COD levels. So for the reuse of the waste water an advanced technology has been developed and research is going on still for better result known as Bioremediation which is an efficient and cost-effective treatment method for the cleanup of contaminated soils/water. The present study is aimed to treat the industrial effluents in the production of by products in drug manufacturing to reduce the COD, TSS, TDS and sulphates by the process of bioremediation.

Keywords: Bioremidiation, COD, TSS, TDS, Sulphate

INTRODUCTION

Pharmaceutical industries are widely distributed and there is a consistent global increase in the use of potent pharmaceuticals driven by drug development. Given the fact that a variety of pharmaceuticals can now be detected in surface, ground and drinking waters, there are valid concerns about the potentially adverse environmental consequences of this contamination. Bye-products are the major pharmaceutical waste is released into the environment through air/water/soil [13]. In order to control the environmental pollution pharmaceutical industries have different methods to treat the waste and reuse it. The ancient methods employed for the treatment of waste water includes physical, chemical and thermal methods. But these treatment methods have disadvantages which includes huge labour requirement, high maintenance cost, low efficiency, huge equipments. In order to attain maximum efficiency in waste water treatment and reuse the water, an advanced technology has been developed and research is going on for better result which is known as bio remediation. Bioremediation is the process of using microorganisms to clean up harmful chemicals in the environment [1]. When the microbes completely digest these chemicals, they change them into non-toxic products such as water and carbon dioxide [8]. The automobile effluent parameters were analyzed such as pH, Temperature, total solids, total dissolved solids, acidity, hardness, chlorides, biological oxygen demand and chemical oxygen demand [9]. A *Pseudomonas sp*. was used for the remediation of the effluent. The rate of degradation of oil was 70.61% in the treatment of CMBI. Another research work in India was done on textile effluent direct orange-102. They used *Pseudomonas fluorescens* bacteria for the degradation of dye which was obtained from National Chemical Laboratory, Pune, India as pure culture [2, 15]. The bioremediation experiments with cell-free extract before and after degradation of the dye by *Pseudomonas fluorescens* were performed spectrophotometrically [5, 12]. A research work in bioremediation of lakes in various places like central Europe, Middle East and India [7]. These lakes were very poor in quality, high algae number, high nutrient

concentrations, high pathogenic count, and fish kills were quite common. In these lakes microbial consortiums which contained one or more of the following organisms like *Bacillus sp*., *Aspergillus sp*., *Azotobacter sp*., *Pseudomonas sp*., and *Saccaromyces cerevisiae*. After the treatment 75% reduction in the algae number, decrease in ammonia, total dissolved solids and nitrates was observed [17, 18]. The objectives of the study is to reduce the Chemical Oxygen Demand (COD), Total Suspended Solids (TSS),Total Dissolved Solids (TDS),Sulphates in the pharmaceutical effluent.

EXPERIMENTAL SECTION

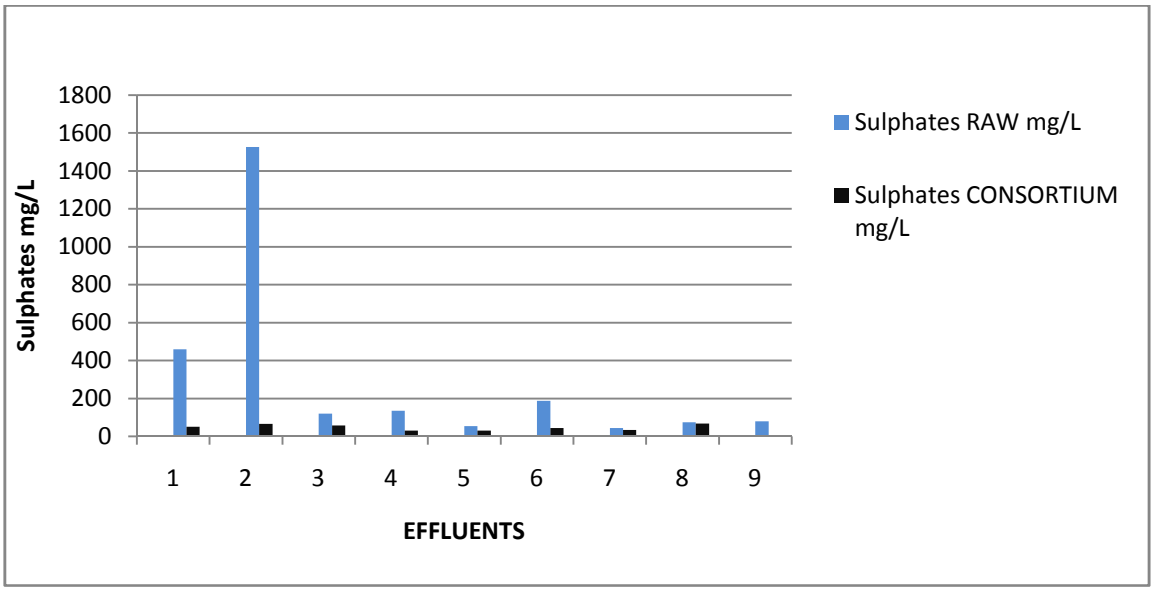
Sampling collection & treatment

The samples were collected from the various sites situated in the industry. Around nine effluents were collected from various sites namely ETP, MEE, PROCESED SALT(collected in solid form), MEE FEED WATER, CONDENSATE WATER, CONDENSATE WATER ONLINE, BOILER BLOW DOWN WATER, COOLING TOWER WATER, S.T.P WATER(collected in liquid form).The samples were collected in plastic polythene bags and were transported to the laboratory for further treatment. The samples were added to the media (nutrient broth and potato dextrose broth) for the isolation of native bacteria or fungi present in the effluents or sludges [4, 6]. The gram staining was performed in order to specify gram positive or gram negative isolates [11]. The organisms used to prepare bacterial consortium are *Bacillus megatherium, Psuedomonas fluorescens, Phosphate solubilising bacteria, Bacillus subtilis, Bacillus pumilis, Pseudomonas putida, Aspergillus niger, Bacillus licheniformis, Nitrobacter, Nitrosomonas, Rodococcus* [14].

The methods employed to check the initial characters of the effluent were standardized based on APHA method. TDS (Total Dissolved solvents): 10 ml of filtrate was collected from the raw sample or treated sample in china Petri dishes. The dishes were kept in hot air oven at 180^0 until total sample get dried and the final weight was measured. TSS (Total Suspended Solvents): The dried filtrate from 25 ml of raw/treated sample was collected and weighed.Sulphates: 25 ml of raw/treated sample was added with barium chloride and filtrate was collected and weighed. COD (Chemical Oxygen Demand): The COD estimation is done by Open Reflex Method [1].

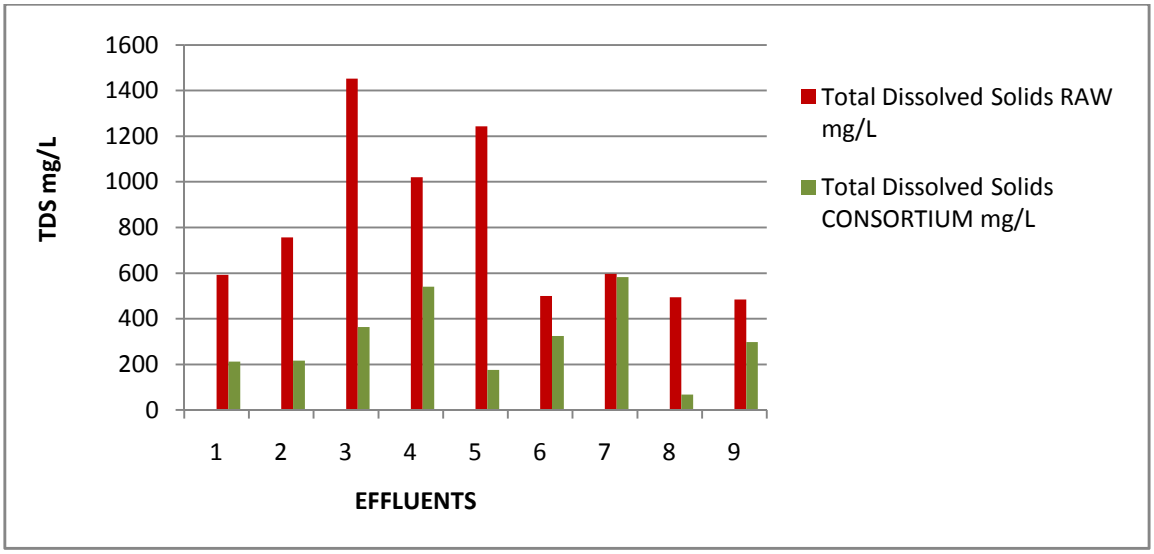
RESULTS

After the collection of samples/effluents from the industry, the effluents were added to 100ml of Nutrient broth in 1:100 dilutions for the growth of native bacteria. Then tests were conducted for sulphates, TSS, TDS and COD.



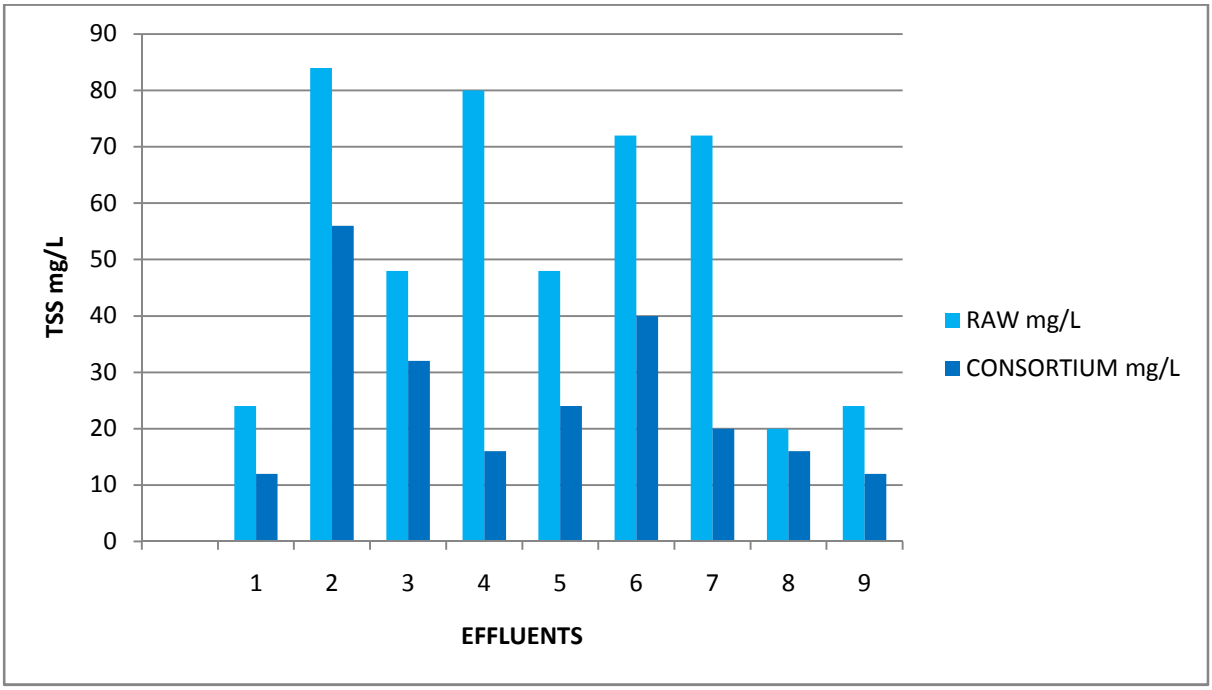
Graph 1: Comparison of raw sulphates with consortium sulphates

1 – ETP 2- MEE 3- Processed salt 4- MEE feed water 5- Condensate water
6-STP water 7- Cooling tower water 8- Boiler Blow water 9- Condensate water online



Graph 2: Comparison of raw TDS with consortium TDS

1 – ETP 2- MEE 3- Processed salt 4- MEE feed water 5- Condensate water
6-STP water 7- Cooling tower water 8- Boiler Blow water 9- Condensate water online

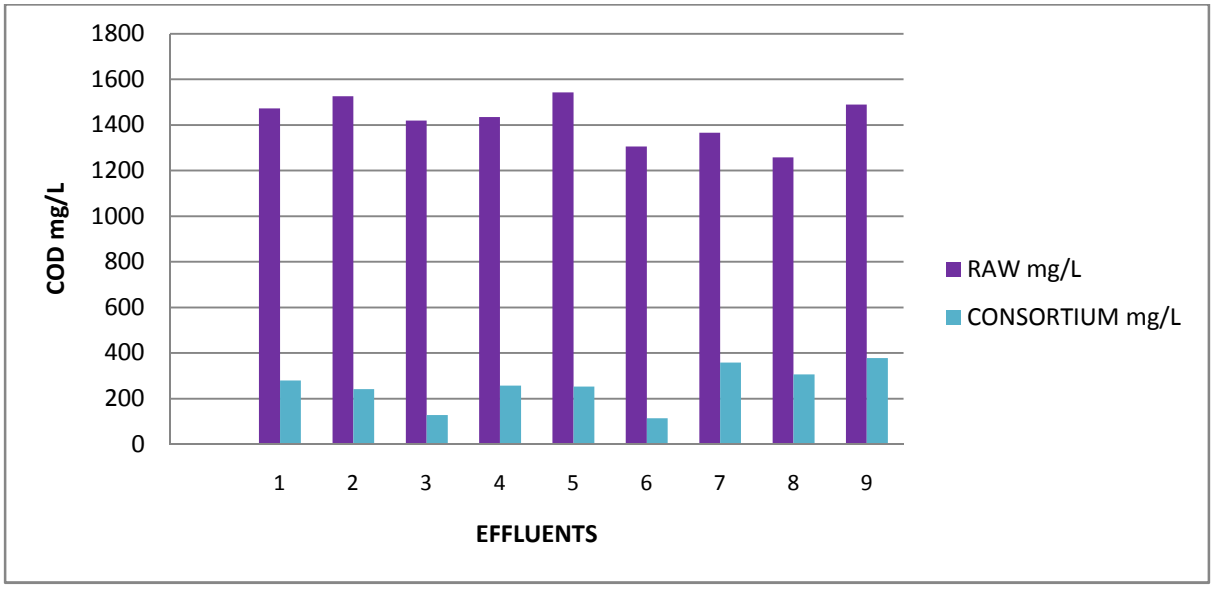


Graph 3: Comparison of raw TSS with consortium TSS

1 – ETP 2- MEE 3- Processed salt 4- MEE feed water 5- Condensate water
6-STP water 7- Cooling tower water 8- Boiler Blow water 9- Condensate water online

Treatment of effluents with bacterial consortium

In this process, 100ml of nutrient broth was prepared and to it 1ml of effluent/sample was added and 2ml of bacterial consortium was added and kept in a shaker for 24 hours,The process of bacterial consortium addition was continued periodically for 3 days and the sample was tested for sulphates (Graph 1), TSS (Graph 2), TDS (Graph 3) and COD (Graph 4) were performed after 72 hours to check the efficiency of the inoculated bacteria consortium.



Graph 4: Comparison of raw and consortium treated effluents
1 – ETP 2- MEE 3- Processed salt 4- MEE feed water 5- Condensate water
6-STP water 7- Cooling tower water 8- Boiler Blow water 9- Condensate water online

DISCUSSION

The release of pharmaceutical effluents into the water streams and lakes, soil etc is due to the waste released from the pharmaceutical industries. Nowadays these industries are widely distributed and there is a consistent global increase in the use of potent pharmaceuticals driven by drug development [10]. Due to these, pharmaceuticals can now be detected in surface; ground and drinking waters, there are valid concerns about the potentially adverse environmental consequences of this contamination. The main pharmaceutical waste that causes damage to the environment is the effluents releasing from the industry as bye-products during the production of drugs or chemicals. This waste is released into the environment through air, water or soil [3, 13].

In this study, the effluent parameters in the waste water released from the pharmaceutical industry by using an advanced technology known as BIOREMEDIATION. So the samples were collected from different areas of industry. These samples are in the form of liquid (MEE FEED WATER, CONDENSATE WATER, CONDENSATE WATER ONLINE, BOILER BLOW DOWN WATER, COOLING TOWER WATER, S.T.P WATER) and solid (ETP, MEE, PROCESED SALT).

By comparing both the results of raw samples and treated samples, sulphates in the effluent ETP were reduced from 460 mg/l to 51 mg/l , in effluent MEE it was reduced in a maximum level from 1527mg/l to 65.8 mg/l and in the effluent PROCESSED SALT it was reduced from 120mg/l to 57mg/l, in MEE FEED WATER it was reduced from 135 mg/l to 29.6 mg/l, and in CONDENSATE WATER it was reduced from 54 mg/l to 31 mg/l, in STP water sulphate levels were reduced from 187 mg/l to 44 mg/l. And in the COOLING TOWER WATER sample only a little amount of degradation was observed, which was reduced from 44 mg/l to 34 mg/l, in BOILER BLOW DOWN WATER sample also there was no efficient degradation, in CONDENSATE WATER ONLINE sample a considerable level of degradation was observed, which is reduced from 79mg/l to 6 mg/l

Due to the biological activity of bacterial consortium, the level of total dissolved solids in ETP sample was reduced from 592 mg/l to 212 mg/l, in MEE sample it was reduced from 756 mg/l to 216 mg/l, in PROCESSED SALT sample a remarkable degradation of TDS was observed which was reduced from 1452 mg/l to 364 mg/l, and in MEE FEED WATER sample it was reduced from 1020 mg/l to 540 mg/l, in CONDENSATE WATER sample high level of degradation was observed in which it is reduced from 1244 mg/l to 176 mg/l, in STP sample it was reduced from 500 mg/l to 324 mg/l, in COOLING TOWER WATER sample there was only a minute degradation of TDS, in BOILER BLOW DOWN WATER sample it was reduced from 494 mg/l to 68 mg/l, in CONDENSATE WATER ONLINE sample it was reduced from 484 mg/l to 298 mg/l.

The levels of total suspended solids after the treatment in ETP sample were reduced from 24 mg/l to 12 mg/l, in MEE sample it is reduced from 84 mg/l to 56 mg/l, in PROCESSED SALT sample it was reduced to 32 mg/l from

48 mg/l, in MEE FEED WATER sample it was reduced from 80 mg/l to 16 mg/l, and in CONDENSATE WATER sample it was reduced from 48 mg/l to 24 mg/l, in STP sample it was reduced from 72 mg/l to 40 mg/l, in COOLING TOWER WATER sample it was reduced from 72 mg/l to 20 mg/l, in BOILER BLOW WATER sample , CONDENSATE WATER ONLINE sample only slight degradation was observed.

Due to the enzymatic activity of the bacterial consortium, the COD levels after the treatment in ETP sample were reduced from 1473 mg/l to 279.4 mg/l, in MEE sample it was reduced from 1526.7 mg/l to 241.6 mg/l, in PROCESSED SALT sample it was reduced from 1419.2 mg/l to 128.3 mg/l, in MEE FEED WATER sample it was reduced from 1435.3 mg/l to 256.7 mg/l, in CONDENSATE WATER sample it was reduced from 1542.9 mg/l to 252.9 mg/l, in STP sample it was reduced from 1306.3 mg/l to 113.2 mg/l, and in BOILER BLOW WATER sample it was reduced from 1257.9 mg/l to 305.8 mg/l, in CONDENSATE WATER ONLINE sample it was reduced from 1489.1 mg/l to 377.6 mg/l.

CONCLUSION

In this project, we have collected raw effluents from the pharmaceutical industry and these effluents were transferred in plastic polythene bags and then examinations are conducted to detect the parameters like SULPHATES, TSS, TDS and COD. After that the samples are inoculated with bacterial consortium as detailed above. Then the results before treatment and after treatment were compared and have shown a drastic change in the degradation of above listed parameters. By examining all the effluents, we conclude that by applying the technique Bio-remediation by using microorganisms there was a change in the degradation of effluent parameters. It was observed that there was a maximum degradation of total suspended solids in the effluents MEE, Processed salt, STP and in Boiler blow down water. And the degradation of sulphates was up to 80% in cooling tower water and Boiler blow down water effluents. Degradation of total dissolved solids was up to 70% in STP, cooling tower water, Boiler blow down water and in Condensate water online. And only slight changes were observed in COD levels in all the effluents.

REFERENCES

[1] Analytical Methods Approved for Compliance Monitoring under the Ground Water Rule, The methods and monitoring requirements for these contaminants are specified in 40 CFR 141.402 and 141.403. 4500-Cl H Standard Methods for the Examination of Water and Wastewater, 21st Edition **2005** Standard Methods
[2] BV PANDEY; RS UPADHYAY. *International Society for Tropical Ecology*, **2010**, 397-403.
[3] C Garćia; DA Moreno; A Ballester; ML Blázquez; F González. *Minerals Engineering*, **2001**, 14(9), 997 – 1008.
[4] C Yatome; T Ogawa; M Matsui. *Journal of Environmental Science and Health* **1992**, 26, 75-87.
[5] HN Wouter; BJ Dick. *AppliedEnvironmental Microbiology,* **2002**, 68, 4502-4508.
[6] JA Bumpus; BJ Brock. *Applied and Environmental Microbiology*, **1988**, 54, 1143-1150.
[7] Kamath; Ganesh. Bioremediation of lakes:Myths and Realities, ,Proceedings of Taal **2007**, The 12th World Lake Conference,44-49.
[8] M Alexander. *San Dieg Academic Press*, **1994**.
[9] P Sathiya moorthi; M Deecaraman; PT Kalaichelvan. *Advanced Biotech*, **2008**, 34.
[10] RH Kaake; DJ Roberts; TO Stevens; RL Crawford; DL Crawford. *Applied and Environmental Microbiology,* **1992**, 58, 1683-1689.
[11] RM Atlas. *Microbiological review,* **1981**, 45, 180- 209.
[12] S Sarnaik; P Kanekar. *Journal of Applied Bacteriology*, **1995**, 79, 459–469
[13] SD Aust. *Microbial Ecology,* **1990.**
[14] Technical and Regulatory Requirements for Enhanced In Situ Bioremediation of Chlorinated Solvents in Groundwater; Interstate Technology and Regulatory Cooperation (ITRC) Workgroup, *In Situ Bioremediation Subgroup*, **1998**.
[15] W Chobchuenchom; S Mongkolsuk; A. Bhumiratana. *World Journal of Microbiology and Biotechnology,* **1996**, 12, 607-614.
[16] WR Grace & Co. *Bioremediation Technology: Pesticides/Herbicides,* **1999.**
[17] M Suguna; N Siva Kumar; M Venkata Subbaiah; A Krishnaiah. *J. Chem. Pharm. Res.*, **2010**, 2(1),7-20.
[18] PK Baskaran; BR Venkatraman; M Hema; S Arivoli. *J. Chem. Pharm. Res.*, **2010**, 2(5), 642-655