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Advances in Applied Science Research, 2015, 6(4):157-161

ISSN: 0976-8610
CODEN (USA): AASRFC

Performance evaluation of effluent treatment plant and hazardous waste management of pharmaceutical industry of Ankleshwar

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ABSTRACT

Industrial development manifested due to setting up of new industries or expansions of the existing industrial establishments resulted in to environmental degradation therefore it is necessary to evaluate, monitor and check various environmental parameters whether they are complying with given standard or not given by regulatory authority. During the entire study period performance evaluation of effluent treatment plant and hazardous waste management has been carried out at pharmaceutical industry, Ankleshwar. The monitoring data of the effluent treatment plant will give information on the pollution control by the company and management of solid waste. Statistical analysis showed that there are no significance difference in pH, BOD, COD and ammonical Nitrogen. Hence determination of various environmental aspects of pharmaceutical bulk drugs process and parameters of generated effluents were carried out.

Key words: Effluent treatment plant; Hazardous solid waste; pH; COD; BOD; Ammonical nitrogen;

INTRODUCTION

This briefing paper has been produced to make the Commission aware of the approaches that can be taken in environmental management including effluent treatment plant and hazardous waste management of pharmaceutical industry. This pharmaceutical industry engaged in manufacturing of ethumbutol hydrochloride, 7-ADCA, 7-ACCA, D & L Mandelic acid, 7-AVAC, 7-APCA, 7-Amino ester, cefpodoxime acid, (2S)-3-dimethylamino-1(3-methoxyphenyl)-2methylpropan-1-one, BAL1026, cefadroxil, 7-anca and R & D Pilot plant trial run products.[1] This industry has taken sustainable steps in amelioration of environment and minimization or mitigation of environment pollution. The plant properly maintains records of effluent generation, energy consumption and has prepared onsite & offsite emergency plan and taken proper safety measures for the workers.[2] The byproducts obtained are calcium sulphate, sodium chloride, MESO, aminobutol, dilute sulphuric acid, ammonium chloride solution, dilute acetic acid, phenyl acetic acid solution, recovered ammonium solution, ammonium bromide solution, sodium acetate, potassium bromide, recovered isobutyl chloride, ethyl acetate, Paratoluenesulphonic acid solution. TPPO, potassium chloride, boric acid, MBT, recovered IPA, recovered n-propanol, recovered THF.[1] Industry has received ISO 14001: 2004 Certificate for the development and manufacturing of bulk drugs and bulk drugs intermediate. It has received OHSAS18001-2007 certificate for the development and manufacturing of bulk drugs and bulk drugs intermediate.[3] Housekeeping is good within the premises. Green belt is well developed. Health records are maintained by industries. Industry has displayed relevant data for the production, hazardous chemicals, waste water and emission outside the main factory gate.[7] Industry has installed two no. of RO plants to meet the parameters of GPCB. Permeate generated from this RO plant was probably similar to raw water and it is recycled to

the cooling tower as well as the raw water preparation in ETP. Condensate generating from MEE plant also recycle in cooling tower as a result the industries has reduced the effluent discharge by more than 50%.[4]

Materials and Methodology

The methods of treatment of waste water vary a lot. It mainly depends on the characteristics of effluent, level of effluent, level of toxicity to be removed and the type of environment to receive the effluent. Physico-chemical and biological processes are treatment processes that have been adopted for the effluent treatment plant. The physico-chemical process consists of the screening, coagulation, flocculation and sedimentation. Biological treatment process is responsible for the removal of BOD and COD. Every effluent treatment plant is unique with respect to its process flow sheet. This is because the treatment scheme is adopted on the basis of design and input characteristics of the effluent as well as the stipulated pollution level of the treatment. It must therefore be appreciated that effluent treatment plants are tailor made and hence the mode of operation would be specific for the treatment envisaged. [5] Effluent treatment plant involves step wise treatment systems.

Physico Chemical Treatment

Oil and grease trap: Effluent from various plants is pumped into oil and grease trap which has been divided in compartments. The structure is of R.C.C with acid and alkali proof brick lining. Here effluent goes from one compartment to another by gravity and oil or grease which remains floating on top is skimmed regularly. Clear effluent goes to equalization come neutralization tank. Equalization tank: Two tanks of R.C.C structure with acid, alkali proof brick lining. Each has working capacity of 500 m^3Effluent is homogenously mixed in this tank. Continuous Neutralization System (CNS): Three tanks having 20 m^3capacities, in the first tank, effluent from equalization tank is pumped and pH is corrected by adding lime. Ferrous sulphate is added as coagulant in second tank and polyelectrolyte is added in third tank for flocculation. Primary settling tank: Treated effluent from neutralization system is pumped to primary settling tank to remove settable solids from the effluent. Settled solids are sent to decanter for water solid separation. Solid sent to BEIL and decanted liquid sent to aeration tank. Clear effluent from the clarifier goes to aeration tank for Biological treatment.

Secondary Treatment

Aeration tank: Three stages of aeration tank are provided. The clear over flowing effluent from primary settling tank are transferred to these aeration tanks. Microbes decompose the organic matter dissolved in effluent. Nutrients are added in the aeration tank for the growth of microbes. Clarification mechanism is provided after each tank. Secondary clarifier: The over flow of last aeration tank is taken in secondary clarifier, excess sludge goes to decanter for solid liquid separating while part of it is recycled into aeration tank by pumping to maintain desired level of mixed liquor suspended solid(MLSS). Over flow from secondary clarifier transferred to tertiary clarifier.

Tertiary Treatment:

Company has installed Reverse Osmosis (RO) plant to treat secondary treated effluent from ETP. This is based on membrane technology and it is automatic plant. Permeate generated from this system is recycled and reused/shall be disposed through GIDC underground drainage to convey FETP (BEIL).

Rejects generated from this plant is evaporated in Multiple Effective Evaporator (MEE). The condensate i.e. water evaporated from multiple effective evaporator is recycled and reused in the process. Solid separated is send to TSDF site along with ETP sludge.[5]

Statistical analysis: Statistical analysis was performed with One Way ANOVA, using software KyPlot Version 2.0beta 13 (© 1997-2000 Koichi Yoshioka). Means were separated using the last significance Difference (LSD) test as $p<0.05$ *q.*[8][9]

RESULT AND DISCUSSION

Various parameters of effluent of this pharmaceutical industry like pH, Ammonical Nitrogen, BOD & COD were analysed. Obtained data compared with the standards of GPCB as the industry is situated in Gujarat and its solid waste management also studied for waste management.

The pH of the individual sample was measured immediately after its collection by pH meter. The pH of the effluent varied from 8.02 to 9.99 before the treatment, whereas the value of pH after physical and biological treatment was

found 7.20. The percentage reduction of 22.33 % reduction was achieved. The findings of the present study are in agreement with GPCB standards (TABLE 2). The Ammonical nitrogen was analysed after 30 minutes after the collection in laboratory, The Ammonical nitrogen of the effluent varied from 110 to 210 mg/l. before the treatment, whereas the value after physical and biological treatment was found 32.57 mg/l. The value of Ammonical nitrogen after treatment was under GPCB standards (TABLE 2). The BOD was measured in 5 days interval and three times in a month. Before treatment it was 1330 mg/l., after treatment it was found 22.66 mg/l. The value of BOD after treatment was under GPCB standards (TABLE 2). For COD determination samples were preserved using H_2SO_4 and processed for COD determination after the entire sampling operation was complete. COD was varied from 1047 to 2555 mg/l before the treatment and after the treatment it was found 49.88 mg/l. The value of COD after treatment was under GPCB standards (TABLE 2).

Statistical analysis by One Way ANOVA showed that Experiment data have no significant difference after comparison.

Comparative analysis of results with standard norms of GPCB:
Comparative analysis showed all the data are under limits of pollution norms of GPCB, which are shown in below graph. Specification of GPCB mentioned below.

Table 1: Physico chemical parameters of the effluent and percentage reduction

Parameter	Before Treatment	After Treatment	% Reduction
pH	9.27	7.02	22.33
Ammonical N_2	157.5	32.57	79.32
COD	1868	49.88	97.32
BOD	1330	22.66	98.34

Table 2: Effluent water specification based on GPCB standards:

Parameter	GPCB Standard	Treated Effluent
Temperature	not more than 35 °C	25 to 29°C
pH	5.50-8.50	7.2
Ammonical Nitrogen	not more than 50 mg/l.	32.57
COD	not more than 100 mg/l.	49.88
BOD	not more than 30mg/l.	22.66

ANOVA Table:

FACTOR	SS	Df	Ms	F (cal)
Between groups	24115.771	3	8038.5905	185.07939
Within groups	3344.3565	77	43.43320167	
Total	27460.12798	80		

**Significant at the 0.05 level*

	pH	COD	BOD	Ammonical nitrogen
MEAN	7.2023077 ±	49.884615±	22.666667 ±	32.576923 ±
S.E.M	0.03	1.83	1.33	1.32

**Significant at the 0.05 level*

Solid Waste Management: Organic solid waste is sent for Incineration. Inorganic solid waste is sent to TSDF (Transport Storage Disposal Facilities)

Sr. No.	Name of waste	Waste generating process	Physical characteristics	Mode of disposal
1	Used oil	Lubrication	Liquid	Collection, Storage, Transportation, Disposal by incineration within premises/at common incinerator(BEIL,GEPIL,SEPPL)/Send for co-processing to cement/steel/power industry
2	Process waste	Process	Semi solid	Collection, Storage, Transportation, Disposal by incineration within premises/at common incinerator(BEIL,GEPIL,SEPPL)/Send for co-processing to cement/steel/power industry
3	Spent carbon	Process	Solid	Collection, Storage, Transportation, Disposal by incineration within premises/at common incinerator(BEIL,GEPIL,SEPPL)/Send for co-processing to cement/steel/power industry
4	Spent Catalyst	Process	Solid	Collection, Storage, Transportation, Disposal by incineration within premises/at common incinerator(BEIL,GEPIL,SEPPL)/Send for co-processing to cement/steel/power industry
5	Date expired, off specification product	Process	Liquid/ solid	Collection, Storage, Transportation, Disposal by incineration within premises/at common incinerator(BEIL,GEPIL,SEPPL)/Send for co-processing to cement/steel/power industry
6	Spent solvent	Process	Liquid	Collection, Storage, Transportation, On site recovery/off site recovery/sale to authorised unit(DMF only for shubh Rasayan)/Send for co-processing to cement/steel/power industry
7	Discarded container Beg/liners	Handling of row materials/chemicals hazardous waste	Solid	Collection, Storage, Decontamination, and Sale or Send at TSDF(BEIL,GEPIL,SEPPL)
8	Spent resin	Process	Semi solid	Collection, Storage, Transportation, Disposal by incineration within premises/at common incineration(BEIL,GEPIL,SEPPL)
9	ETP sludge	ETP	Solid	Collection, Storage, Transportation, Disposal at TSDF(BEIL,GEPIL,SEPPL)
10	Ash from incinerator	Multiple effect	Solid	Collection, Storage, Transportation, Disposal at TSDF(BEIL,GEPIL,SEPPL)
11	Salts from MEE	Multiple effect	solid	Collection, Storage, Transportation, Disposal at TSDF(BEIL,GEPIL,SEPPL)

CONCLUSION

Environmental system management has been a great success in the evaluation, monitoring and compliance of the environment parameters with the given standards given by the regulatory authority. From the entire study it can be conclude that the effluent discharge was found under the given permissible limits by statutory authority, this was possible only because of wisely formed environmental policy, installation of effective and efficient pollution control technology and equipment, regular monitoring of various environmental parameters, and solid waste management whether they are complying with the given standard or not. As the holistically the better and efficient EMS system of the company makes it CLEAN and GREEN.

Acknowledgements
I am thankful to V P Science collage as well as S P University, Gujarat and Pharmaceutical industry of Ankleshwar for provide me laboratory infrastructure for experimental analysis.

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Abbreviations:

ISO 14001: 2004 *is an Environmental Management System Specification.*
OHSAS 18001:2007 *is International Occupational Health & Safety Management System Specification.*
RO: *Reverse Osmosis*
ETP: *Effluent Treatment Plant*
MEE: *Multiple Effective Evaporator*
CNS: *Continuous Neutralization System*
MLSS: *Mixed Liquor Suspended Solids*
FETP: *Final Effluent Treatment Plant*
TSDF: *Transport Storage Disposal Facilities*
BOD: *Biological Oxygen Demand*
COD: *Chemical Oxygen Demand*
GPCB: *Gujarat Pollution Control Board*
SS: *Sum of Sqaure*
Df: *Degree of freedom, Ms: Mean Square, F: Factor*