*Available online at* **www.joac.info**

ISSN: 2278-1862

*Journal of Applicable Chemistry*

2019, 8 (1): 228-236

(International Peer Reviewed Journal)

# Comparison Study of Waste Water Generated from Manufacturing of Cardiovascular and Anti-Epileptic Bulk Drugs with ASP and MBBR Treatment

**Mahesh S. Pathak* and P. R. Patil**

School of Environmental and Earth Science, North Maharashtra University, Jalgaon, Maharashtra, **INDIA**

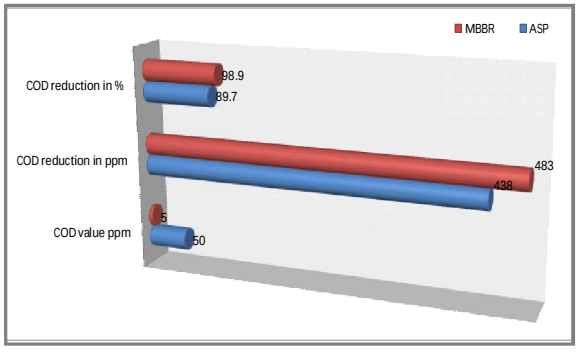
Email: mpathak13@rediffmail.com

**Accepted on 15th December, 2018**

## ABSTRACT

*Bulk drug industry is one of the major industries causing water pollution. Poorly treated wastewater with high level of pollutants caused by poor design, operation or treatment systems creates major environmental problems when discharged to surface water or land. Considering the above stated implications an attempt has been made in the present work for Cardiovascular and anti-epileptic bulk drugs industry. After primary treatment, bio degradation in Moving Bed Bio Reactor is more effective treatment than Activated Sludge Process. Adjustment of pH by sodium hydroxide, coagulation process, evaporation process, bio degradation by mixed bio-culture mainly pseudomonas and activated carbon adsorption applied, which is treatment process to degrade organics (In Cardiovascular dilute effluent degradation in MBBR COD :3.1 %, BOD: 3.0% TDS: 0.3 % more than ASP. In concentration effluent degradation in MBBR COD: 0.05%, BOD: 0.07% TDS: 0.06 % more than ASP. In Anti- epileptic dilute effluent degradation in MBBR COD: 3.69 %, BOD: 2.76% TDS: 5.95 % more than ASP. In concentration effluent degradation in MBBR COD: 0.38%, BOD: 6.01% TDS:0.2 % more than ASP) present in waste water of Cardiovascular and Anti- epileptic therapeutic bulk drug manufacturing process. The experiments were carried out at lab scale. Obtained result shows as maximum degradation of compound and volatile organic presents. The results revealed that pH, addition of coagulant agents, evaporation % age and bio degradation retention time affects the extent of degradation of compound.*

## Graphical Abstract




Comparison of COD reduction in Cardiovascular concentrate effluent stream in Activated Sludge Process & Moving Bed Bio Reactor Treatment.

**Keywords:** Activated sludge process, Bio degradation, Coagulation, Evaporation, Moving bed bio reactor, Waste water

## INTRODUCTION

Bulk drug industry is one of the major industries causing water pollution. This industry generates lots of effluent, depending upon the process and product manufactured. Considering the increased demand for drugs, the drug-based industries in India is expected to grow rapidly and have the waste generation and related pollution problems are assumed increased importance. Traditional wastewater treatment methods are not sufficient for the complete removal of organic and inorganic material constituents from these waters [1]. Untreated or partially treated wastewater with high levels of pollutants caused by poor design, operation or treatment systems creates major environmental problems [2], when discharged to surface water or land. Considering this factor has been made in the present work can evaluate one of the WWTP for Drug industry [3].

Biological treatment of wastewater is the most common and economical treatment method, However biological methods has shown to be insufficient for the removal of all potentially hazardous constituents of the wastewater [4].

The origin of bulk drugs wastewater as spent liquors from processes, Chemical waste, condensate waste from evaporation and floor and laboratory washing waste. Problem involved in Bulk drugs waste water treatment as diverse characteristics of Bulk drugs waste water, different medicines produce different type of waste, variable amount of products, mixing of Bulk drugs waste with other type of waste and also, it may contain high COD/BOD and highly pH variable [5].

In this work for Cardiovascular and Anti- epileptic bulk drug waste water carried out coagulation study as a primary treatment with different settling time and optimized primary treatment, then separated volatile compounds by distillation/force evaporation method as physico- chemical treatment of concentrate effluent . After getting sufficient reduction in COD, wastewater is treated by biological method as secondary treatment of Activated Sludge Process (ASP) and Moving Bed Bio Reactor (MBBR). After getting maximum reduction in COD, Activated charcoal adsorption method is applied as tertiary treatment.

## MATERIALS AND METHODS

The wastewater samples were collected from North Maharashtra Region in plastic can of 2-liter capacity as per standard procedure during November 2016-January 17. The Physico-chemical parameters like pH, COD, Chlorides, Sulphates, BOD, TSS and TDS etc. were determined using standard methods disclosed in literature [8]. The reagents used for the analysis were AR grade and double distilled water was used for preparation of solutions.

**Physico-Chemical Treatment:** In present work Physico-chemical treatment is applied as neutralization of waste water, coagulation, solid–liquid phase separation and distillation. In the neutralization process compounds are neutralized and precipitated at bottom, it helps to reduce COD concentration. In coagulation process by using of coagulant agent, most of suspended and other compounds are settled at bottom. In the separation technique settled compounds were separated, to helps reduction of COD and BOD in the effluent. In distillation process total dissolve solids (TDS) are separated along with volatile compound. This process is most effective to reduce COD and TDS.

**Primary treatment:** Neutralization carried out with dilute sulfuric acid and coagulation carried out with aluminium Alum, poly-electrolyte solution and poly aluminium chloride. Force evaporation is

the second method is applied after removing of first 10 % volume low boilers, COD is reduced drastically.

**Secondary treatment:** Third treatment method is biological degradation. Mainly pseudomonas bacterial development is applied with mixed culture with 1600 ppm MLVSS. In this method after 96 h continuous fresh air supplied, bio degradation is completed in Activated Sludge Process (ASP) and in Moving Bed Bio Reactor (MBBR) process and COD reduced at optimum level.

In the MBBR bio-film technology the bio-film grows protected within engineered plastic carriers, which are carefully designed with high internal surface area (3000 $m^2/m^3$). These bio-film carriers are suspended and thoroughly mixed throughout the water phase. With this technology it is possible to handle extremely high loading conditions without any problems of clogging, and treat industrial wastewater on a relatively small footprint.

**Tertiary treatment:** In the forth treatment granular activated charcoal with iodine value 900, used 100 mL volume for 100 mL of waste water for carbon adsorption. After passing through Activated Carbon column, COD is reduced up to required effluent parameters [**6**].

**Characterization:** Treated effluent characterized by various modern techniques such as COD analyzer, BOD analyzer, Distillation setup, TDS meter, Digital pH meter, Muffle furnace, Oven etc.

## RESULTS AND DISCUSSION

The Cardiovascular and Anti-epileptic therapeutic drugs concentrate and dilute waste water is selected for the study. In the primary treatment neutralization by dilute sulfuric acid and coagulation by aluminium alum, polyelectrolyte solution is performed.

Initial quality of Cardiovascular concentrate effluent is slight turbid liquid and faint yellowish in color, basic in nature and of dilute effluent clear and colorless in nature, COD, BOD and TDS values are high and after complete treatment of its final quality is achieved as clear liquid in nature, COD, BOD and TDS values are within limits of pollution norms [**7**], also chloride, sulphates and suspended solids are within limits (Table 1). It can be reuse **[8]**, recycle for utility purpose and gardening.

Initially, COD value of effluent is very high i.e. 75000 ppm, after physico-chemical treatment it reduces 14.6 %, then in evaporation process reduces drastically, in biological treatment in ASP its reduces on optimum level and in MBBR it reduces at maximum level, remaining COD is reduced in charcoal adsorption treatment, trend of this treatment shown in table 1.

**Table 1.** Stepwise quality of ASP and MBBR treatment of Cardiovascular concentrate effluent stream

| Parameter | Initial | Primary treatment | Evaporation | Secondary/Biological treatment | | Tertiary Treatment | |
|---|---|---|---|---|---|---|---|
| | | | | ASP | MBBR | ASP | MBBR |
| pH | 11.56 | 7.8 | 7.76 | 7.82 | 7.3 | 7.56 | 7.2 |
| COD | 75000 | 64000 | 488 | 50 | 5 | 40 | 1 |
| TDS | 216000 | 210000 | 248 | 232 | 202 | 220 | 108 |
| BOD | 20400 | 17320 | 173 | 19 | 2 | 15 | 1 |

(All values are in ppm except pH)

Third treatment method is biological degradation ASP and MBBR. In this method after 96 hrs continuous fresh airs supplied, bio degradation is completed and COD reduced 50 ppm from 488 ppm in ASP and 5 ppm from 488 ppm in MBBR (Table 2).

**Table 2.** Biological degradation in ASP and MBBR of Cardiovascular concentrate effluent stream

| Treatment in hours (Retention time) | In ASP COD | In MBBR COD |
|---|---|---|
| Initial Sample | 488 | 488 |
| 24 | 180 | 11 |
| 48 | 81 | 5 |
| 72 | 62 | 5 |
| 96 | 50 | 5 |

(All values are in ppm).

In table 3 shown, that initial quality of effluent with eleven parameters, then shown after ASP treatment and after MBBR treatment. MBBR treated quality is better than ASP treated quality.

**Table 3.** Comparison of Cardiovascular concentrate effluent stream in Activated Sludge Process and Moving Bed Bio Reactor Treatment

| Parameters | Initial quality in ppm | ASP | MBBR |
|---|---|---|---|
| pH | 11.56 | 7.56 | 7.2 |
| COD | 75000 | 40 | 1 |
| BOD | 20400 | 15 | 1 |
| TDS | 216000 | 220 | 108 |
| TSS | 9170 | 20 | 0 |
| Chloride | 62300 | 10.65 | 6.6 |
| Sulphate | 1952.4 | 42.7 | 28.2 |
| Color | Faint Yellow | Colorless | Colorless |
| Nature | Slight turbid | Clear | Clear |
| Conductivity | 724 | 196 | 102 |
| Alkalinity(Total) | 260 | 40 | 28 |

(All values are in ppm except pH)

In figure 1 reveals that 39 ppm COD reduction in MBBR is more than ASP treatment.

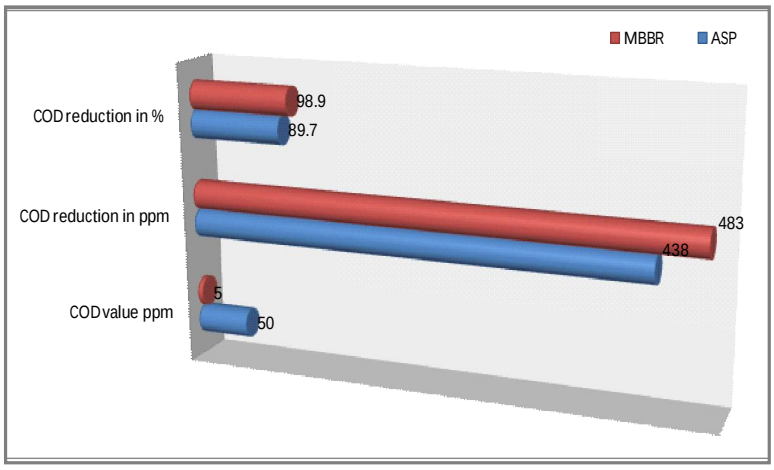



**Figure 1.** Comparison of COD reduction in Cardiovascular concentrate effluent stream in Activated Sludge Process & Moving Bed Bio Reactor Treatment.

Initially COD value of effluent is high i.e. 3708 ppm, after physico-chemical treatment it reduces 13.4 %, then in biological treatment in ASP its reduces on optimum level and in MBBR it reduces more, remaining COD is reduced in charcoal adsorption treatment, trend of this treatment shown in table 4.

**Table 4.** Stepwise quality of ASP and MBBR treatment of Cardiovascular dilute effluent stream

| Parameter | Initial | Primary treatment | Secondary/Biological treatment | | Tertiary Treatment | |
|---|---|---|---|---|---|---|
| | | | ASP | MBBR | ASP | MBBR |
| pH | 7.59 | 7.34 | 7.06 | 7.12 | 7.21 | 7.42 |
| COD | 3708 | 3210 | 282 | 228 | 248 | 130 |
| TDS | 3200 | 2240 | 680 | 650 | 520 | 510 |
| BOD | 1001 | 784 | 104 | 54 | 56 | 27 |

(All values are in ppm except pH)

Third treatment method is biological degradation ASP and MBBR. In this method after 96 hrs continuous fresh airs supplied, bio degradation is completed and COD reduced 282 ppm from 3006 ppm in ASP and 228 ppm from 3006 ppm in MBBR (Table 5).

**Table 5.** Biological degradation in ASP and MBBR of Cardiovascular dilute effluent stream

| Treatment in hrs (Retention time) | In ASP COD | In MBBR COD |
|---|---|---|
| Initial Sample | 3006 | 3006 |
| 24 | 1839 | 2002 |
| 48 | 1211 | 1124 |
| 72 | 552 | 524 |
| 96 | 282 | 228 |

(All values are in ppm)

In table 6 shown, that initial quality of effluent with eleven parameters, then shown after ASP treatment and after MBBR treatment. MBBR treated quality is better than ASP treated quality.

**Table 6.** Comparison of Cardiovascular dilute effluent stream in Activated Sludge Process and Moving Bed Bio Reactor Treatment

| Parameters | Initial quality | ASP | MBBR |
|---|---|---|---|
| pH | 7.59 | 7.21 | 7.42 |
| COD | 3708 | 248 | 130 |
| BOD | 1001 | 56 | 27 |
| TDS | 3200 | 520 | 510 |
| TSS | 12 | 1 | 0 |
| Chloride | 3077 | 22.1 | 16.4 |
| Sulphate | 96.4 | 14.2 | 8.6 |
| Color | Colorless | Colorless | Colorless |
| Nature | Clear | Clear | Clear |
| Conductivity | 35.5 | 16.5 | 16.2 |
| Alkalinity(Total) | 170 | 32.5 | 36.8 |

(All values are in ppm except pH)

Initially COD value of effluent is very high i.e. 31600 ppm, after physico-chemical treatment it reduces 24 %, then in evaporation process reduces drastically, in biological treatment in ASP its reduces on optimum level and in MBBR it reduces at maximum level, remaining COD is reduced in charcoal adsorption treatment, trend of this treatment shown in table 7.

**Table 7.** Step wise quality of ASP and MBBR treatment of Anti- epileptic concentrate effluent stream

| Parameter | Initial | Primary treatment | Evaporation | Secondary/Biological treatment | | Tertiary Treatment | |
|---|---|---|---|---|---|---|---|
| | | | | ASP | MBBR | ASP | MBBR |
| pH | 10.1 | 7.6 | 8.14 | 7.72 | 7.2 | 7.62 | 7.1 |
| COD | 31600 | 24000 | 936 | 197 | 16 | 130 | 11 |
| TDS | 53364 | 48028 | 70 | 68 | 58 | 60 | 49 |
| BOD | 5160 | 3808 | 312 | 57 | 9 | 31.7 | 7 |

(All values are in ppm except pH)

In figure 2 reveals that 118 ppm COD reduction in MBBR is more than ASP treatment.

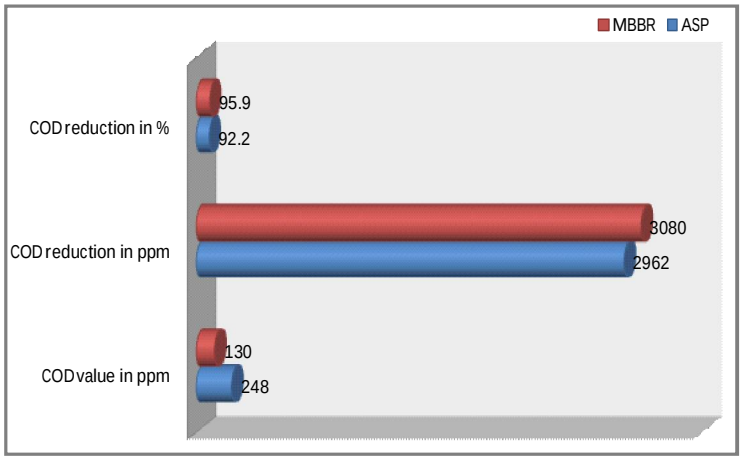



**Figure 2.** Comparison of COD reduction in Cardiovascular dilute effluent stream in Activated Sludge Process and Moving Bed Bio Reactor Treatment

Third treatment method is biological degradation ASP and MBBR. In this method after 48 hrs continuous fresh airs supplied, bio degradation is completed and COD reduced 197 ppm from 936 ppm in ASP and 16 ppm from 936 ppm in MBBR (Table 8).

**Table 8.** Biological degradation in ASP and MBBR of Anti- epileptic concentrate effluent stream

| Treatment in hours (Retention time) | In ASP COD | In MBBR COD |
|---|---|---|
| Initial Sample | 936 | 936 |
| 24 | 300 | 37 |
| 48 | 197 | 16 |

(All values are in ppm)

In table 9 shown, that initial quality of effluent with eleven parameters, then shown after ASP treatment and after MBBR treatment. MBBR treated quality is better than ASP treated quality.

**Table 9.** Comparison of Anti- epileptic concentrate effluent stream in Activated Sludge Process and Moving Bed Bio Reactor Treatment

| Parameters | Initial quality | ASP | MBBR |
|---|---|---|---|
| pH | 10.1 | 7.62 | 7.1 |
| COD | 31600 | 130 | 11 |
| BOD | 5160 | 31.7 | 7 |
| TDS | 53364 | 60 | 49 |
| TSS | 3182 | 13.1 | 8 |
| Chloride | 12283 | 35.5 | 16.1 |
| Sulphate | 2132 | 41.18 | 20.4 |
| Color | Yellowish | Colorless | Colorless |
| Nature | Turbid | Clear | Clear |
| Conductivity | 148 | 12 | 9 |
| Alkalinity(Total) | 1360 | 110 | 76 |

( All values are in ppm except pH)

Initially COD value of effluent is high i.e. 2600 ppm, after physico-chemical treatment it reduces 16 %, then in biological treatment in ASP its reduces on optimum level and in MBBR it reduces more, remaining COD is reduced in charcoal adsorption treatment, trend of this treatment shown in table 10.

**Table 10.** Stepwise quality of ASP and MBBR treatment of Anti- epileptic dilute effluent stream

| Parameter | Initial | Primary treatment | Secondary/Biological treatment | | Tertiary Treatment | |
|---|---|---|---|---|---|---|
| | | | ASP | MBBR | ASP | MBBR |
| pH | 7.6 | 7.4 | 7.01 | 7.03 | 7.12 | 7.1 |
| COD | 2600 | 2184 | 312 | 212 | 242 | 146 |
| TDS | 1076 | 861 | 707 | 701 | 566 | 502 |
| BOD | 870 | 722 | 98 | 52 | 63 | 19 |

(All values are in ppm except pH)

In figure 3 reveals that 119 ppm COD reduction in MBBR is more than ASP treatment.

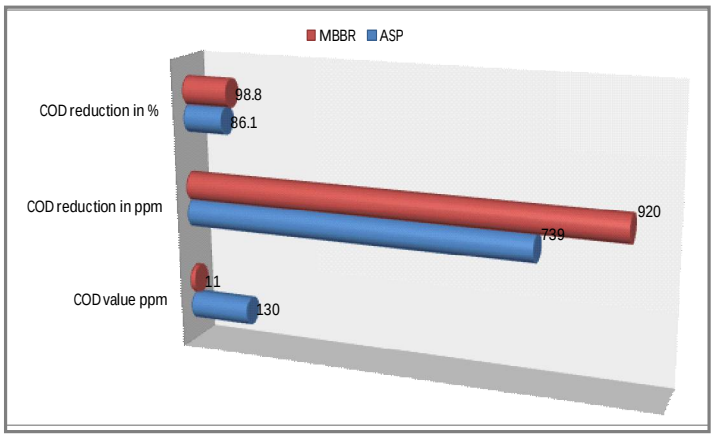



**Figure 3.** Comparison of COD reduction in Anti- epileptic concentrate effluent stream in Activated Sludge Process and Moving Bed Bio Reactor Treatment

Third treatment method is biological degradation ASP and MBBR. In this method after 96 h continuous fresh airs supplied, bio degradation is completed and COD reduced 312 ppm from 2060 ppm in ASP and 212 ppm from 2060 ppm in MBBR (Table 11).

**Table 11.** Biological degradation in ASP and MBBR of Anti-epileptic dilute effluent stream.

| Treatment in hours (Retention time) | In ASP COD | In MBBR COD |
|---|---|---|
| Initial Sample | 2060 | 2060 |
| 24 | 1582 | 980 |
| 48 | 1102 | 692 |
| 72 | 644 | 402 |
| 96 | 312 | 212 |

(All values are in ppm)

In table 12 shown, that initial quality of effluent with eleven parameters, then shown after ASP treatment and after MBBR treatment. MBBR treated quality is better than ASP treated quality.

**Table 12.** Comparison of Anti- epileptic dilute effluent stream in Activated Sludge Process and Moving Bed Bio Reactor Treatment

| Parameters | Initial quality | ASP | MBBR | Parameters | Initial quality | ASP | MBBR |
|---|---|---|---|---|---|---|---|
| pH | 7.6 | 7.12 | 7.1 | Sulphate | 174 | 27.4 | 22.6 |
| COD | 2600 | 242 | 146 | Color | Colorless | Colorless | Colorless |
| BOD | 870 | 63 | 19 | Nature | Slight turbid | Clear | Clear |
| TDS | 1076 | 566 | 502 | Conductivity | 12 | 6.1 | 5.9 |
| TSS | 160 | 1 | 0 | Alkalinity(Total) | 182 | 28 | 23 |
| Chloride | 1009 | 24.1 | 18.3 | - | - | - | - |

(All values are in ppm except pH)

In figure 4 reveals that 96 ppm COD reduction in MBBR is more than ASP treatment.

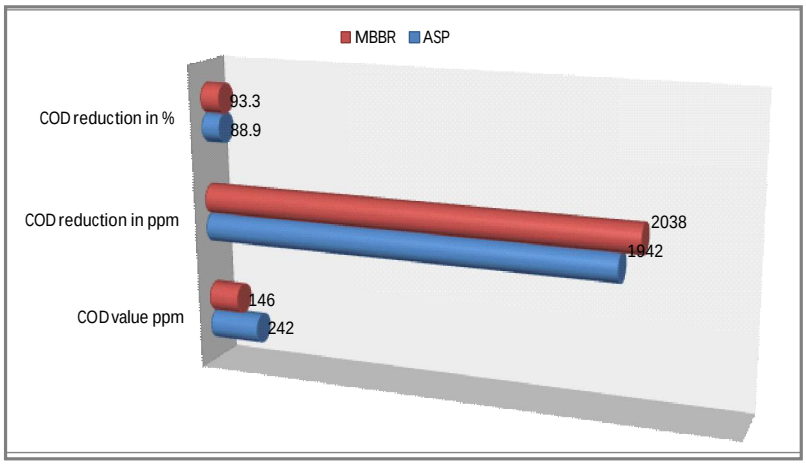



**Figure 4.** Comparison of COD reduction in Anti- epileptic dilute effluent stream in Activated Sludge Process and Moving Bed Bio Reactor Treatment

## CONCLUSION

The coagulation of wastewater compounds rate is affected by the alum, polyelectrolyte and poly aluminum chloride dosage. The evaporation process is also effective to separate volatile organic compounds, along with refractive organics in wastewater produced from Cardiovascular and Anti-epileptic therapeutic drug manufacturing. Biological degradation with Moving Bed Bio Reactor instead of conventional Activated Sludge Process and adsorption by activated Charcoal with high Iodine value is important treatment to achieve norms. MBBR treatment could be effectively utilized in bulk drug manufacturing industries for treatment of their effluent. This quality of treated waste water of Cardiovascular and Anti-epileptic therapeutic drugs to achieve pollution control authority and it can be reuse for utility purpose for makeup water of cooling towers, road, floor cleaning and equipment cleaning and can achieve 'Zero Liquid Discharge' strategy.

## REFERENCES

[1]. G. Wirzinger, L. Weltje, J. Gercken,; L, H. Sordyl *Genotoxicdamage in field-collected three-spined sticklebacks (GasterosteusaculeatusL.): a suitablebiomonitoring tool. Mutat.* Res.30, 2**007**, 628(1), 19-30.

[2]. H. I. Shuval, Wastewater recycling and reuse as a water resource for editerranean countries:hygienic and technological aspects. *In Proc.Conférence Méd-Travaux des Experts, Rome, Itally,* **1992**.

[3]. NV. SrikanthVuppala, Ch. Suneetha and V. Saritha, Study on treatment process of effluent in Bulk drug industry, *International Journal of Research in Pharmaceutical and Biomedical Sciences*, **2012**, 3(3), 1095 .

[4]. P. B. Jonathan, V. Nicolaos, Household disposal of pharmaceuticals as a pattern for aquatic contamination in the United Kingdom. *Environ Health Perspect*, **2005**, 113, 1705-1711.

[5]. Mriganka Sekhar Mukhopadhyay, Treatability Study of Effluent From Bulk Drug (Calsium D-Secharet) Industry Using Aerobic Biological Treatment, *International Journal of Emerging Trends in Engineering and Development*, 2013, 3(1), 264.

[6]. Eugene W. Rice, Rodger B. Baird, Andrew D. Eaton, Lenore S. Clescen American Public Health Association, *Standard Methods for the Examination of water and waste water,. 22nd Edition,* **1996,** Page no. 2-65, 2-66, 5-5, 5-17

[7]. V. G. Kulkarni, Indian Textile Industry, A review, *J. JEI (Textile Division)*, 1996, 77

[8]. PSI: Guidelines for treated wastewater: Disposal and reuse, Final Draft (Arabic version No. 2).*Palestine Standards Institution, Ramallah, West Bank, Palestine,* **2003**.