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A STUDY ON THE IMPACT OF SULFATE FREE ON HUASB REACTOR

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ABSTRACT - *This study evaluates the performance of HUASB reactors in anaerobic treatment of Sulfate rich wastewater. A Hybrid Up flow Anaerobic Sludge Blanket (HUASB) reactor, having a working volume of about 13L and Polypropylene rings were used as packing media. The initial feed concentration was about 500mg/L and further increased. Various characteristics like pH, COD, Temperature, TS, TSS, TDS and sulfate were analysed. Neutralization is achieved by adding suitable quantity of NaOH solution. The successful start up of both reactors was achieved in 60days. This study attempted to determine the influence of the HRT and feed concentration on the treatment of wastewater. The COD removal efficiency increased as HRT was increased. The maximum efficiency of both reactors was achieved at 8hrs of HRT. Optimum COD removal efficiency for "A" reactor was 84.28% and for "B" reactor was 83.71% for influent feed concentration 3,500mg/L. Sulfate free wastewater performance was analysed against normal wastewater. However the COD removal efficiency increased drastically to 94.3% for sulfate free influent feed at optimum feed concentration. From experimental investigation it was clear that reactor with sulfate free wastewater is efficient in treating spentwash when compared with normal wastewater.*

Key words: HUASB Reactor, HRT, Sufate, Industrial wastewater, Packing media, COD removal efficiency.

1. INTRODUCTION

Wastewater contains numerous substances that are consider has polluting influences. Impurities are any substances that are not found in pure water. Water, because of characteristic of solvent and its movement of particles, fuses altogether different pollutions that describe the water quality. Water quality is an after effect of natural aspect and the acts of human being. [1].

2. Wastewater from distillery industry

Wastewater generated from distilleries are spent lees from analyzer column, Spent wash from distillation process and other waste waters like fermenter washing, spillage, cleaning and cooling. The low strength waste water incorporates air blower water, spent lees, evaporation process, cooling water etc. The low strength wastewater which is treated might be reused in process and non-process applications lessening new water prerequisite in distilleries [4].

3. Hybrid Upflow Anaerobic Sludge Blanket Reactor (HUASBR)

The HUASBR is a two new concept that is the hybridized version of a UASB reactor the top of the reactor with a random packing media.

4. Sulfate

Many industries are intending to decrease sulfate toxicity and reuse water for industrial purposes and they also expect biogas to be recovered from their wastewater. Sulfate rich wastewater during anaerobic digestion plays a significant role in sulfate reducing bacteria.

5. Statement of problem

The Spentwash is major polluting wastewater from distilleries. For every liter of alcohol about 10-14 liters of spentwash is generated. When spentwash disposed off without treating, it is hazardous to crops and aquatic life. The HUASBR has been found to be a solution for treating such wastewater. However efficiency of the reactor has always been dependent on presence of sulfate in the wastewater. A attempt has been made to find the effect of sulfate on efficiencies of reactors.

6. Objectives

The objectives set for the studies are listed below.

- To investigate the characteristics of Industrial wastewater.
- To investigate the optimum Hydraulic Retention Time of the reactors.
- To find the optimum feed concentration and compare the performance of both the reactor.
- To compare the efficiencies of both reactors for COD reduction by varying concentrations of Sulfate and COD in wastewater.

7. Material and Methodology

In this study, a Plexiglas column was used as the anaerobic hybrid reactor. The overall height and effective volume of the hybrid UASB reactor is 1220mm and 16.9liter respectively. The sampling port was fixed

at various levels 25%, 50% and 75% of overall height of the reactor to collect the sample. Acrylic sheet was placed at 100mm from top and 50 mm distance from the bottom to arrest packing material and to avoid choking problem in both inlet and outlet of the reactor. Up to 50% of packing material was filled to the overall height of the reactor. The seeded sludge was fed into the reactor before feeding spent wash. The sludge was sieved into 1mm sieve in order to remove the beats. Both reactors were filled with cow dung and sludge (from KLE hospital treatment plant) of about 25% and 15% of working volume of the reactor respectively.

7.1 Polypropylene pall rings

In present study polypropylene ring is used as packing material by investigating previous studies polypropylene pall rings are more advantageous and has maximum removal efficiency. It is also known as polypropylene (PP).which is made of thermoplastic polymer. PP is used as packing material in many industries. Its specification are having low pressure drop, high free volume, small specific gravity and so on. PP is used in stripping, scrubbing and absorption services [9].

8. Results and Discussion

8.1 Characteristics of distillery spent wash

Table 1: Characteristics of distillery spent wash.

Characteristics	Values
pH	4.88
Colour	Dark brown
Conductivity (µs/cm)	14.61
BOD_3@27^{0}C (mg/L)	15800
COD (mg/L)	40000
Total Solids (mg/L)	35000
Dissolved Solids (mg/L)	34750
Suspended Solids (mg/L)	250
Sulfate(mg/L)	7606.41

8.2 COD removal efficiency at different Hydraulic Retention Time (HRT):

Initially both the reactors were loaded with COD feed concentration of 500mg/l and then concentration of COD was increased up to 1000mg/l. The HRT which had been set at 48 hrs was step by step decreased to find efficiency of COD removal at various HRT's.

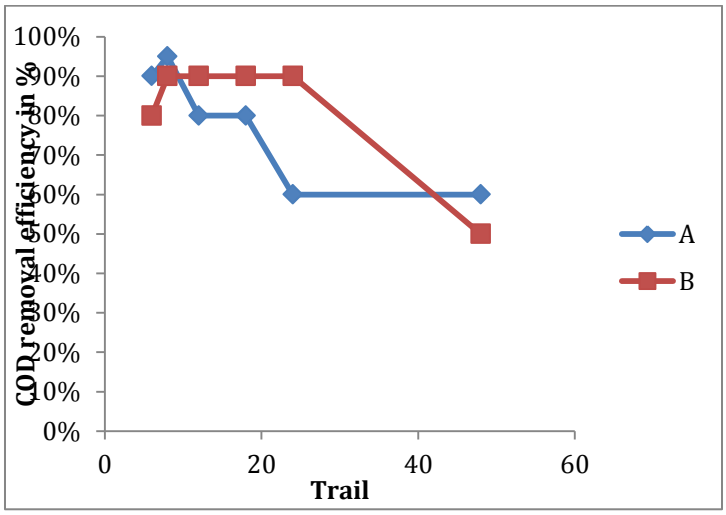

Figure 1: Reduction of COD at decreasing HRTs for influent COD fed concentration of 1000mg/L

From above graph it was evident that, the COD removal efficiency increased as HRT was reduced. The maximum efficiency for both the reactors was 95% and 90% at HRT of 8hrs. At 6hrs HRT the removal efficiency was reduced due to increase in OLR.

8.3 Overall performance of both the reactors for different feed concentration at optimum HRT

Overall performances of both the reactors were noticed for various COD concentration which was fed at optimum HRT

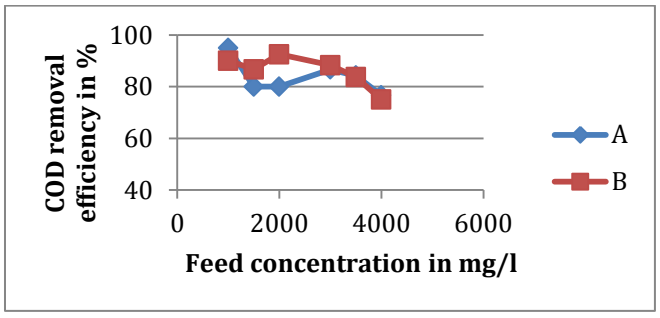

Figure 2: Efficiency in COD removal at different concentrations at optimum HRT

The experimental results obtained from working of both the reactors indicate that the reactors performed fairly well till the feed concentration reached 3,500mg/l and there after a steep decline in performance was notice around 4,000mg/l of feed concentration. Hence the feed concentration of 3,500mg/l was chosen as benchmark for further more optimization of the feed concentration.

8.4 Total solids: Total Solid removal efficiency for both reactors.

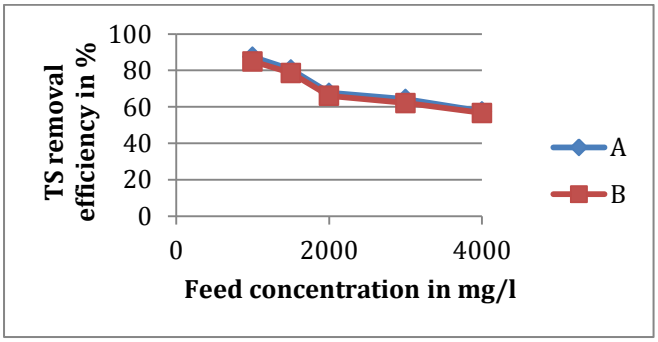

Figure 3: Total solid removal efficiency for both reactors at different feed concentration

During the study it was noticed that the Total solids removal efficiency at various concentrations declined as feed concentration of wastewater was increased.

8.5 Total dissolved solid (TDS): Total dissolved solid removal efficiency for both the reactor.

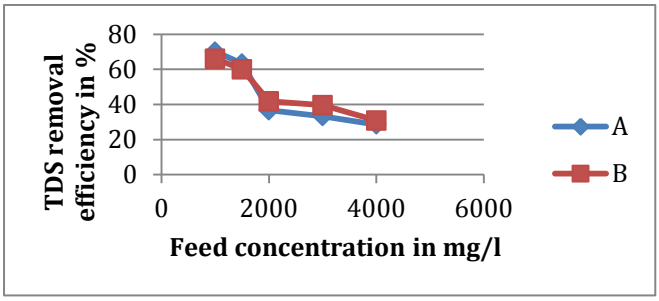

Figure 4: Total dissolved solid removal efficiency for both reactors at different feed concentration

During the study it was noticed that the Total dissolved solids removal efficiency at various concentrations declined as feed concentration of wastewater was increased.

8.6 Total suspended solids (TSS): Total suspended solid removal efficiency for both "A" and "B" reactor.

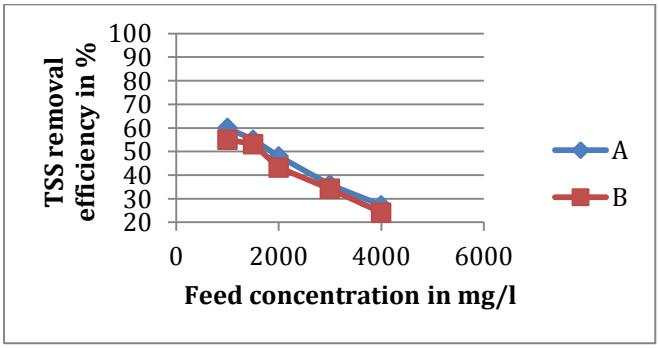

Figure 5: Total suspended solid removal efficiency for both reactors at different fed concentration

During the study it was noticed that the Total suspended solids removal efficiency at various concentrations declined as feed concentration of wastewater was increased.

8.7 Effect of Sulfate free wastewater in HUASB reactors

The experiments were further conducted to find out the effect of sulfate free wastewater on HUASB reactor behavior. Hence reactor "A" was feed with sulfate free wastewater. The sulfate removal was achieved by adding Zero valent Iron [12]. During the experiment 2gm of ZVI for 35 ml was added as per reference taken and continuously stirred for 3 hours later the sample was filtered with cloth and filter paper to remove fine particle of ZVI, thus filtered sulfate free wastewater was fed to the reactor to observe the COD removal efficiency.

8.8 Overall comparison of sulfate and sulfate free for different COD concentration at optimum HRT

For the present study the reactor "A" with sulfate free wastewater and "B" fed with normal wastewater varied with COD concentrations and each process was observed and studied to carry out the removal efficiency.

Table 2: Overall comparison of sulfate and sulfate free COD

Feed concentration	COD removal efficiency of sample with ZVI	COD removal efficiency of sample without ZVI
3250	86.1	84.6
3500	94.3	85.7
3750	85.3	84

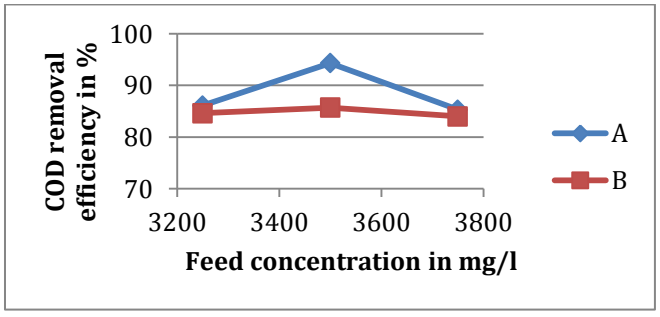

Figure 6: COD removal efficiency for sulfate and sulfate free waste water at different fed concentration at optimum HRT

From the above graph we can notice that for various COD concentration the sulfate free waste water has high COD removal efficiency as compared to "B" reactor.

9. CONCLUSIONS

Following conclusions are drawn from this study

· The wastewater analysed for parameters pH, colour, conductivity, BOD_3, COD, TS, TDS, TSS and Sulfate were found to be 4.88, Dark brown, 14.61 µs/cm, 15,800mg/L, 40,000mg/L, 35,000mg/L, 34750mg/L,250mg/L and 7606.41mg/L respectively.

The parameters were beyond permissible limits of CPCB standards and hence need to be treated before disposal.

· The successful start up of both reactors was achieved in 60days. The reactors were maintained at ambient temperature (temperature) and wastewater was neutralized by adding a suitable amount of NaOH solution.(pH trend)

· The optimum HUASB reactor retention time was 8 hrs.

· The maximum solid removal efficiencies decreased with increase in feed concentration in both reactors.

· Optimum COD removal efficiency for "A" reactor was 84.28% and for "B" reactor was 83.71% for influent feed concentration 3,500mg/L.

· The COD removal efficiency increased drastically to 94.3% for sulfate free influent feed at optimum feed concentration.

· From the experiment it is clear that "A" reactor with sulphate free wastewater has high efficiency in treating when compared to "B" reactor with normal wastewater.

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