

REDUCTION OF SULFATE FROM DISTILLERY SPENTWASH USING HYBRID UPFLOW ANEROBIC SLUDGE BLANKET REACTOR

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Abstract - The treatment of distillery spentwash using hybrid upflow anaerobic sludge blanket reactor with packing media as fluidized aeration bed (FAB) was evaluated for their ability to remove sulfate. Distillery spentwash has COD 70,000-90,000 mg/l and Sulfate 5400-6000mg/l SO_4 . During study, initial sulfate feed concentration was given 50 mg/l SO_4 and COD was at 900 mg/l. It was operated at different hydraulic retention times (HRT) i.e 48,24,12,8,6 and 4 hour at room temperature 25°C. Initially distillery spentwash was acidic in nature and it was neutralized by adding NaOH, pH to 7. The hydraulic retention was decreased gradually till 4 hours and at HRT 2 hours there was sudden collapse in sulfate reduction. Hence optimum hydraulic retention time (HRT) was considered at 4 hours. The optimum hydraulic retention time (HRT) was fixed to 4 hours. Keeping optimum hydraulic retention time (HRT) 4hours, sulfate feed concentration was increased from 50-300 mg/l SO_4 at an interval of 50 mg/l. The sulfate reduction was increasing gradually, At 200mg/l sulfate feed concentration, it showed optimum sulfate reduction. The COD reduction was optimum at 3500 mg/l. The Sulfate removal efficiency in HUASB reactor with packing media as fluidized aeration bed (FAB) was 95% at optimum sulfate feed concentration 200mg/l and the COD removal efficiency was 55% at optimum feed concentration at 3500mg/l. When sulfate feed concentration was increase at an interval of 50 mg/l, Sulfate efficiency of reactor was decreased and reached in 84% in HUASB reactor with packing media as fluidized aeration bed (FAB) at maximum sulfate feed concentration 300 mg/l.

Key Words: HUASB, Sulfate, Packing Medias, HRT, FAB and Distillery spentwash.

1. INTRODUCTION

Industrial wastewater mainly originated in pharmaceutical, paper and pulp, chemical units, edible oil, and molasses have high concentration of sulfate. Most of Industries are treating their wastewater aiming to reduce the toxicity of sulfate and reuse the water for their industrial process. Industries which are aiming to recover biogas from their wastewater, have more concern about sulfate. During anaerobic digestion sulfate rich

wastewater, Sulfate reducing bacteria play vital role in reduction of sulfate into hydrogen sulphide and other terminal products[1].

Sulphide toxicity can be reduced in many methods and easy way to dilute the wastewater, But this will increase the volume of wastewater which is not recommended. The physico-chemical techniques such as stripping, chemical by precipitation, coagulation, oxidation and as well biological methods such as anaerobic & followed by aerobic treatments are the other alternative [3,4].

Most of the industrial wastewaters were treated both aerobic and anaerobic biological methods. Anaerobic biological methods have more advantages than aerobic methods especially in energy recovery i.e. methane yield. But methane yield is being affected by larger concentration of sulfide. Many industries have larger concentrations of sulfate in their effluents, when sulfate rich wastewaters were treated in anaerobic conditions, sulfate was reduced to hydrogen sulfide. Hydrogen sulfide generated during the sulphidogenesis phase would affect the methanogenesis and methane yield. Hydrogen sulfide is toxic, odorous gas is corrosive in nature.

This work evaluated the biological sulfate removal using two anaerobic hybrid upflow sludge blanket reactors with different packing medias and keeping specific objectives:

- to determine the optimum hydraulic retention time HRT
- to determine the optimum feed concentration of sulfate and COD
- to evaluate performances of reactors for sulfate removal

2. MATERIALS AND METHODOLOGY

The experimental set-up of the anaerobic hybrid upflow sludge blanket reactor is shown in Fig. 1. The reactor was made from acrylic tubes with internal diameter 142 mm and overall height of reactor was 1220 mm, Influent inlet was provided 50 mm from bottom of the reactor and effluent was provided 100 mm from top level of the reactor. An opening was made at top of reactor for gas collection and three sampling ports were provided at height of 318 mm from bottom of the reactor at 268 mm

c/c, effective volume of the reactor 16.9 litres. U-shape was provided for influent and effluent as well as to sampling ports, to avoid air leaks. To withdraw excess sludge, sludge removal port was placed opposite to influent at 30 mm from bottom of the reactor. The dosing pump was used for feed the reactor.

The reactor was filled with fluidized aeration bed (FAB) media in the reactor. Temperature, Surface area and void ratio of FAB media were 55° C, 400 m²/m³, 90%. The ratio of packed material to total volume was 50% in reactor. The distillery spentwash was collected from Ugar Sugar work ltd., Ugar Khurd, Belagavi and neutralized with NaOH to a pH 7.

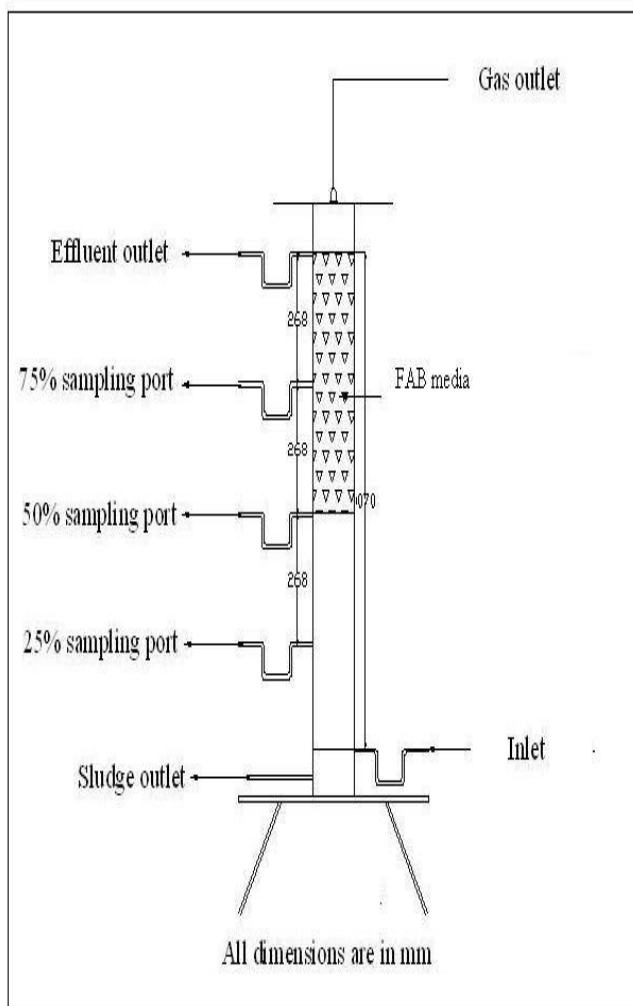


Fig -1: Experimental setup

Anaerobically digested non-granular sludge from septic tank, coupled with cow dung was used as seed for the study. The sludge was sieved with a mesh of 2 mm to remove large debris and inert impurities of large size, which may hinder operation. The initial concentration of seed was 900 mg/l COD and sulfate was 50 mg/l. The study was carried out using distillery spentwash. The

average characteristics of distillery spentwash are shown below.

Table 1: Average characteristics of distillery spentwash

| Parameters | Concentration |
|-------------------------------|---------------|
| pH | 3.6 |
| Color | Dark brown |
| COD (mg/L) | 70,000-90,000 |
| BOD ₃ @27°C (mg/L) | 36,000-45,000 |
| Total solids (mg/L) | 85,000-88,000 |
| Suspended solids (mg/L) | 10,00-11,000 |
| Dissolved solids (mg/L) | 75,000-78,000 |
| Sulfate (mg/L) | 5400-5500 |

The samples were collected from feed tank and the outlet provided in the reactor and were analysed immediately after collection. The flow rate, pH of influent an effluent was recorded daily. The parameters such as influent and effluent Sulfate, COD were measured once in every two days. These parameters were analysed as per standard methods for examination of water and wastewater (APHA and AHW, 1995).

3. RESULTS AND DISCUSSION

The reactor was started with an initial sulfate feed concentration of 50 mg/l and COD 900 mg/l at constant hydraulic retention time 48 hours. The study was conducted at temperature 25°C-35°C. The sulfate feed concentration was increased step wise from 50-300 mg/l and COD was increased accordingly, simultaneously HRT decreased step wise from 48 hours to 24 hours. Again sulfate feed concentration was increased by 50 mg/l interval and HRT was decreased from 24 hours to 12 hours. The process performance data of HRT study i.e Sulfate and COD removal are shown in the Fig 2 respectively.

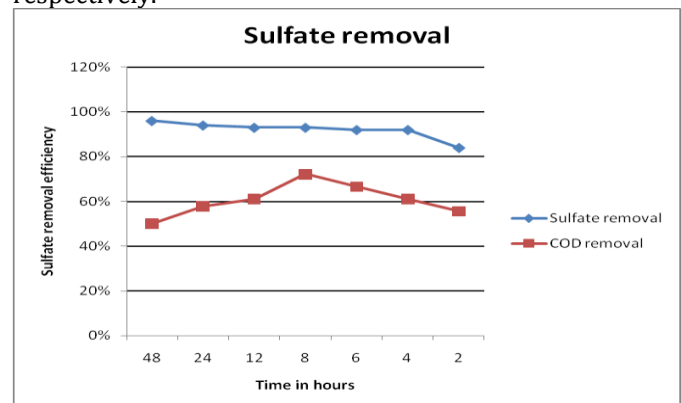


Fig-2:Sulfate and COD removal profiles at various HRT

Initially Sulfate reduction was maximum at 48 hours, as HRT was decreased from 48 to 4 hours, sulfate reduction decreased gradually till 4 hours and at HRT of 2 hours there was sudden collapse in sulfate reduction hence at 4 hours was considered as optimum HRT. Keeping optimum HRT 4 hours, Sulfate feed concentration was increased at an interval of 50 mg/l. The HUASB reactor with FAB as media showed sulfate reduction maximum 95% at optimum 200 mg/l sulfate feed concentration. Further the HUASB reactor showed COD reduction maximum 55 % at optimum 3500 mg/l CO feed concentration. The Figure 3-4 shows the pattern of different sulfate and COD feed concentrations at HRT 4 hours.

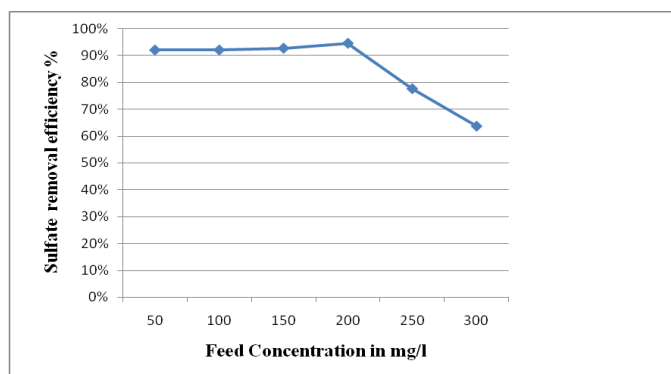


Fig -3: Sulfate reductions for reactor at various feed concentrations

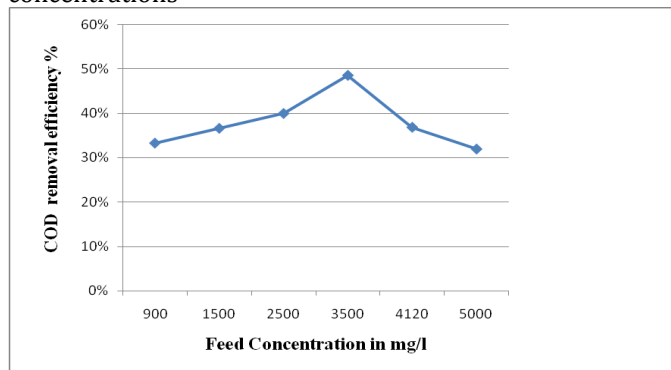


Fig -4: COD reductions for reactor at various feed concentrations

3. CONCLUSIONS

The following conclusions can be drawn from the present study:

- The distillery spentwash was analysed and sulfate was found to be 5500 mg/l and COD was 70000 mg/l. The hybrid upflow anaerobic sludge blanket reactor was fabricated with FAB media as packing materials.
- The optimum HRT was found to be 4 hours at initial sulfate concentration 50 mg/l and COD 900mg/l.

- The Sulfate feed concentration was increased from 50 to 300 mg/L and COD 900-5000mg/l keeping the constant HRT of 4 hours.
- The optimum sulfate feed concentration was found to be 200mg/l and COD feed concentration 3500 mg/l.

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BIOGRAPHIES



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