International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-7, May 2020

# Treatment of Real Sugarcane Industry Effluent using HUASBR

**T. Kavimani, K. Balaji**

***Abstract: Sugar mill is one among the foremost industries that discharge the effluent in immense amount causes grim effects on soil and ground water which in turn creates serious environmental issues. This study investigates the reactor interpretation and performance of treating real sugar industry effluent. The system was protected with seed sludge from the obtained anaerobic treatment process unit managing sago effluent followed by it is started using synthetic sago wastewater, then it is fed with real sugar industry wastewater. The reactor is fed with the industrial effluent having the Chemical Oxygen Demand (COD) of 4560 to 4880 mg/L with Hydraulic Retention Time (HRT) of 24 hours. The various parameters such as pH, % COD removal Efficiency, Volatile Fatty Acid (VFA), Alkalinity and Bio-gas production are measured.***

***Keywords: Biogas, HUASB, Sugar industry, Wastewater.***

## I. INTRODUCTION

The sugar mill is contributing to economic development in many countries, but it may also have a negative impact on the surrounding condition [1]. The changes of organic environment for the sugarcane agriculture in coastal region and tropical regions were resulted in critical damage to environment, loss of biodiversity and landscape ecosystem [2].These effluents not only indicates a surrounding hazards, whereas also obtain a possible energy value which is not fully utilized despite the fact that they are economical and overflowing in almost throughout the world [3]. The water resources must be protected from these wastes, and the adequate treatment is to be provided to reduce their pollution potential. The biodegradable impurities present in wastewater can be treated by using either aerobic or anaerobic process [4]. The anaerobic process are advantageous than aerobic process, since the aerobic process needs an external supply of air. In all varities of reactors, particularly in anaerobic reactors, Upflow Anaerobic Sludge Blanket (UASB) reactor is used widely for treating the wastewater [5].

Nowadays HAUSBR, the anaerobic biological sludge blanket systems proposed over recent years have elicited considerable interest because of their good removal efficiency. It has the advantages of relatively simple layout, low capital and operating costs. In these HUASB reactors, Granular biomass and magnificent settling properties can be enlightened [6].

**Revised Manuscript Received on May 30, 2020.**
* Correspondence Author
**Kavimani. T***, Associate Professor, Department of Civil Engineering, Government College of Engineering, Thanjavur, Tamilnadu, India. Email: tkavimani@gmail.com
**Dr. K. Balaji,** Associate professor, Department of Civil Engineering, University College of Engineering, Anna university, Panruti, Tamilnadu, India.



This HUASB reactor is used successfully for treatment of all kinds of industrial wastewaters as elucidated in [7]; [8]; [9] and [10]. Various investigations are carried out to fetch the feasibility of treatment of real sugar industry effluent under bench scale hybrid UASB of stress loadings. Shortening the period of start-up is one of the consequences as it can have major advantages of HUASB applications. After the start-up process [7] the operating parameters, such as COD and pH were varied and fed to rector at constant HRT of 24 hours. The rise in COD removal efficiency is observed when the HRT is increased is a sign of high pollution of microbes existing to change organic matter to valuable byproducts rapidly [11].

## II. MATERIAL AND METHODS

### A. Biomass

The active anaerobic granular sludge and effluent were collected from SAGO factory, Salem, Tamilnadu, India. To remove the impurities granular sludge was clearly washed filtered through a fine mesh and then it is loaded into the reactor. The volatile suspended solid content of the collected sludge is estimated about 60000 mg/l which is well within its required prescribed limit [12].

### B. Wastewater

Real sugar industry wastewater was collected from MRK sugar industry, Sethiyathope, Tamilnadu, India. The characteristics were immediately analysed before feeding the reactor.

### C. Experimental Setup

Figure 1 illustrates the schematic arrangement of the proposed HUASBR in this research. The polymethyl methacrylate tube is used in this fabrication of reactor .In this study bio balls were used as packing media and it was loaded in the upper third segment of the reactor. The black colored bio balls of 152 pieces with same size of diameter 28mm , specific area of 550 $m^2/m^3$, porosity hollow of 0.97 were used to prevent the movement of biogranules from the reactor. For analyzing the collected samples at different heights 5 sampling ports were installed. The reactor was operated at room temperature of 31º C to 35º C.Specifications along with physical features are tabulated briefly in Table 1.

**Table 1: Distinct Characteristics of HUASBR**

| S.NO | SPECIFICATION | RANGE |
|---|---|---|
| 1. | Volume of HUASBR | 30 liters |
| 2. | Operative volume of HUASBR | 20 liters |

| | | |
|---|---|---|
| 3. | Diameter of HUASBR | 150 mm |
| 4. | Height of HUASBR | 1420 mm |
| 5. | Effective height of HUASBR | 1170 mm |
| 6. | Influent Feeding Pump | 20 model Peristaltic pump |
| 7. | Packing Media | Bio ball with bio sponge (inside), 28mm |
| 8. | Specific area of Packing media | 550 $m^2/m^3$ |
| 9. | Void ratio of Bio Ball media | 97% |
| 10 | Density of Bio Ball Packing Media | 27grams / liters |
| 11. | Material of HUASBR | Acrylic Plastic Plexiglass Tube |

## III. RESULTS AND DISCUSSION

### A. COD removal

The proposed HUASB reactor is fed with real sugar industry effluents with a COD concentration ranges from 4560 mg/l to 4880 mg/l at 24 hrs HRT. The result acquired throughout the method run for various days after start-up of the reactor is illustrated in Figure 2. Figure 3 portrays the COD removal efficiency of the proposed HUASBR at different days and it is found to vary from 73.30% to 82.7%. Ndobeni et al., [1] achieved 77.6% of highest removal efficiency of COD by treating sugar cane molasses using UASB reactor. Mijaylova Nacheva et al., [14] have achieved around 82 % of COD removal efficiency using UASB reactor by treating similar sugar mill wastewater. Compared to available reactors in the literature, the proposed HUASB reactor has fetched 82.7% COD removal efficiency at 24 h HRT on 4th day.

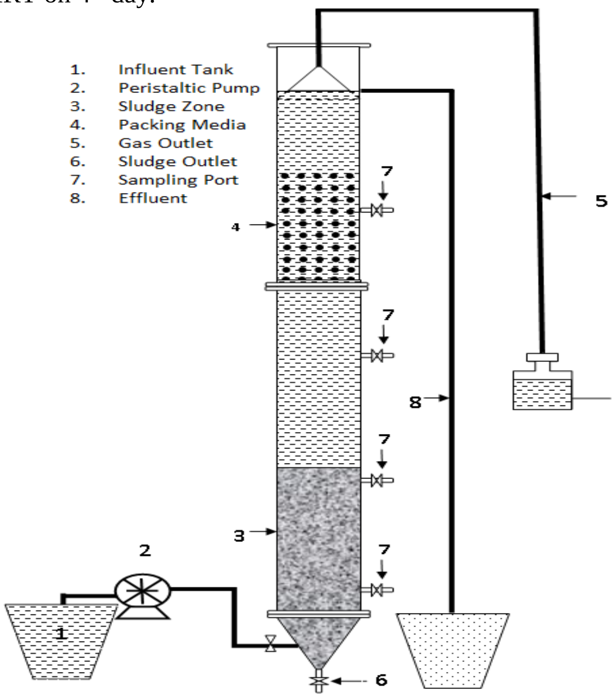


**Figure 1: Schematic representation of HUASBR**

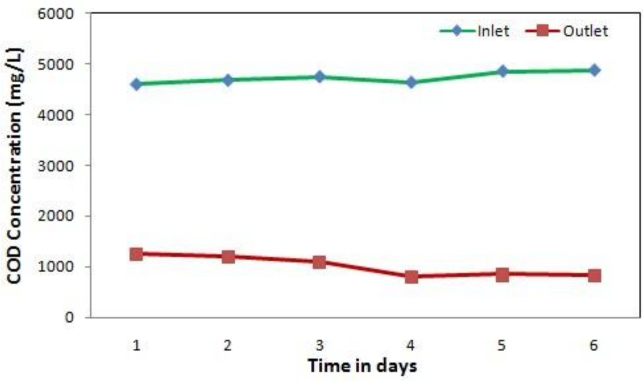


**Figure 2: Concentration of COD**

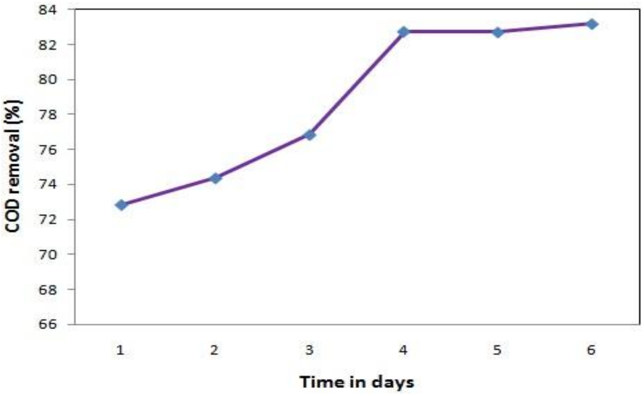


**Figure 3: COD Removal efficiency**

### B. pH, VFA and Alkalinity

The various essential characteristics of the effluent such as pH, VFA and alkalinity are also carefully analyzed at constant HRT. The inlet and outlet pH values of the effluent sample in HUASBR is measured and illustrated in Figure 4. It is observed that the inlet pH value is in the range of 6.3 to 6.9 and the outlet pH value lies in the range of 7.2 to 8, which indicates the stable operation of the proposed reactor. Further, the concentration of VFA over 6 days are measured carefully and portrayed in Figure 5. The variation of VFA ranges from 36 to 48 mg/l over its horizon for all the HRTs. The nearly persistent range of VFA obtained, proves the redundancy and secure performance of the proposed HUASBR. Figure 6 depicts the change in alkalinity of the HUASBR over the prescribed time horizon. The alkalinity values for the reactor ranges from 664 to 760 mg/l. From the obtained results of pH, VFA and alkalinity, it is observed that the performance of proposed reactor is under control for the secure performance of the UASBR as in [15].

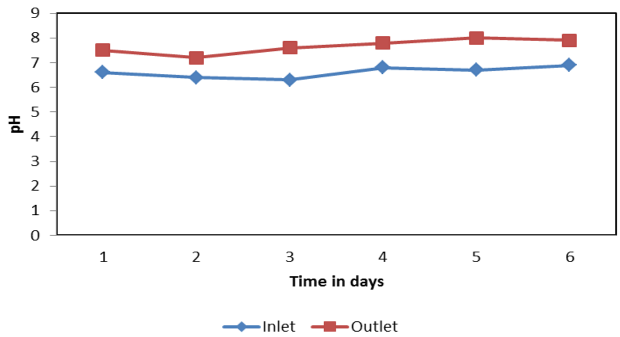


**Figure 4: pH of inlet and outlet at all HRTs**

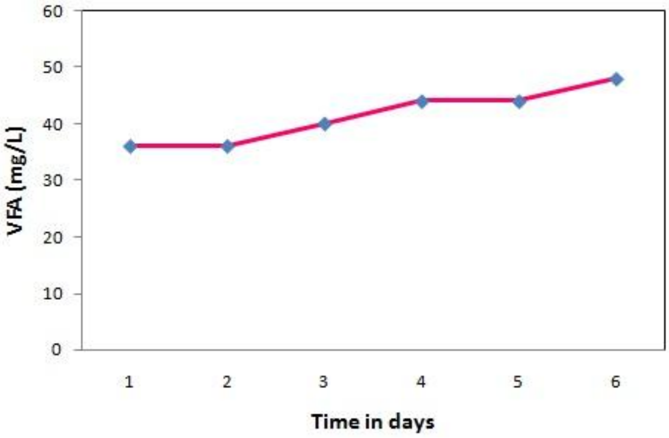


**Figure 5: Concentration of VFA**

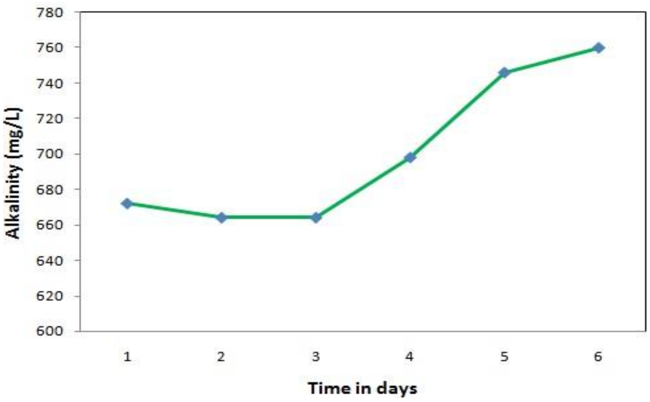


**Figure 6: Alkalinity of the reactor**

### C. Biogas

The HRT is varied in the reactor over a time horizon and the biogas production at constant HRT is measured and portrayed in Figure 7. The obtained result clears that as the removal efficiency of COD increases biogas production increases with increase in HRT to a certain level and then it get decreased. The maximum biogas production of 10.8 l/d was attained at 24 h of HRT on 4$^{th}$ day. Biogas production pattern is unswervingly associated with COD stabilization pattern. Hampannavar et al., [16] in 2010 had attained maximum of 14.66 l/d of biogas production while treating sugar industry wastewate. Tanksali [17] in 2013 had attained maximum of 13.7 l/d of biogas production treating sugar industry wastewater in UASB reactor.

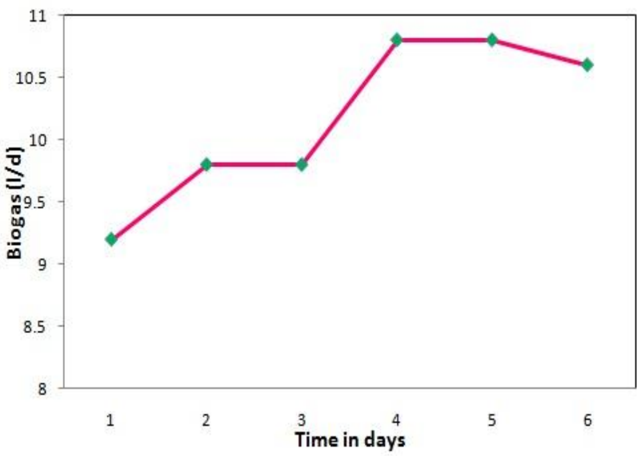


**Figure 7: Biogas Production at various days**

## IV. CONCLUSION

The results obtained while treating the real sugar industry wastewater by the proposed HUASB reactor is superior and highly reliable. The maximum removal efficiency of COD achieved by the reactor is 82.7 with biogas production of maximum 10.8 l/d. The pH, VFA and alkalinity of the reactor effluent are also under control for every 24 h of HRT which greatly signifies the redundancy of the proposed reactor. From the results obtained, it is clear that the HUASB reactor could be a very feasible and can be able treat the supply of high organic effluents also.

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## AUTHORS PROFILE

**T. Kavimani** is currently working as Associate professor in Department of Civil Engineering, at Government College of Engineering, Thanjavur, Tamilnadu. He has been teaching UG & PG classes well over 16 years. His research interests include Industrial Wastewater Treatment and Environmental Engineering. He has to his credit 20 research papers of which 5 papers are Scopus Indexed.

**Dr. K. Balaji** , Associate professor in Department of Civil Engineering, University College of Engineering, Panruti, Tamilnadu. He has completed his doctoral research at Annamalai University in 2016. He has been teaching UG & PG classes well over 16 years. He has to his credit 30 research papers of which 10 papers are Scopus Indexed.