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CHEESE WHEY TREATMENT BY HYBRID UASB

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ABSTRACT
Utilization of cheese whey is a major concern nowadays which creates many environmental problems. Characterization study of whey effluent for Color, Total Suspended Solid (TSS), pH, BOD, COD, Sulphates, Alkalinity was performed. Raw whey was given the primary treatment of coagulation by using FeCl3 as a coagulant and secondary treatment by hybrid UASB (UASFF). The lab scale potential of UASFF for pretreated whey effluent was assessed for the organic loading in the range of 0.5 to 6 kg COD/ m3. d. The HRT is also varied in the range of 8, 20, 24 and 48 hrs. The influent and effluent were analyzed for the parameter for Total Suspended Solids, Total Dissolved Solids, pH, Alkalinity, Sulphates, Volatile Fatty Acids, COD and BOD. UASFF system is efficient to treat whey effluent with average COD removal efficiency of 88% at an organic loading of 4 kg/m3.d at 20 hrs HRT.

KEYWORDS: Hybrid UASB, organic loading, BOD, COD.

I. INTRODUCTION

The dairy industry in India has shown a steady progress since Indian independence. It has grown from producing 17 million tones of milk in 1951 to producing 121 million tones in 2011. (Gyan Research and Analytics Pvt. Ltd., 2013). The dairy industry is one of the largest industries in India. It has been estimated that, the world whey production is over than 160 million tons per year approximately half of this total cheese whey (CW) production is discarded directly to the environment, representing a significant loss of resources and a major pollution problem. To make one kilo of cheese, nine kilos of CW are produced. Disposal of untreated CW shows high risk to aquatic life and leads to water pollution. The high pollutant load of CW, along with its continuously increasing production (>2% every year,), lead to a serious management problems.[2]

Cheese whey has a very high organic content (60 to 80 gCOD/L) In addition; whey in nature has low bicarbonate alkalinity and tends to rapidly acidify due to its very high biodegradability. Supplemental alkalinity is required so as to avoid anaerobic process failure.[3]

Anaerobic treatment of cheese whey is widely used method to deal with cheese whey management. Various laboratory and pilot scale trials of anaerobic treatment of whey have been conducted. Many of researchers used diluted whey which is much simpler to use and treatment of raw whey is problematic to treat anaerobically because of very low bicarbonate alkalinity, high COD(~70 g-COD), a tendency to acidify very rapidly, the difficulty to obtain granulation.[4]

Therefore aim of this study was to treat pre-treated cheese whey with hybrid UASB. This HUASB reactor enjoys the advantages of both UASB (which ensures good contact between biomass and substrate) and anaerobic filter (AFs can retain more biomass within the reactor).This kind of reactor is called by various names viz., Sludge Bed Filter (SBF), Up-flow Bed Filter (UBF), Hybrid Up-flow Anaerobic Sludge Blanket (HUASB) reactor or simply hybrid reactor.[5]

II. MATERIALS AND METHODS *A. Sample collection*

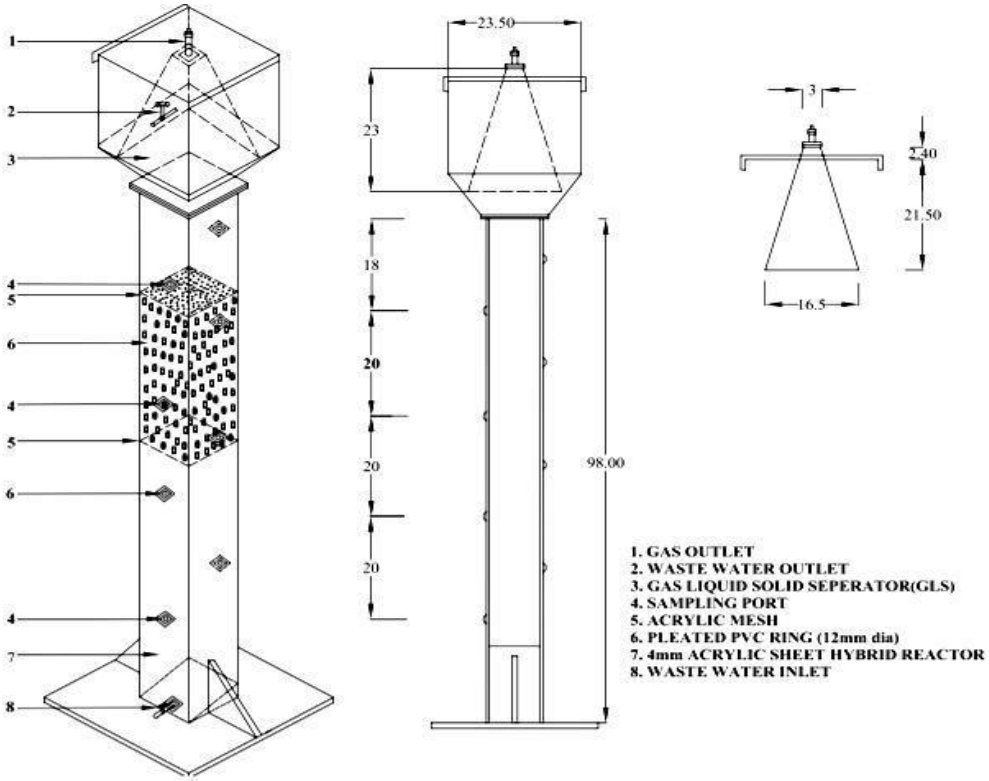
Cheese whey which is used in UASFF reactor obtained from a dairy industry near city of Kolhapur. The wastewater was analyzed for color, total Suspended solid, pH, BOD, COD, sulphates employing methods detailed in standard methods. (APHA 1992).

B. Pretreatment of cheese whey

Raw whey effluent given primary treatment of coagulation in Jar test by using Fecl3 at optimum pH4 and Optimum dose 200mg/L. After addition of coagulant the solution was rapidly mixed at 150 rpm for 5 minutes this was followed by slow mixing of 30 minutes at 30 rpm. Suspensio n kept undisturbed for settling time for 60 minutes. The final effluent was analysed for COD, TSS.

C. Experimental Setup

Experimental set up of UASFF is designed to treat pre-treated whey effluent from cheese section of dairy industry. The components of set up are influent tank, inlet with peristaltic pump, UASFF reactor, outlet arrangement for effluent. The reactor is fed by influent tank through peristaltic pump.



Reactor is made up of 4m m thick clear acrylic sheet to study the performance evolutio n of whey effluent. The volume of the reactor is 19.25L. In thiis UASFF reactor poll rings are used as solid support material. The influent tank is made up of plastic with 20 L capacity. Sil icon tube is assembled to pump whose one end is dipped into t he influent tank and other end is connected to reactor. GLS separator is connected to gas assembly through gas pipe. Ga s measurement is done with the help of water displacement me thod.[6]

D. Bioreactor operation: Characteristics of Cheese whey

Inoculum used for the UASFF reactor is taken from UASB reactor of dairy. The whey effluent collected pre-treated and diluted so as to obtain required organic loading for feed to the reactor. Pretreated whey effluent was assessed for the organic loading in the range of 0.5 to 6 kg COD/ m3. d. The HRT is also varied in the range of 8, 20, 24 and 48 hrs. The purpose is to optimize organic loading and HRT. The influent and effluent were analyzed for the parameter for Total Suspended Solids, Total Dissolved Solids, pH, Alkalinity, Sulphates, Volatile Fatty Acids, COD and BOD.

First organic loading of 0.5 kg COD/ m3.d was selected after initial start up. the pre-treated whey effluent is carried out to obtain required organic loadings. The influent and effluent was analyzed for at constant HRT of 24 hrs, six organic loading were At constant HRT of 24 hours six organic loadings were applied i.e. 0.5, 1, 2, 3, 5 and 6 kg COD/ m3. d.

RESULT AND DISCUSSION

E. Characteristics of cheese whey The characterization study of whey effluent was carried out. The wastewater sample were collected from whey section and analyzed.

Pretreatment of cheese whey

At optimum pH and optimum dose the removal efficiency of Fecl3 for COD, TSS is 67%, 80% respectively.

Treatment of pretreated cheese whey with hybrid UASB

The UASFF reactor was operated for 79 days. During initial days the performance was not good as it was the fig.a. shows organic loading and it's variation with time is shown in the organic loading was continuously varied to pre determined values ranging from 0.483 to 6.1109 kg COD/ m3.d. fig.b. shows Variation of percent of COD removal with organic loading is shown in fig. 3.4. Influent COD varied in range from 500 to 8000 mg/L and effluent COD varied from 260 to 1270 mg/L. During initial loading COD removal was not satisfactory.

Variation of influent and effluent alkalinity with Organic Loading is shown in fig.c. It shows that as organic loading increases there is increase in influent and effluent alkalinity. At organic loading of 6 kg COD/ m^3.d, there was highest effluent alkalinity i.e. 598 mg/L and highest influent alkalinity 495 mg/L.

Variation of effluent alkalinity with organic loading is shown in fig.d. It shows that as organic loading increases effluent alkalinity is also increases. Steady rise in the effluent alkalinity was observed from 3 kg COD/ m3.d when external alkalinity was not added.

Fig.a. Variation of Organic Loading applied with respect to time.

Fig.b. Variation of percent of COD removal with organic loading.

CONCLUSION

This study was aimed to evaluate the potential of UASFF bioreactor to treat the high strength whey effluent which is pretreated. UASFF system was assessed for different organic loadings and HRTs. The performance evaluation was carried out for various parameters. The organic loadings was varied from 0.5 kg/m^3.d to 6 kg/m^3.

The characterization study carried out for raw effluent which shows that the whey effluent is amenable for treatment by UASFF bioreactor.

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7. At constant HRT 24 hrs, optimum organic loading is obtained i.e. 4 kg/m3.d with COD removal efficiency of 84.03%.
8. UASFF system is efficient to treat whey effluent with average COD removal efficiency of 88% at an organic loading of 4 kg/m3.d at 20 hrs HRT.
9. Increase in organic loading beyond 4 kg/m3.d there is decrease in average COD removal efficiency.