COMPARISON OF THE BEHAVIOUR OF EXPANDED GRANULAR SLUDGE BED (EGSB) AND UPFLOW ANAEROBIC SLUDGE BLANKET (UASB) REACTORS IN DAIRY WASTEWATER TREATMENT.

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Abstract

In the present study an upflow anaerobic sludge blanket (UASB) reactor and an expanded granular sludge bed (EGSB) reactor were operated with different substrates under the same conditions. The application of the UASB and EGSB reactors for the treatment of low strength wastewaters was investigated. The effect of dissolved oxygen on the methanogenic activity of granular sludges, the low substrate levels inside reactors and lower temperatures on the treatment performance were evaluated. The results showed that methanogens located in granular sludge have a high tolerance to oxygen. The concentration to cause 50% inhibition to methanogenic activity was between 7% and 41% oxygen in the head space of flasks, corresponding to 0.05 mg/I and 6 mg/I of DO prevailing in the media, respectively.The feasibility of UASB and EGSB reactors at 30°C was demonstrated. In UASB reactors, COD removal efficiencies exceeded 95% at organic loading rates up to 6.8 g CODI/.d and influent COD concentrations ranging from 422 to 722 mg/l, during the treatment of ethanol substrate. In EGSB reactors, efficiencies were above 80% at OLRs up to 12 g CODI/.d with COD as low as 100 to 200 mg//. The studies confirmed that in practice DO does not constitute any detrimental effect on the reactor treatment performance.Lowering the temperature down to 15°C in EGSB reactors also showed that the potentials of anaerobic technology can be further explored in the treatment of dilute wastewaters

Key words: *EGSB Reactor ,Dairy industries,methanogenic,UASB.*

Introduction

Rapid growth of industries has not only enhanced the productivity but also resulted in the production and release of toxic substances into the environment, creating health hazards and effected normal operations, flora and fauna. These wastes are potential pollutants when they produce harmful effects on the environment and generally released in the form of solids, liquid effluent and slurries containing a spectrum of organic and inorganic chemicals.

Thus pollution is a necessary evil of all development. To combat the plethora of environmental evils of present day society, efficient and environmentally safe organic waste treatment technologies are needed.Beside like other industries that have serious waste disposal problem, the milk based food industry is faced with the prospect of having to erect a large number of relatively small treatment plants. Liquid effluent from milk based food industry pose environmental problems like water and soil pollution. Oil & grease in wastewater generated from milk based food industry poses a major threat to the environment besides lactose, another pollutant component considering the project demand by 2020 A.D.

The milk based food industry in India is expected to grow rapidly and have the waste generation and related environmental problems are also assumed increased importance. Poorly treated wastewater with high levels of

pollutants caused by poor design, operation or treatment systems creates major environmental problems when discharge to surface water or land. During the last twenty years, the anaerobic digestion processes for the treatment of wastewater experienced an important development. In this evolution, the UASB reactor has played an important role, becoming probably the most used alternative. In this reactor, a high sludge concentration can be retained inside the reactor with simple and low cost equipment. This high sludge concentration allows the operation of the reactors under high organic loads.

The EGSB reactor is a modification of the traditional UASB technology. Both use granular sludge, but the EGSB reactor operates at high superficial velocities (7-1O m/h), which are obtained by high recirculation rates and an elevated height/diameter ratio. This causes high hydraulic mixing which improves the wastewater-sludge contact. No support matter is needed, which can be an important aspect for some applications.

Traditionally, anaerobic digestion has been applied to medium and high strength wastewaters. In recent years, growing efforts have been applied in order to establish the feasibility of high rate anaerobic digestion to the treatment of diluted effluents. Under dilute wastewater operation, low concentrations of substrates are present in the reactor, which will produce a low bacterial activity. In a traditional UASB reactor this may result in channeling of the wastewater through the bed and therefore in a poor water-sludge contact. The high superficial velocities of EGSB reactors enhance mass transfer rate . Besides, the EGSB reactor has shown to be suitable for the treatment of biodegradable toxic or inhibitory compounds.Since they operate with high recirculation ratios, the inlet is diluted to levels that are no longer dangerous for bacterial activity. Superficial velocities have shown also to have an effect over size and activity of anaerobic granules.

The present research deals with the comparison of EGSB and UASB reactors, operated with different substrates, focusing on the effect of the superficial velocity on the removal efficiency.

EXPERIMENTAL PROCEDURE

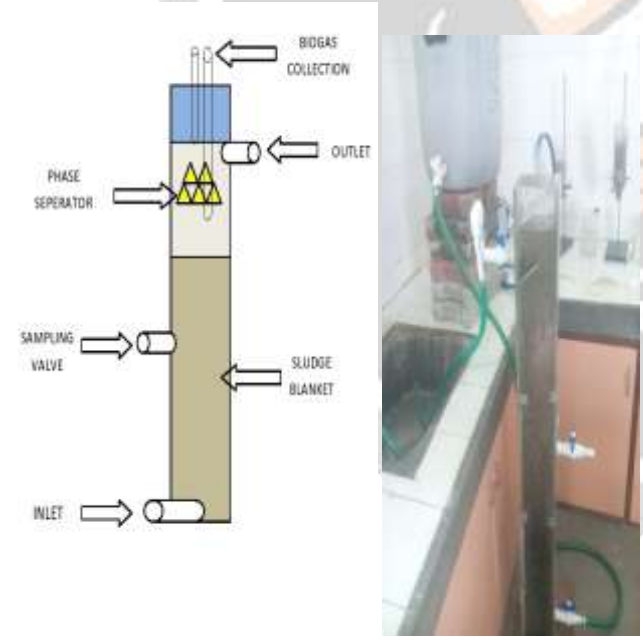


Diagram **fig.1**

The reactor consists of a column portion (11.7 L) and a gas-solid separators (GSS) portion (5.1 L). The height and inside diameter of PVC cylinder column are 130 cm and 10.2 cm. The total liquid volume of the reactor is 16.8 L including GSS . This volume was used for calculations of volumetric loading and hydraulic retention time. The EGSB reactor was operated for over 200 days under 20°C. The up-flow velocity was set to 5 m/h; effluent recirculation was set to maintain this required up-flow velocity. In previous work, it was found that inoculation of granular sludge was effective in shortening the reactor start-up period needed to maintain a sufficient SRT. Our

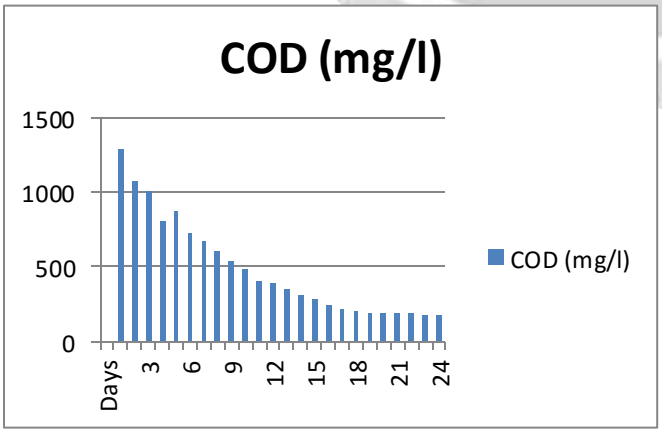
reactor was inoculated with mesophilic granular sludge, obtained from a full-scale UASB reactor receiving sugar-containing wastewater, and started with 360 g VSS, giving a concentration of 45 g VSS/L of reactor.

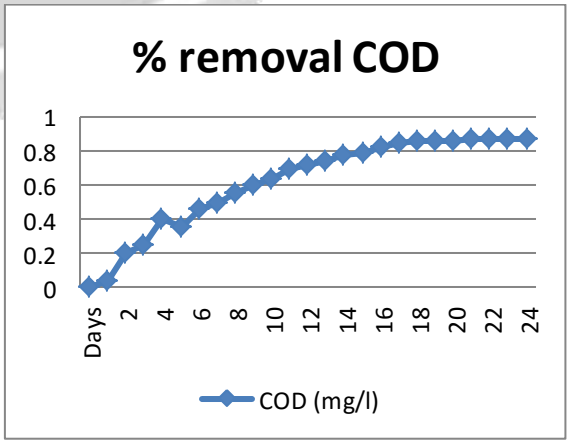
Characteristics of dairy wastewater

characteristics	Combine effluent	Test method
pH	6.1	
TSS	1650 mg/l	APHA 2540 C
BOD	810 mg/l	APHA 5210
COD	1340 mg/l	APHA 5220
TDS	1150 mg/l	APHA 2540 B

RESULTS

COD mg/l							
Days	Inlet	After Using EGSB	COD Removal %	Days	Inlet	After Using EGSB	COD Removal %
1	1340	1286.4	4	13	1340	354	73.58
2	1340	1072	20	14	1340	309.2	76.93
3	1340	1005	25	15	1340	280	79.05
4	1340	804	40	16	1340	244.1	81.78
5	1340	871	35	17	1340	209	84.40
6	1340	723.6	46	18	1340	199.7	85.10
7	1340	670	50	19	1340	190.4	85.79
8	1340	603	55	20	1340	186.2	86.10
9	1340	536	60	21	1340	184	86.27
10	1340	482.4	64	22	1340	181.9	86.43
11	1340	406.9	69.63	23	1340	180.1	86.56
12	1340	387	71.12	24	1340	179.6	86.60





UASB Performance at same condition.(By study paper)

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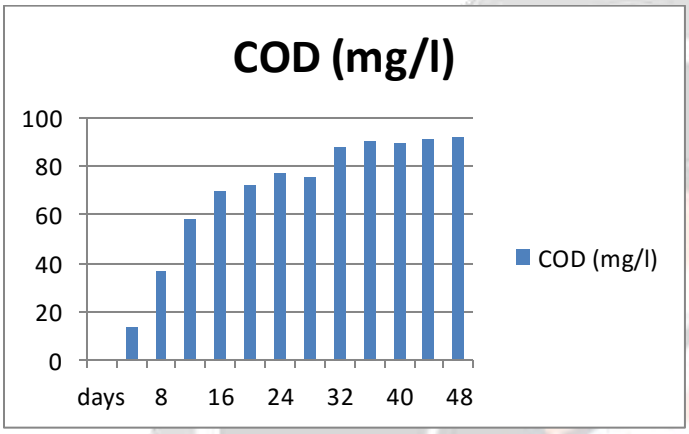
Days	COD removal %	Days	COD removal %
4	13.40	32	**88**
8	36.72	36	**90**
12	58	40	**89**
16	70	44	**91**
20	72	48	**91.5**
24	77		
28	75		



CONCLUSION

- Higher upflow velocities 5.5 m/hr in EGSB when in UASB 0.5 m/hr. It shows higher upflow velocity of EGSB.
- More suitable for dilute wastewater than UASB reactors (in that case effluent recirculation is not applied).
- The sludge is always granular, very active, and the settleability is good.
- Start up time less compare to UASB
- High recycle ratio than UASB

So , in near future EGSB will surely demanded.

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