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TO EVALUATE YIELD COEFFICIENT OF MICROAEROPHILIC UPFLOW SLUDGE BED REACTOR (MUSB) USING ACETIC ACID AS AN ORGANIC SUBSTRATE.

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INTRODUCTION

Microaerophilic Upflow Sludge Bed Reactor (MUSB) is a process in which sulfate is utilized as an electron acceptor by sulfate reducing bacteria to degrade organic substances present in the wastewater. Instead of fully aerating the wastewater, which result in large energy consumption, wastewater is partially aerated and is allowed to pass through the reactor in an upflow fashion. This upflow pattern coupled with development of filamentous Beggiatoa under microaerophilic conditions result in the formation of granular sludge. High settelability of granular sludge results in low ss in the efluent. This research paper evaluate the yield coefficient of MUSB process.

MATERIALS AND METHODS

Fig 1 shows two stage MUSB. Each stage has two vessels ; Aeration Vessel (AV) and Biological Vessel (BV). Air diffuser is provided in AVs. In each BV mixer with speed varying from 0.5 - 2.0 rpm has been installed. Attached media has been provided in AVs for a depth of about 1m. The total Volume of MUSB reactor is about 120 litre. The wastewater was recirculated from BV2 to BV1 as shown in Fig 1.

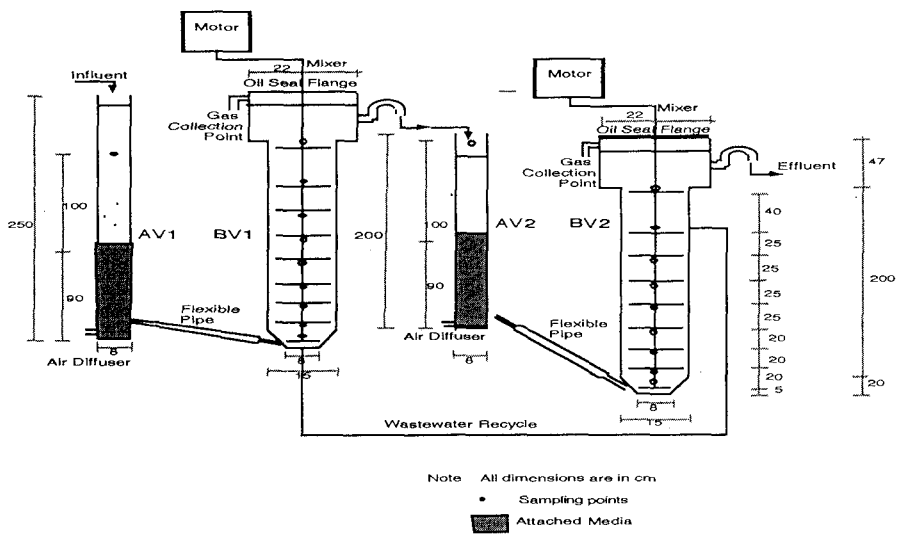


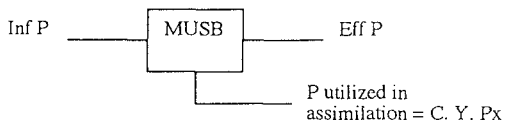
Fig 1 Microaerophilic Upflow Sludge Bed Reactor (MUSB)

Sludge from anaerobic digester was used as a seed sludge. About 5-10 % of total volume of BVs was fed with the digested sludge. Synthetic wastewater with acetic acid as an organic substance was used. Table 1 shows composition of concentrated synthetic waste water. Influent concentration was maintained between 200-250 mg/l by diluting with tap water. Table 2 shows the operating conditions maintained in the reactor.

Table 1 Composition of wastewater

Substance	Concentration
Lactic acid	10.0 g/l
NH_4SO_4	8.0 g/l
K_2HPO_4	1.0 g/l
$NaHCO_3$	10.0 g/l
$MgSO_4$	1.0 g/l
$CaCl_2$	1.2 g/l
KCl	4.0 g/l
Yeast Extract	1.0 g/l

It is difficult to evaluate yield coefficient of granular process such as MUSB using conventional carbon balance. Hence phosphorous balance was carried out to determine yield coefficient of MUSB. The main principle involved has been explained in Fig 2.



Inf P - Eff P = P utilized in assimilation

Where

C = Organic matter removed
Y = Yield coefficient
Px = P content of sludge = $\frac{\text{Total P - Dissolved P}}{\text{MLVSS}}$

Fig 2 Phosphorous (P) balance for MUSB.

RESULTS AND DISCUSSIONS

At a flow rate of 35 l/hr, at a detention time of 3.5 hrs about 200-220 mg/l of COD was applied. Effluent total COD was found to vary between 40-50 mg/l and filtrate COD was about 25 mg/l as shown in Fig 3. Hence about 80 % of COD removal effeciency was achieved at about 1.4 Kg COD/cum.d of loading. SS in the effluent was less than 20 mg/l.

About 50 % of COD was degraded in AVs due to attached media where total detention time is only 35 min. And remaining COD was degraded in BV1 either by heterotrophs utilizing oxygen coming from AV or by sulfate reducers utilizing sulfate as an electron acceptor. In BV1 granules were formed and resulted in a sludge blanket in the whole BV1. MLVSS was found to vary between 7000-8000 mg/l. However in BV2 MLVSS was less than 1000 mg/l as most of the COD is consumed upto AV2. Fig 4 shows biomass profile along the depth for BV1.

To calculate yield coefficient P balance was carried out. Fig 4 shows that % P stored in the sludge was uniform along the depth in BV1. 1.4 % of P was stored in the sludge. Fig 5 shows the amount of P in the influent and effluent. Organic matter removed was calculated from Fig 3. Yield coefficient was calculated using P balance as shown in Fig 2 and was found to vary between 0.35-0.45.

Table 2 Operating Conditions maitained in MUSB

Flow rate	35 l/hr
Total detention time	3.5 hrs
Detention time in	
AV1	20 min
BV1	89 min
AV2	16 min
BV2	89 min
Upflow velocity in SB part of BV1 and BV2	142 m/d
Recirculation ratio	200 %

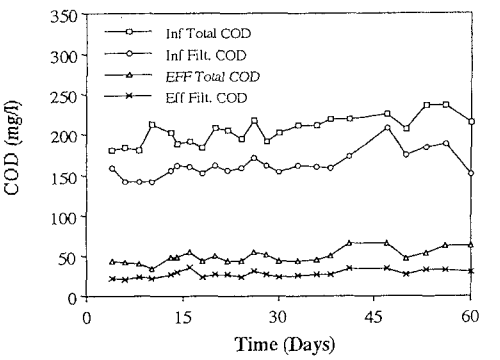


Fig 3 Performance of MUSB in terms of COD removal.

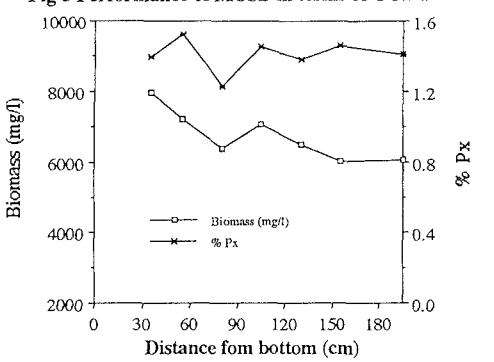


Fig 4 % P stored in the sludge of BV1 of MUSB for phase II.

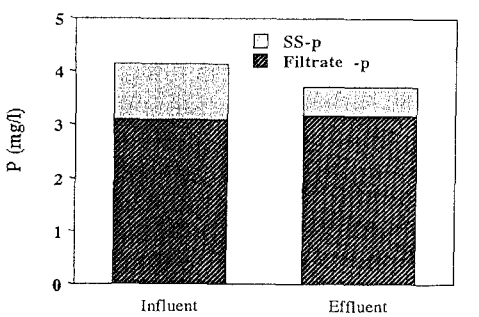


Fig 5 Change of P conc in the reactor.