Development of Decentralized Wastewater Treatment System for Kitchen Wastewater

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***Abstract*— Decentralized Wastewater Treatment System (DEWATS) is treatment system in which wastewater is treated at the point of wastewater generation source. This project is mainly focuses on providing low cost treatment at source only project study based on design of DEWATS for department of technology hostel kitchen wastewater. A laboratory scale experiment carried out treating hostel kitchen wastewater using anaerobic baffled reactor (ABR) and horizontal gravel filter (HGF). ABR show 77% removal efficiency for COD, 78% for BOD, TSS is 81%, TDS it is 33%. Also HGF shows removal of BOD is 84%, Chemical oxygen demand (COD) is 72%, TSS is 61%, TDS it is 30%.**

Keywords*— DEWATS, Anaerobic baffled reactor, Horizontal gravel filter

I. INTRODUCTION

There are mainly three types of methods followed to treat wastewater that is centralized system, cluster and decentralized system. Centralized system has lowest plant construction cost but on the other hand, connecting individual sources to the treatment unit may result in up to five times the cost for the required sewerage. Maintenance costs also high because sophisticated mechanized equipment requires permanent care. Second is a cluster system connects several smaller treatment units to sewerage of shorter overall-length. Construction costs are relatively low, but qualified management may be needed for each plant, thus increases the cost. Third one is a fully decentralized system would need a natural environment that is capable of absorbing the discharged wastewater of each individual plant on-site. Structural costs are likely to be the lowest for fully decentralized systems, especially if slightly sub-standard treatment is accepted. [7]

DEWATS is an approach, rather than just a technical hardware package. It provides treatment for wastewater flows from 1 - 500 m3 per day, from both domestic and industrial sources. .It is based on a set of treatment principles the selection of which has been determined by their reliability, longevity and tolerance towards inflow fluctuation also it provides permanent and continuous operation, however fluctuation in effluent quality may occur temporarily. [8]

Wastewater pretreatment in high-rate anaerobic reactors like UASB and post-treatment by CW have already been investigated and promising results have been reported. Also the applicability of ABR as high-rate anaerobic reactor for pretreatment and secondary treatment through CW for DEWATS has been investigated and promising results are reported. The main advantages of this combination were assumed to be.

- Reducing the complexity in the construction, O&M of high rate anaerobic reactors
- Reducing SS removal to reduce the clogging in the following CW
- Reducing the sizing of the CW. [9]

Wastewater generated from kitchen is of high strength as comparing to domestic wastewater therefore it is essential o treat this wastewater separately if quantity of wastewater generation is large.

Therefore this study is carried out to determine removal efficiency of by providing such type of low cost treatment for specially kitchen wastewater.

II. MATERIAL AND METHODOLOGY

The laboratory scale models for anaerobic baffled reactor and horizontal gravel filter was prepared .The size of the ABR Was: length 50 cm, width 20cm, height 30 cm. A proper construction of the baffles allowed wastewater to flow through the sludge bed from bottom up. Anaerobic digested sludge is provided for seeding of ABR. For horizontal gravel filter a tray is used having dimensions length 52 cm height 17cm width 23 cm in which at the bottom a perforated pipe is provided to collect the outlet sample. As substrate gravel is placed up to 10cm above which sand layer and soil layer is provide for growth of plants. Most important part of HGF is vegetation, it is selected by considering local availability, tolerance to high pollutant loading therefore plant chosen is conna indica and it is placed in top layer of soil. Kitchen wastewater is collected from department of technology, Shivaji University, Kolhapur hostel kitchen. Wastewater is applied to ABR with HRT 21 hours, Outlet of ABR is then applied to Horizontal gravel filter of having HRT 3.5 days and parameters BOD, COD, TSS, TDS, pH are checked for inlet and outlet for both reactors.

III. RESULT AND DISCUSSION

The domestic wastewater was analyzed for the following parameters such as pH, BOD, COD, a, total suspended solids, dissolved solids. Model worked out for one month during which six times analysis are done. The influent concentration of parameters was high and varied daily.

Table No. I shows results of analysis before and after process of wastewater for anaerobic baffled reactor. And Table no.2 shows parameters for horizontal gravel filter.

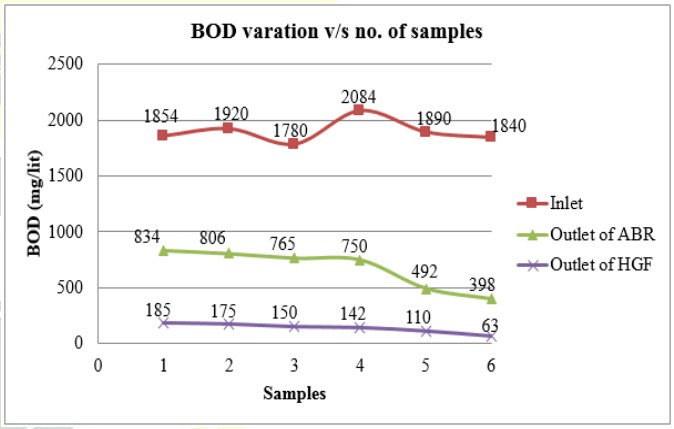
TABLE I. INLET AND OUTLET RESULTS FOR ANAEROBIC BAFFLED REACTOR

Sr.no	Inlet/outlet	ph	BOD	COD	TSSW	TDS
1	Inlet	8.2	1854	3100	1480	950
	Outlet	6.5	834	1450	310	735
2	Inlet	8.1	1920	2948	1390	865
	Outlet	6.7	806	1238	213	557
3	Inlet	7.9	1780	3000	1248	854
	Outlet	6.6	765	1280	165	589
4	Inlet	8.1	2084	3332	1550	1000
	Outlet	6.7	750	1100	242	650
5	Inlet	7.8	1890	2890	1456	798
	Outlet	6.6	492	742	220	535
6	Inlet	8.1	1840	2900	1350	820
	Outlet	6.5	398	643	254	574

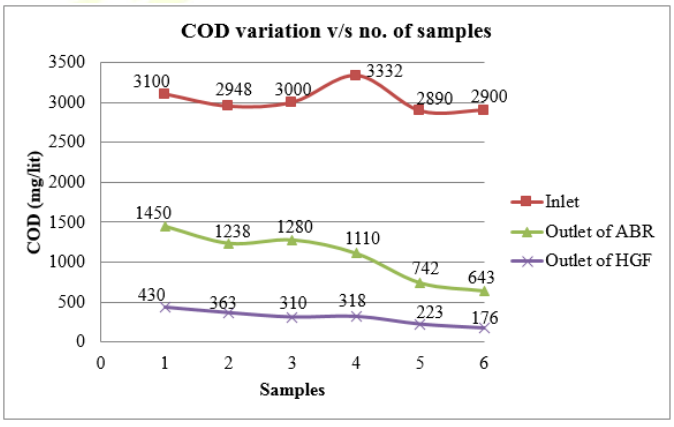
TABLE II. INLET AND OUTLET RESULTS FOR ANAEROBIC BAFFLED REACTOR

Sr.no	Inlet/outlet	ph	BOD	COD	TSSW	TDS
1	Inlet	6.5	834	1450	310	735
	Outlet	7.2	185	430	120	573
2	Inlet	6.7	806	1238	213	557
	Outlet	7.1	175	363	90	487
3	Inlet	6.6	765	1280	165	589
	Outlet	7.0	150	310	65	448
4	Inlet	6.7	750	1100	242	650
	Outlet	7.1	142	318	105	461
5	Inlet	6.6	492	742	220	535
	Outlet	7.2	110	223	83	375
6	Inlet	6.5	398	643	254	574
	Outlet	7.0	63	176	98	413

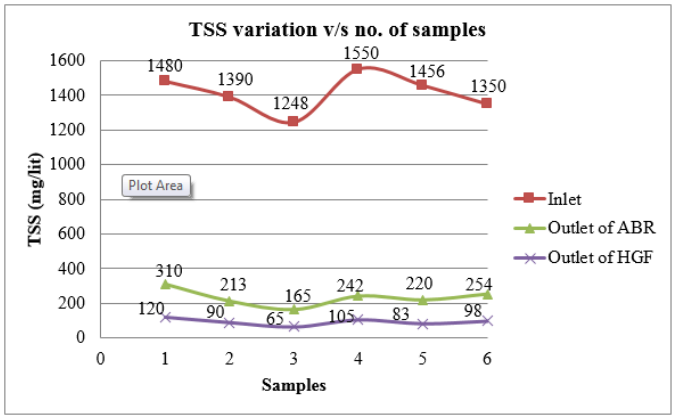
Graph No.1 shows that anaerobic baffled reactor (ABR) initially shows 55% reduction for Biochemical Oxygen Demand (BOD), and then next successive reading it shows higher BOD removal up to 78% percentage due to good sludge formation and For Horizontal Gravel Filter BOD reduction is higher than ABR it does not showed difference in reduction as like ABR. Maximum BOD reduction for HGF is 84%. COD of inlet wastewater ranges from 2900-3100 mg/lit. Graph No 2 shows that inlet concentration is very high but after anaerobic digestion process it reduces up to 70%- 75% of inlet concentration. TSS of inlet wastewater ranges from 1250-1550 mg/lit. Graph No.3 shows TSS reduction of different samples. It shows that inlet concentration is very high but after anaerobic digestion process it reduces up to 85% due to high HRT 21 hrs and media provided in 2nd chamber. In HGF TSS reduction is 60%. TDS of inlet wastewater ranges from 800-1000 mg/lit. Graph No.4 shows TDS reduction of different samples. Graph shows that inlet concentration is very high but for anaerobic digestion process it reduces up to 33% and for HGF it is 30%



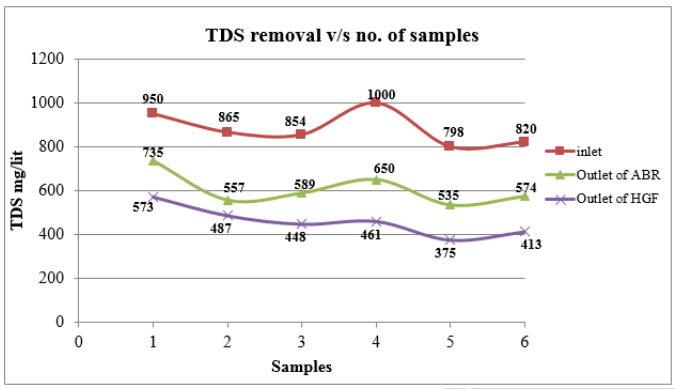
Graph. 1. Graph of BOD v/s No. of samples.



Graph. 2. Graph of COD v/s No. of samples.



Graph. 3. Graph of TSS v/s No. of samples.



Graph. 4. Graph of TDS v/s No. of samples.

CONCLUSION

It can be concluded that there is high potential of using ABR as primary treatment. ABR is very effective in the removal of organic parameters and could achieve TSS removal up to 85%, BOD up to 78% and COD up to 75% also more efficiency can be achieved by increasing number of chambers. Horizontal gravel filter also shows BOD is 84%, Chemical oxygen demand (COD) is 72%, and TSS is 61%. For designing DEWATS for high strength wastewater combination of ABR and HGF shows good results.

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