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DESIGN OF SEQUENTIAL ANAEROBIC AEROBIC BIO FILTER BASED REACTOR FOR THE TREATMENT OF TANNERY WASTE WATER

Deepakraja T G[1], Prabhu P[2], Dr.S.Keerthinarayana[3]

[1]P.G Scholar, Dept. of civil engineering, Coimbatore Institute of Technology.
[2]PhD Scholor, Dept. of civil engineering, Coimbatore Institute of Technology.
[3]Professor, Dept. of civil engineering, Coimbatore Institute of Technology.

Abstract - *Ever since the industrial revolution in any country, it was obvious that several environmental impacts have been marred in all components until it was appropriately noticed and properly monitored. So, end-of-pipe treatment scheme is being the sole practice (or option) from several decades, in effectively treating and disposing-off liquid emissions to the receiving environment, both in advanced and developing nations. Anaerobic –aerobic systems have been remarkably employed in Industrial and municipal wastewater treatment for many years. In recent years, high rate Anaerobic-aerobic bioreactors have been increasingly employed for wastewater with high Chemical Oxygen Demand (COD). This paper demonstrates treating of high strength tannery waste water by Sequential Anaerobic-aerobic bio filter based reactor is advantageous due to minimal space requirements, low capital cost, excellent COD removal efficiencies (in excess 80%). Alkanity, volatile fatty acids and gas production is also monitored in this Sequential anaerobic-aerobic bio filter based reactor.*

***Key Words*: COD, bio filter, tannery waste water, bio reactor, gas production.**

1. INTRODUCTION

The agricultural development and industrial growth are the two integral components of sustainability of India, after independence. The sustenance and economic stability of independent India is due to its major industries like mining, iron and steel, cement, fertilizers, and chemicals, petroleum refinery, energy, petrochemicals, pesticides, leather tanning, textiles and others. Among these, tanneries are the oldest which are still being operational throughout the World. As far as south India is concerned, Tamilnadu is being contributed much towards the significant growth of tanneries and textile fabric industries. One of the report documents about the operation of about 6000 tanneries in the Vellore district of Tamilnadu, generating huge amount of wastewater (Das, 2001).

Pre-tanning and tanning (either chrome or/and vegetable based) are the vital operations in any tannery industry, apart from post process. They not only consume huge amounts of process chemicals (about 300 kg/t of hide to be processed) and water (around 60 m^3/t of hide) but also, produce equivalent amount of highly polluted wastewater (Verheijen *et al*, 1996). Hence, the wastewaters from tanneries are highly saline containing 1 to 10 % of salts (w/v) and greatly complex possessing BOD, COD, TDS, SS, NH_3, TKN, acids, alkalis, vegetable tans, Cr, and others at substantially high levels. Due to high degree of complexity and pollution potentials of these wastewaters, many industries are struggling hard (especially in developing and under developed countries) to meticulously treat them before discharging these to the environment. Substantial efforts are being applied to prevent the environmental damage caused by these wastewaters, by making use of both conventional and advanced technologies such as coagulation, coagulation-cum-settling, ozonation, filtration, biological treatments like stabilization pond, solar pond, sequential batch reactor (SBR), anaerobic filters, fluidized beds, UASBP, and others around the globe (Song *et al,* 2004; Lidia *et al, 1994*; Punal*et al,* 2003; Woolard and Irvine, 1995; Singh and Viraraghava, 2004: Saffermane*t al*, 2004; Lefebvre *et al,* 2005; and Rajesh Banu and Kaliappan, 2007). In all these studies pertaining to biological methods, some level of inhibition of microbial activity by certain class of pollutants like tannin, Cr^{6+}/Cr^{3+}, sulphites, acids and/or alkalis, salts, and others have been reported.

1.1Objective

- To effectively treat the real tannery wastewater by using Sequential Anaerobic – Aerobic Bio filter.
- Performance Study of Sequential Anaerobic – Aerobic Bio filter.
- To effectively reduce the COD

2. REACTOR DESIGN

The laboratory scale reactor is designed to an overall capacity of 7.71 liters with inside diameter of 100 mm and the total height of column was 1750 mm. The overall volume of the reactor was 7.7 liters and this was separated as anaerobic and aerobic zone of volume 3.31 and 3.21 liters. The total effective volume of the reactor considering aerobic and anaerobic zone was 6.51 liters. Also hoods are provided at the top and the bottom of the reactor for gas venting and probable sludge accumulation, respectively; along with three different sampling ports at appropriate location. Further, good quality PVC tubing was provided for the influent flow, gas collection and others.

- Internal diameter of glass column – 100 mm
- Total height of the column – 1750 mm

- Overall effective volume of the anaerobic zone – 3.3 l
- Overall effective volume of the aerobic zone – 3.2 l
- Total effective volume of the reactor considering aerobic & anaerobic zones – 6.5 l
- Overall volume of the reactor – 7.7 l(including bio filter)

2.1 Packing Media Material

In all studies, the polypropylene hexagonal inert media (heat and corrosion resistant) were used to pack the top 25 cm depth (about 72 numbers) above the liquid portion in the reactors. The typical specification of these balls is shown below.

Table-1: Specification of Polypropylene Polyhedral Spherical Balls Inert Media

Sl No:	Specification	Result
1	Colour	White
2	Diameter	36mm
3	Height	30mm
4	Weight	4.41 g/piece
5	Specific gravity	0.92
6	Total specific surface area	3882 m^2

3. METHODOLOGY

3.1 Startup of reactor

An effective performance of anaerobic reactor chiefly depends on the efficient startup of the reactor. For this, many inoculums medium, such as horse dung, cow dung, rumen liquid of animal, sewage sludge, septic tank sludge, distillery sludge and others have been successfully used in the startup of various reactors. Although the acclimatized sludge obtained from the particular anaerobic – based treatment d been used in the startup of the reactor, while treating the respective waste water generated from the industry; other inoculums mixtures containing the above mentioned media had been used. Based on the previous studies pertaining to the startup of the reactor. combination of rumen liquid of goat and cow dung slurry at 3:1 (v/v) was selected for the efficient startup of reactor

Reactor was started by sending appropriate portion of inoculum mixture and waste water with influent cod of 9600mg/l into the reactor periodically. initially ,500ml of inoculum mixture containing 350 ml of rumen liquid and 150ml of cow-dung was pumped through peristaltic pump at the rate of 0.5ml/min. subsequently ,at the second and third days of the startup, about 1l solution of inoculums mixture and wastewater at the ratio of 1:1 and 1:3(v/v),were respectively pumped at the rate of 0.5ml/min. On the last day 800ml of waste water introduced into the reactor at constant rate of 0.5ml/min. Finally reactor was covered with black cloth kept undisturbed for 22 days .during the startup period color changes from olive green to blackish

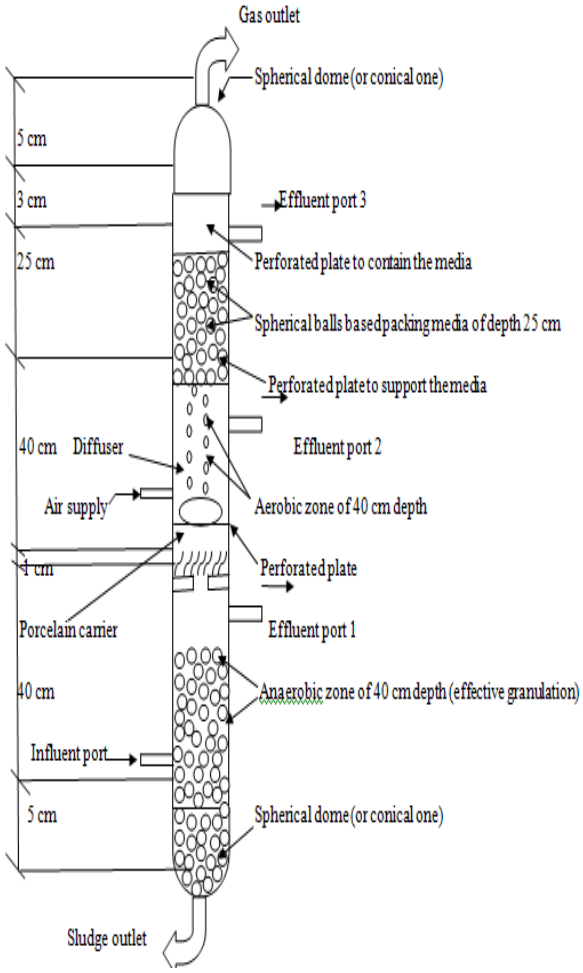

Fig- 1: Layout of reactor

Fig-2: Typical colour changes during the startup of reactor

3.2 Non –stepwise performance studies of reactor

The performance of any reactor chiefly depends on the prime parameters like OLR (based on cod values) and HRT together with other secondary factors. Effort was made to assess the non –stepwise performance of the reactor under moderate HRT. Vital parameters associated with the assessment of performance of reactors are VFA, COD, Gas production with the composition of pH, alkalinity, TSS and others.

4. CONCLUSIONS

Based on the studies pertaining to the treatment of the waste water by sequential anaerobic –aerobic bio filter based reactor, the following conclusions were drawn

1. The Sequential Anaerobic-aerobic reactor is highly suitable for tannery waste water
2. The polypropylene polyhedral spherical inert media are suitable in reactor
3. A high correlation is expected between cod removals with those of variations in Vfa and alkalinity
4. Expected maximum COD removal of 63.8 and 74% can be achieved proper by utilization of reactor

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