TREATMENT OF SLAUGHTERHOUSE WASTES

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ABSTRACT

Wastewater from slaughterhouses and meet processing industries have been classified by EPA as the most harmful to the environment. Slaughterhouse operated by Faculty of Agriculture at south east of Alexandria has been discharging raw wastewater on open chanel. Wastewater of slaughterhouse was collected, analysed and treated anaerobically without recycling. Operation of the lab scale reactor was maintained at 5, 4, 3,2,1 and 0.5 day as a hydraulic retention time. Removal efficiency of COD, PO_4 and NH_4 were in the range of 77-96%, 65-84% and 31-52% respectively. Anaerobic treatment must be followed by an aerobic unit to improve the effluent quality before discharging on to surface water.

Keywords: Slaughterhouse, Anaerobic Mesophilic, Aerobic, Reactor

INTRDOUCTION

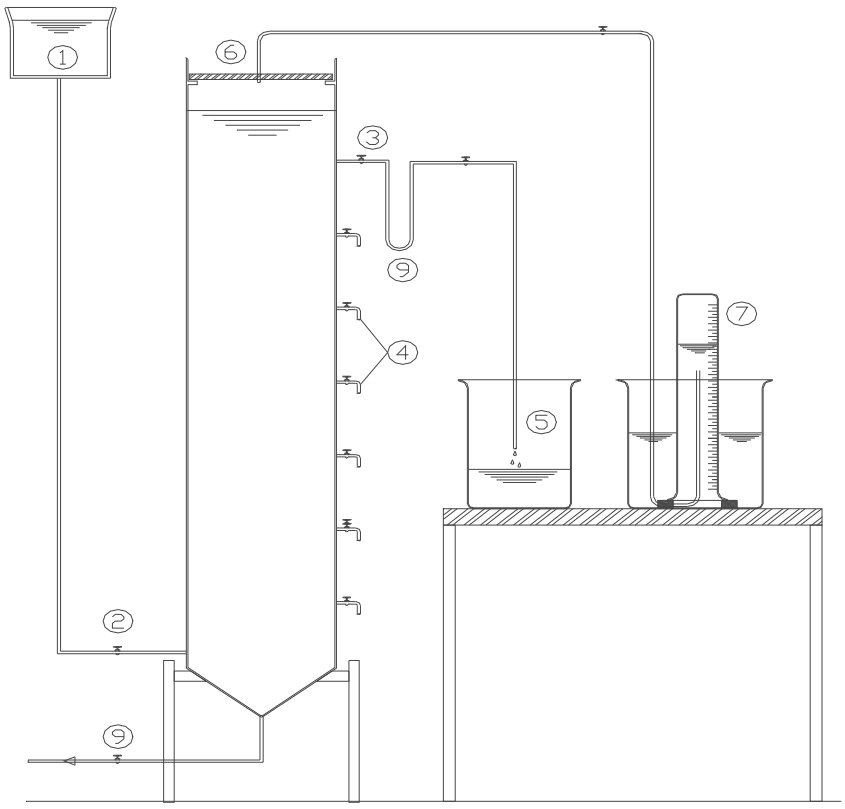
Slaughterhouse wastewater has been classified as industrial waste in the category of agricultural and food industries. Wastewaters from slaughterhouses and meataaa processing industries have been classified by Environmental Protection Agency (EPA) as one of the most harmful to the environment [1]. For the treatment of this type of wastes, Conventional biological processes do not offer the solution to satisfy environmental requirements. As an alternative to more efficient treatment process for treating highly loaded effluents, the anaerobic process is particularly designed to effluents discharged at high concentrations of COD and other biodegredable [2] components. Meat processing effluents exhibit high organic and inorganic load. High suspended solids content, dark color and offensive odor, are of poor bacteriological standards. Discharging slaughterhouse wastewater without treatment contribute to greatly degrading the aquatic environment and pollution of irrigation water [3]. McCarty et al. [4] have done pioneering work in characterization of anaerobic reactors. Some investigators had used different types of anaerobic upflow contact process, in which wastes were passed upward

through a blanket of concentrated anaerobic biological solids [5]. No work has been reported about such kind of sloughterhouses which discharge large quantities of blood mixed with fats and dung. Usually, the slaughterhouse wastes are classified to be reused in diffirent industries. But in this undertaken case we have completely mixed slaughterhouse wastes. The present research is undertaken to investigate the treatability and practical aspects related to the utilization of the anaerobic process for slaughterhouse wastewater (beef, Buffalo and sheeps).

MATERIALS AND METHODS

Laboratory scale vertical reactor is fabricated from perspex sheet 8mm thickness. The reactor dimensions is 15 cm x 15 cm in cross section and 180 cm in length (Fig. (1)). Wastewater samples are collected from a slaughterhouse operated by the Faculty of Agriculture, University of Alexandria. The processed cows and buffalo are about 50000 heads per year. Average flow rate of wastewater is about 60 m^3/d (50-170 m^3/d). Samples were free of fats and solids because the slaughterhouse has a grease separator recieve the effluent of processing. Samples were stored at 4 °C in containers of 20 letters each and were used as feed medium for bacterial growth. The characteristics of wastewater are listed in Table (1). Domestic sludge was obtained from wastewater treatment plant at Kafr El-Dawar for start-up inoculation. Sludg (5L) was mixed with raw slaughterhouse wastewater (40L) and set-up was left for about 45 days until gas production was observed. The reactor was fed every day with 2 letters for several days and then with 3,4,5 and 9 lettere through 15 days to fix hydraulic retention time at 5 days for 15 days. The dose of batchs was increased gradualy to decrease the HRT to 4 days for duration of 15 days. Again HRT was decreased to 3 days and then decreased to 2 days for duration of 15 days. After that the reactor was operated at HRT of 1 day for one week and lastly at HRT of 0.5 day for three days only.

Sample analysis included, pH, suspended solids, total solids, Volatile solids, chemical oxygen demand, Ammonia nitrogen, orthophosphate and gas production. All parameters were measured according to Standard Methods (APHA, 19th edition 1995).



1-Feed tank.
2-Influent pipe.
3-Effluent pipe.
4-Inverted siphone.
5-Effluent tank.
6-Gas pipe.
7-Gas holder.
8-Sampling points.
9-Eccess sludge.

Figure 1. Anaerobic reactor set-up.

Table 1. Slaughterhouse wastewater characteristics

Parameter	Ave.Value
pH	**6.80**
Suspended solids (SS) mg/l	**400**
Total solids (TS) mg/l	**3900**
Volatile solids (VS) mg/l	**600**
Chemical oxygen Demand (COD) mg/l	**4400**
Ammonia nitrogen (NH_4) mg/l	**25**
Orthophosphate (PO_4) mg/l	**7.5**

RESULTS AND DISCUSSION

Concentration of COD, NH_4 and PO_4 was measured regularly at the influent and effluent of the reactor, the results are given in Table (2). The removal efficiency of COD, PO_4 and NH4 is given in Figures (2,3,4).

Table 2. Influent and effluent concentration of COD, PO_4 and NH_4 with removal efficiency at different HRTs

HRT COD (mg/l) Day				Po_4 (mg/l)			NH_4 (mg/l)		
0	Inf.	Eff.	Removal%	Inf.	Eff.	Removal%	Inf.	Eff.	Removal %
5	4300	172	96	23	4.6	80	195	95	51.3
4	4250	242	94.3	21	4.1	80.5	185	105	43.2
3	4350	287	93.4	23.5	3.9	83.4	190	125	36.8
2	4270	303	92.9	20.5	3.85	81.2	180	114	36.1
1	4240	530	87.5	20	39	80.5	175	120	31.4
0.5	4190	951	77.3	19	6.5	65.8	192	110	42.7

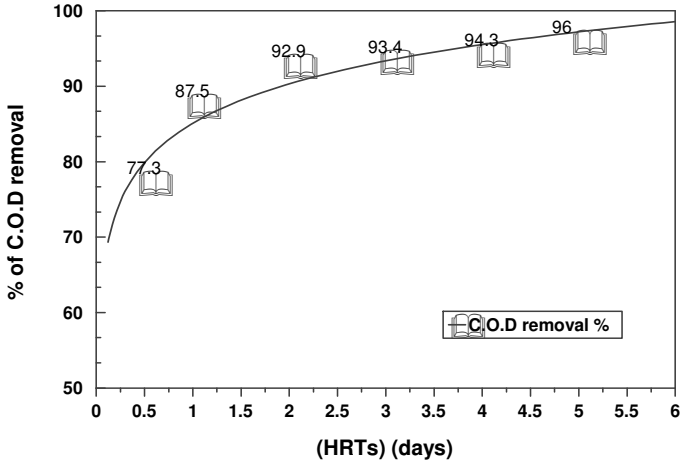


Figure (2) COD removal efficiency with (HRTs)

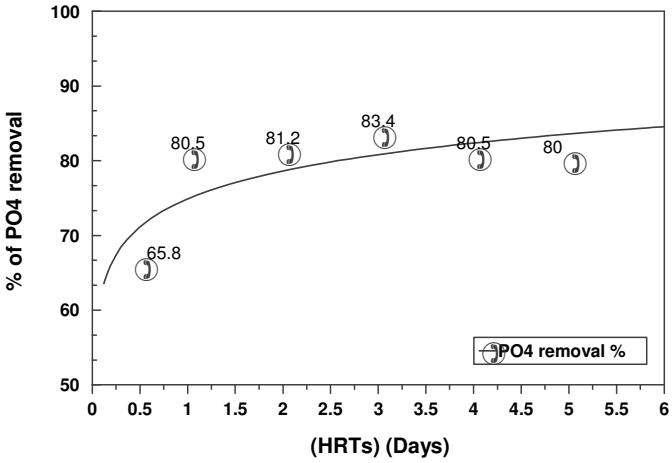
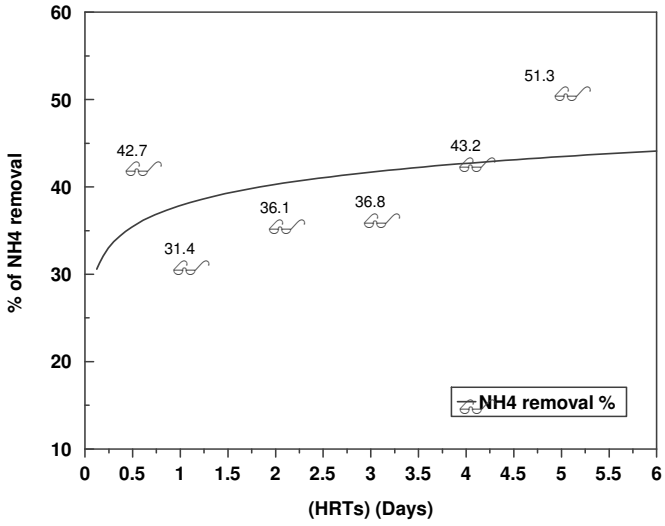


Figure (3) PO_4 removal efficiency with (HRTs)



Figure(4) NH_4 removal efficiency with (HRTs)

Removal efficiency of COD revealed percentage over 90% if HRT is greater than 1 day. When HRT was decreased to one day the removal percentage decreased to 87.5% and then to 77.3 at HRT of 0.5 day. These results are comparable with obtained results by Heddle [9] and Lovett [10].

It is knowing that orthophosphate constituents about 60% of total phosphorus content in slaughterhouse wastewater. For activated sludge systems operating with high ratio of F/M, phosphorus removal as reported by Heddle (9) might reach the range of 70-90% as obtained for this research. Lovett (10) recorded a better PO_4 removal efficiency at short HRT with reduction values of 89%, 60% and 60% at HRTs of 5, 10, 20 days respectively. These findings results show that our results are good because of ambient temperature is higher during summer. The ammonia generated under anaerobic conditions is due to the activity of microorganisms which oxidized the amines remaining in the animal wastes and freed the ammonium hydroxides [11]. Consequently, the level of ammoniacal nitrogen concentration introduced in the bioreactor did not correspond to the level which prevailed in real operation conditions. Not with standing this fact, obtained results showed a removal efficiency of NH_4 is varying from 30% to 53%. Gas released from the reactor during this research was not containing enough quantity of CH_4 to burn-out. Lab facilities for gas analysis was not available to determine the components of the effluent gas. Anyhow the gas released from slaughterhouse wastewater under anaerobic conditions has not been considered as an economic factor comparing with the main objective, the pollution prevention.

According to the results obtained from this research we find aerobic treatment (activated sludge) should be considered after anaerobic treatment of slaughterhouse wastewater before discharging into surface water bodies.

CONCLUSIONS

Slughterhouse wastewater treatment under anaerobic conditions can efficiently give a good results with COD removal, more than 90% of soluble COD and 80% of PO_4 were removed at an operating ambient temperature of 24 °C in average. The performance of the reactor was not affected when hydraulic retention time was decreased from 5 days to 1 day regarding to COD and PO_4 removal efficiency.

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