INVESTIGATIONS ON WASTE DEGRADATION IN A PARTIALY ANAEROBIC FLUSHED REACTOR

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ABSTRACT

Industrialization and population increase in India has lead to the generation of large quantities of Municipal solid waste and the impact of this is severe. In order to minimize the severity, extensive research work is being carried out, all over the world. An in-situ extensive fermentation cell in the form of a flushing bio-reactor in which biological, chemical & physical process can be controlled through moisture infiltration or leachate recirculation was used in the present investigations. Organic solid waste collected from the college hostel & canteen mixed with 2% by weight of cow-dung was used in the two column reactors. Leachate samples were collected at regular intervals upto 185 days, and these samples were analyzed for various parameters. A detailed analysis of various parameters indicated definite trends with excellent correlation coefficients. It was also observed that addition of cow-dung enhanced the degradation process.

Keywords: *Wavelet transforms, AWGN, Threshold, image denoising, wavelet thresholding*

I. MATERIALS & METHODS

In the present investigations solid waste samples were collected from the college hostel & canteen. Plastic & metallic substances were removed from the so collected waste, there onwards the solid waste was shredded and was mixed with 2% by weight of cow-dung. Finally the matrix was thoroughly mixed in order to obtain a homogenous mix. Two columns with all the arrangements to measure the temperature, to collect the leachate and also to collect the gas were filled with the above matrix. In one of the columns leachate was recirculated. Leachate samples were collected at regular intervals upto 185 days and every time the samples were subjected to quantitative analysis as per the Standards Methods of Examination, 2005 (1).

II. RESULTS & DISCUSSIONS

The results of leachate analysis for the two partially anaerobic reactors namely control reactor & recirculation reactor are presented in Tables 1 & 2.

A detailed study of these tables reveal the following:

(a) Variation of temperature with time: The recirculation reactor records a higher temperature as compared to the partially anaerobic control reactor indicating higher microbial activity during the acetogenic phase. Changes in temperature reflect the enhanced degree of waste degradation in the

partially anaerobic control & partially anaerobic recirculation reactor.

(b) Variation of pH with time: It was observed that the partially anaerobic control reactor enters neutral pH range on the 106th day, while the recirculation reactor on 92nd day, thus indicating its earlier attainment of stabilization phase. Similar trends were reported by Rendra, S., et.al, [2] Sinan Bilgili. M., et al., [3] and Francois, V., et al., [4], in the experimental studies on aerobic and anaerobic waste degradation of solid wastes.

(c) Variation of Alkalinity with time : Tables 1 & 2 indicate that, upto 62 days both the reactors were in acetogenic phase & due to recirculation of leachate, nutrients and moisture supplement increase the activity of the microbial population leading to enhanced waste degradation. Alkalinity greater that 2000 mg/lit in the both the reactors indicated adequate alkalinity was present to maintain optimum conditions for methanogenesis. Similar high alkalinity profiles are reported by Simon Bilgili, M (3).

(d) Variation of chloride with time: Chloride being a non-degradable parameter & change in its concentration indicates the leachate dilution. There was a decrease in chloride concentration initially upto 39 days in both the reactors followed by decrease in chloride concentration. During the methanogenic phase the change in chloride concentration was insignificant.

(e) Variation COD with time: Due to hydrolysis of organic matter, COD concentration increased upto 21 days, there on it started decreasing continuously. Considering the initial COD value of 40650 mg/lt on 2nd day, the COD reduction at the end of 185th day, in the partially anaerobic control reactor was 79.8%, similarly in the partially anaerobic recirculation reactor the reduction was 95.3%.

Similar trends of COD reduction with 80% COD removal was reported by Dong Jun, et.al, 2007 [5], average COD removal of 90.60% was reported by Sanphoti, N., et al., 2006 [6], COD removal of 93% was reported by Sinan Bilgili , M., 2007 [3] and COD removal of 88% was reported by Obuli P. Karthikeyan, et al., 2007 [7] and above 90% COD removal was reported by Giannis, A., et al., 2008 [8] during their experimental studies on landfill bioreactors.

(f) Settlement of waste with time: The rate and magnitude of settlement depends on the waste composition, operational practices & factors affecting biodegradation of landfill waste. The partially anaerobic control reactor records a total settlement of 31.4% and partially anaerobic recirculation records a total settlement of 51.5% at the end of 185 days. Higher settlement in the recirculation reactor indicates that the biodegradation process was affected by the leachate recirculation.

III. CORRELATION OF PARAMETERS

The entire data collected for 185 days from the two reactors was subjected to a simple statistical

analysis in order to know the relationship between them. Table 3 gives the details of the equation fitting the data & the corresponding R^2 value.

Parameter	Partially anaerobic control reactor		Partially anaerobic recirculation reactor	
	Equation	R^2	Equation	R^2
Time vs pH	pH = 4.559 $e^{0.0003t}$	0.835	pH = 4.73 $e^{0.0003t}$	0.878
Time vs Alkalivity	Alk = 18260 $e^{-0.0007t}$	0.897	Alk = 19548 $e^{-0.0008t}$	0.851
Time vs Chloride	Chl = 8270 $t^{-0.33}$	0.882	Chl = 6395 $t^{-0.19}$	0.855
Time vs COD	COD = 63769 $e^{-0.002t}$	0.913	COD = 10079 $e^{-0.002t}$	0.955
Time vs Vol.reduction	Vol.red = $[8.661\ln(t)-1$	0.867	Vol.red = $[12.93\ln(t)-17.$	0.903
Alk vs pH	pH = 11.65 $e^{-5E(Alk)}$	0.851	pH = 13.24 $e^{-6E(Alk)}$	0.849
Chld vs pH	pH = 8.135 $e^{-1E.0(Chl)}$	0.923	pH = $\{0.002(vol.red)+5.734\}$	0.964
Volume reduction vs pH	pH = $\{0.007(vol.re+5.595\}$	0.892	Vol.red = 53.55 $e^{-2E.0(COD)}$	0.860
COD vs vol.red	Vol.red = 37.06 $e^{-2E0(COD)}$	0.929	Vol.red = $[-0.002(Alk)+$	0.806
Alk vs vol.red	Vol.red = $[-0.002(Alk)$	0.909	Vol.red = 341.4 $e^{-8E.0(Chl)}$	0.916
Chl vs vol.red	Vol.red = $[99.88e^{-8E.0(C}$			

Table 3 correlation of parameters

IV. CONCLUSION

Temperature of the partially anaerobic recirculation reactor varies from 26ºC to 33.5ºC, and that of the partially anaerobic control reactor varies between 24ºC to 30.5ºC, where as the pH varies from 4.34 to 8.1 in the control reactor and from 4.9 to 8.4 in the recirculation reactor. Thus the partially anaerobic recirculation reactor operates at higher temperature and pH range without external control indicating enhanced biodegradation process.

(a)Partially anaerobic recirculation recorded higher alkalinity range than the control reactor indicating enhanced waste degradation process.

(b)Partially anaerobic recirculation reactor recorded a higher percentage of COD reduction when compared to the controlled reactor, indicating the waste degradation in faster in the earlier reactor.

(c)Partially anaerobic recirculation reactor recorded 51.5% settlement when compared to 31.4% recorded by the control reactor, indicating enhanced waste degradation in the recirculation reactor.

(d)Statistical analysis indicated good to excellent correlation between the various parameters analyzed.

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