ABSTRACT

Anaerobic method of a wastewater treatment has a number of distinct advantages compared to either chemical or aerobic biological treatment techniques, for the removal of high organic, and nitrates loading. Nitrogeneous waste in form of nitrate (NO_3 - N) is biologically treated under anoxic or anaerobic condition. The present study was undertaken to investigate the removal of COD and Nitrate nitrogen in a laboratory scale packed bed anaerobic fixed film reactor.

Potassium nitrate (KNO_3) Ammonium nitrate (NH_4NO_3) in varied proportion were used as nitrate source where as sucrose and peptone were used as carbon source and organic nutrient source respectively for preparation of synthetic wastewater feed.

A low cost locally available potter's clay was utilized to prepare burnt clay cylindrical rings to be used as packing medium for the reactor. A bed porosity of 0.69 and specific surface area of 328 m^2/m^3 of reactor was achieved with the above packings . The reactor was operated more than two years without experiencing any serious problem of clogging.

The reactor was inoculated with a mixed culture of anaerobic microorganism previously acclimatized in laboratory conditions. The seed was prepared by mixing municipal sewage treatment sludge, cowdung digester sludge and the solid residue of a treatment plant of a distillery. The start up period was found as 70 days when stabilized COD removal and methane yield occurred under the same environmental conditions.

Batch results indicated that, COD removal was faster during 0.5 –2.5 days beyond which removal was marginal using the feed of initial COD range from 2000-5000 mg/L. During first 24 hrs, pH level was progressively dropped due to production of VFA after which it steadily increased and increased to 6.9 –7.1, when methane formation was maximum. Methane content in the biogas was found as 60-75% on an average . A specific methane yield was found 0.42 m^3/Kg COD removal for initial COD concentration of 6960 mg/L.

Batch studies on nitrate removal revealed that within 24 hrs, more than 90% nitrate was removed at lower range of nitrate concentration (60-100 mg/l) with initial COD input as 2000-3000 mg/L when the initial nitrate level was varied in the range 200- 2000 mg/l , the reduction pattern decreased slowly.

The study revealed that at 35°C ± 2°C be the optimum temperature condition for best removal mechanism.
It has been also noted from batch studies that when sulphide level exceeded 300 mg/L ,COD removal was inhibited . The alkalinity level also increased during denitrification studies. It has been also exhibited that, VFA production beyond 5000 mg/L inhibits the COD removal performance.

It was further observed that nitrate removal rate was greatly influenced by initial ratio of COD to nitrate rather than nitrate loading to the reactor. The optimal removal of nitrate was achieved at the ratio of 5.0.for continuous system. However, COD removal rate was dependent on initial COD concentration and organic loading rate. Beyond COD loading of 6.0 kg/m^3.d.the removal rate was significantly low. Specific methane yield had also a decreasing trend.

During denitrification,specific methane yield was reduced to 0.2 - 0.26 L/gm COD removal. At optimum reactor conditions, nitrate removal was observed to be between 86-89%, whereas COD removal concurrently was in the range of using HRT of 25 hours.

The hydraulic study that revealed during unattached film condition, the reactor behaved as plug flow with axial dispersion.

Experimental data on the removal of COD and nitrate nitrogen were obtained from the packed bed laboratory reactor.

The data were fitted with kinetic models proposed by Stover etal (1984) , Venkataramana etal (1992), based on Monod's relationship. The parameters of the model were evaluated from the Lineweaver-Burk plot after linerising the models. A substrate removal kinetic model was also developed in the present study and the kinetic parameters were evaluated by the linearization technique of Lineweaver and Burk plot.

With the evaluated parameters, the simulation was done for the COD removal during the rate controlling stage of methane formation and also for the nitrate removal. The simulated data satisfactorily corresponded to the experimental ones in the methane formation stage. In the latter case, the simulation indicated a larger deviation from the experimental data,indicating the requirement of further modification of the basic model. From the data analysis, the scope of future work on the system has been presented at the end of the dissertation.