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Study of the Biological Treatment of Industrial Waste Water by the Activated Sludge Unit

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ABSTRACT

The activated sludge process simply involves bringing together wastewater and a mixed culture of microorganisms under aerobic conditions. The system usually includes a secondary treatment given to the settled sewage, and requires an environment in which active microorganisms are maintained in intimate contact with wastewater in the presence of sufficient oxygen. In this study, the treatment of industrial effluents, by using laboratory activated sludge unit was investigated. The reduction of the pollution laws was determined, using the biochemical oxygen demand (BOD) and the chemical oxygen demand (COD) methods. The results indicated that the pollution laws was reduced by up to 98% in the activated sludge unit.

INTRODUCTION

The activated sludge process was developed during early1900s. Since that time many variations of the original process have been developed and utilized in wastewater treatment (1,2,3). The activated sludge process simply involves bringing together wastewater and mixed culture of microorganisms under aerobic condition. The system usually includes a secondary treatment given to the settled sewage, and requires an environment in which active microorganisms are maintained in intimate contact with wastewater in the presence of sufficient oxygen. The aeration basin is usually a completely mixed system, with continuous inoculation of micro-flora and micro-fauna from the incoming sewage and sludge recycle.

Air bubbles are created by compressed air forced through a submerged diffuser, or by mechanical aeration where turbulent mixing entrains air in the liquid.

The significant activity of activated sludge microorganisms is the rate of substrate (BOD or COD) removal. The liquid suspension of microorganisms in an aeration basin is generally referred to as mixed liquor, and the biological growth are called mixed liquor suspended solids. The name activated sludge was originated in referring to the return of the biological suspension, since these masses of microorganisms were observed to be very active in removing soluble organic matter from solution. This extraction is a state of endogenous respiration or starvation (4).

The generallized biological process unit takes place in an aeration system is sketched in Fig1 and diagram of laboratory-scale activated unit is shown in Fig 2.

MATERIALS AND METHODS

Chemical Oxygen Demand (COD)

a-Feed:before sampling a plastic container containing feed was well shaken. These samples were then diluted using distilled water.

b-Effluent: samples were taken at the outlet weir of the aeration tank. After centrifuging, the samples were diluted using distilled water. 5 ml of the solution was then added to the approriate flask,while 5 ml of distilled water was added to each of two flasks which served as blanks.

To facilitate refluxing 150ml round bottomed flasks were used, into which 5ml of N/8 potassium dichromate solution and a few glass beads were addad. While cooling the flasks, 10ml of concentrated sulphoric acid (S.G. 1.84) was added. Finally 1ml of saturated silver sulphate solution was added. The diluted samples were then added to the flasks. The flasks were then refluxed for 2 hours using double surface condensers and heating mantles, after which they were allowed to cool. To each flask 45ml of distilled water was added with 3 drops of ferrous phenathroline indicator. This was then titrated against N/8 ferrous sulphate solution using a 25 ml burette. The COD as milligrams of oxygen absored from standard dischromate per litre per sample was calculated:

COD= blank titration-sample titration× dilution ×1000/5 (mg/l)

Biochemical Oxygen Demand(BOD)

The disolved oxygen content of the sample was determined before and after incubation for five day at 20°C (BOD_5).

For each sample to be determined, 1 liter of dilution water was prepared. To this 1ml ferric chloride, calciun chloride, magnesium sulphate and phosphate buffer solutions were added. Also, 5ml of an adapted seed were added. The seed was taken from the aeration tank of the activated sludge unit treating industrial wasts. The prepared dilution water was then saturated with oxygen by bubbling air through it for a minimum of two hours. The water was then used immediately.

Samples were diluted using the dilution water, the dilution being determined by experience. The samples (3.5ml) was then added to a measuring cylinder. The volume was made up to 700ml with dilution water. After sealing the end of the cylinder it was gently rocked to ensure complete mixing of the sample. This solution was then distributed between two 250 ml narrow

Fig 1. **Generalized biological process in activated sludge biological process in activated**

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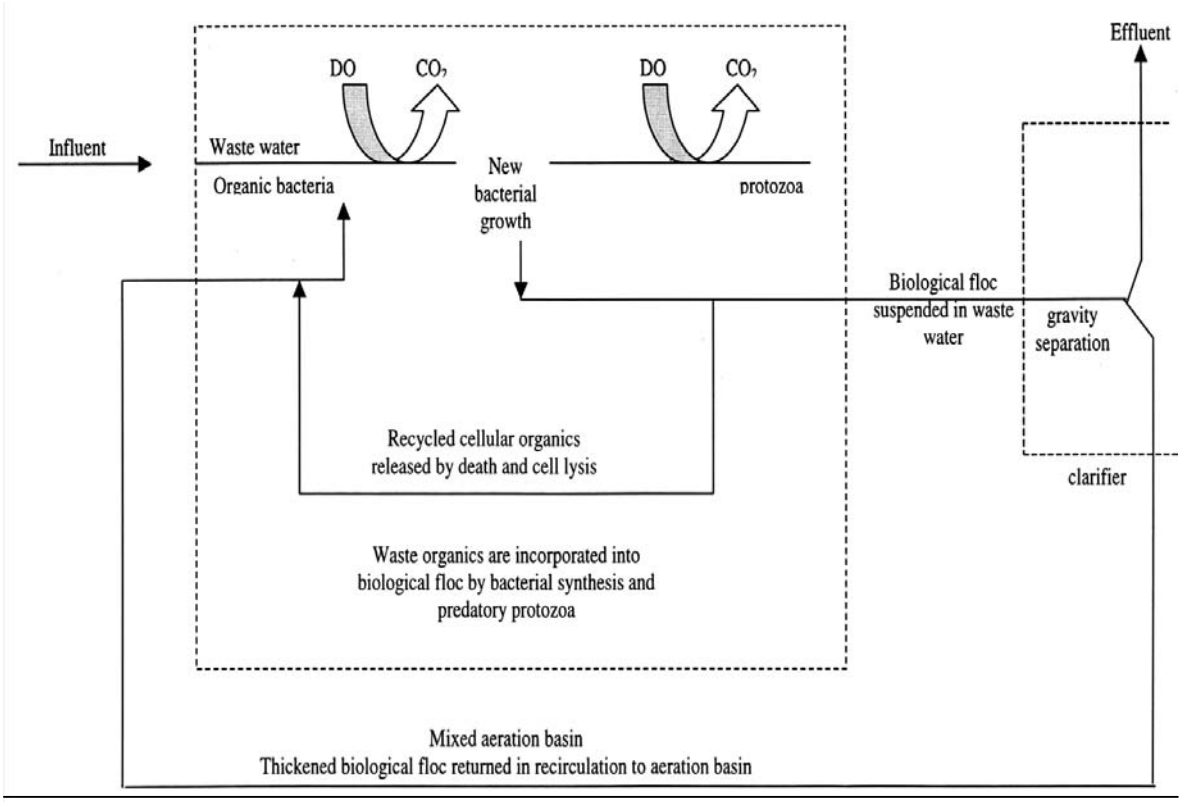


mouthed glass stooppred bottles. Each bottle only being half filled initilly, again to ensure mixing of the sample. The bottles were then filled to overflowing. A glass stopper was then tapped around the side of the bottle to release any trapped air bubbles. The stopper was then dropped in the top and twisted until secure. This method was repeated for all samples. A blank cotained only dilution water.

One set of bottles was then placed in an incubator at 20°C for five days. The other sets were titrated immediately.

Into each bottle 2ml of manganous sulphate solution followed by 2ml. of alkaline iodine solution (500g sodium hydroxide and 150g potassium iodide per litre) were added. The bottles were each shaken and the precipitate allowed to settle. This was repeated. 2ml of concentrated sulphuric acid solution was the nadded. 200ml aliquots of this solution were then titrated against N/80 sodium thiosulphate solution. Starch solution was used as the indicator. The end point was reached when the blue solution became clear. The same method was used for the bottles incubated for five days. The BOD5 expressed as milligrams of oxygen per litre of sample was caculated.

BOD5 = difference of titration insample-diffrence of titration in blank.

RESULTS

The 5-days BOD was measured every other day. The BOD_5 results are shown in Fig.3. The overall efficiency of the BOD_5 removal is indicated by percentage reduction of 5-days BOD in Fig.4.

There was little difference between the aeration tank effluent BOD_5 and that of the setlling tank effluent.

The amount of COD in the effluent from the settlement tank are shown in Fig.5. The results obtained in Fig. 5 indicated that the difference between the aeration tank effluent and the effluent from settling thank was small.

The amount of COD reduction was variable throughout the experiment. The minimum reduction was about 72% and the maximum about 90% (Fig.5). The overall efficiency of removals are indicated by percentage reduction of COD in Fig. 6. The results obtained in Fig.6 indicated that the difference between the aeration tank effluent and the effluent from the settling tank was small.

The amount of COD reduction was variable throughout the experiment. The minimum reduction was about 72% and the maximum about 90% (Fig.6).

DISCUSSION

The biological methods of water treatment are the most economical and widely used for removing organic components from waste water.

The pollution load was estimated by the biochemical oxygen demand (BOD) and chemical oxygen demand (COD).

The results obtained in this study, has indicated that the average influent 5-days BOD was approximately 4/000 mg/l and anaverage reduction to 1,200 mg/l was obtained (Fig.3). The percentage reduction of up to67% was obtained (Fig.4).

The percentage reduction of COD reachedan average of up to 85% in effluent, areduction from 20000 mg/l to 3000 mg/l (Fig.5).

Fig. 2. **Diagram of laboratory-scale activated sludge unit**

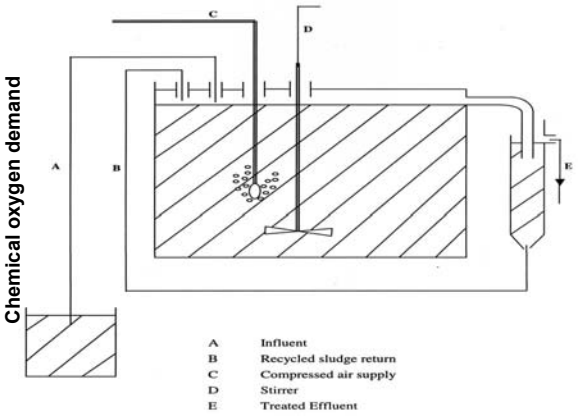


Fig. 3 . **Biochemical oxygen demand of the factory waste before and after passing through the laboratory scale activated sludge unit. The retention time was a constant ninety five hours.**

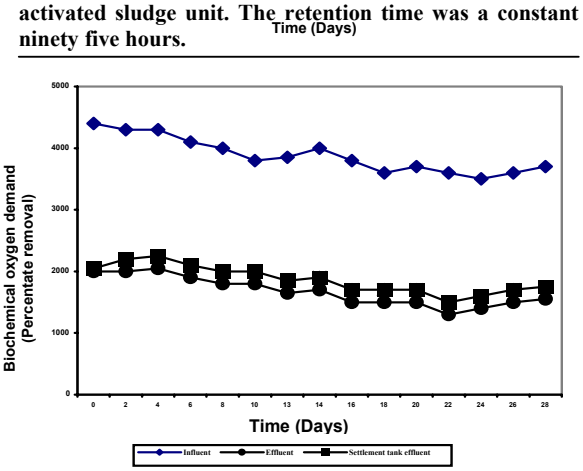


Fig. 4. **Percentage reduction in biochemical oxygen demand in the aeration effluent tank andthe settlement tank effluent**

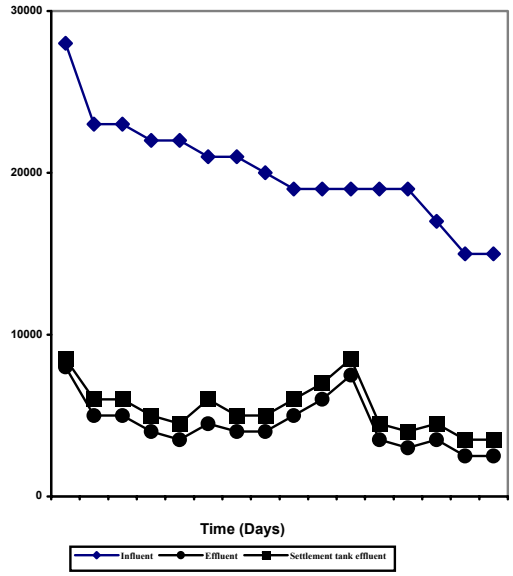


Fig.5. **Chemical oxygen demand of the factory waste before and after passing through the laboratory scale activated sludge unit. The retention time was a constant ninety five hours.**

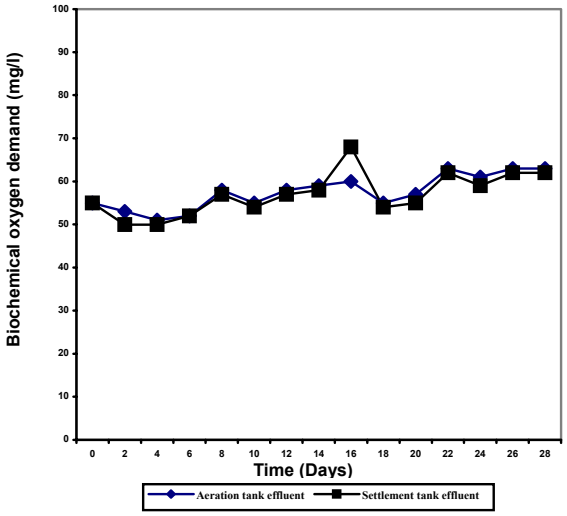
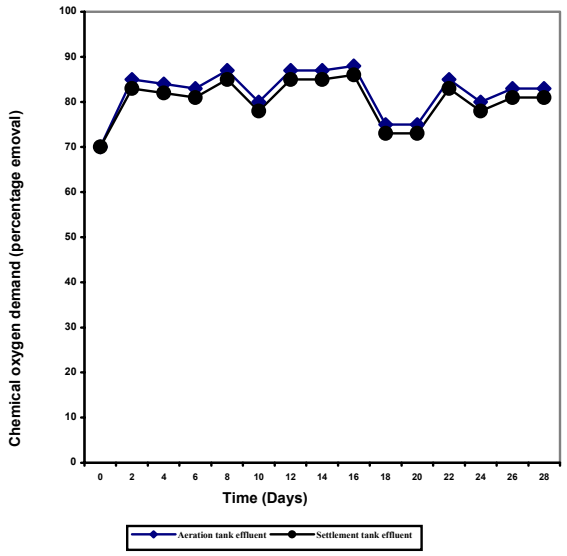


Fig. 6. Percentage reduction in chemical oxygen demand in the aeration effluent tank and the settlement tank effluent.



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