Evaluation of the efficiency of activated sludge process with extensive aeration and sludge return in reducing the COD of effluent of beverage industries

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ABSTRACT

The effluent of the beverage industry has a higher yield, which is biological. Locations The overall objective of this study is to evaluate the efficiency of the activated sludge process with extensive aeration and sludge return to reduce the COD of beverage industry effluents. For evaluation, a 20-liter tank was completely used anaerobically, from which the artificial effluent was transferred to the pilot. The organic load increased from 1.03 kgCOD/m^3.day to 1.93 kgCOD/m^3.day. In this study, the COD parameter was used to measure the pollution of the beverage industry effluent and its working cycle was 24 hours. Hydraulic retention time, temperature and pH were also measured. The results of this process showed that with a final organic load of kg COD/m^3.day of 1.93, the removal efficiency was 90%, which is part of the removal efficiency (20 to 30%) of the anaerobic tank used in the first pilot. By examining the hydraulic retention times of 6, 12, 18 and 24 hours, the highest efficiency was obtained in the retention time of 24 hours and in the research process, the pH was between 7 and 9 and the temperature was in the mesophilic range. Therefore, it can be concluded that the process of activated sludge with extensive aeration and sludge return is effective in the treatment of effluents of beverage industries with medium organic load.

KEYWORDS

Bio-treatment, wastewater treatment, activated sludge, extensive aeration, effluent from the beverage industry.

1. Introduction

Activated sludge is one of the most common methods used to achieve the main purpose of biological wastewater treatment, which is based on the stabilization of organic matter, flocculation and removal of non-precipitating colloidal solids by mixtures of microorganisms, especially bacteria[1]. This method has been developed for reasons such as high efficiency in achieving existing standards, lack of insect accumulation and less problems than other methods[2].

Considering the environmental hazards of industrial effluents and preventing the entry of effluents into water and soil resources, as well as the advantages mentioned in the activated sludge process in the present study And sludge return is checked. An important point in the research is the use of a reservoir in a completely anaerobic manner similar to the function of a septic tank in order to uniformize the flow, sedimentation of suspended solids and in general increase the efficiency of the activated sludge process. Due to the high level of COD in food industry effluents and especially beverage industries, bioaerobic methods or a combination of aerobic and anaerobic methods are usually used to treat the effluents of these industries.

2. materials and methods

The pilot was made on a laboratory scale with dimensions (length 30 cm, width 20 cm and height 20 cm) and glass material with a thickness of 6 mm for use in the present study. Inside the pilot, two baffles are installed, one vertically and 20 cm long with a distance of 2 cm from the floor to return the sludge, and the other at the end with a 45 degree angle on which the outlet valve was. An air pump is used to aerate the pilot, and a rectangular air rock and two tiny bubble circles are used as diffusers to disperse the pilot air. At the beginning of the device, a 20-liter tank that was placed above the reactor was used to streamline the flow, settle the suspended solids and increase the overall efficiency of the pilot.

Initial inoculation of the reactor from the aerobic sludge of the wastewater treatment plant (activated sludge method) was used. To activate the microorganisms, sugar, urea and potash fertilizer with a ratio of C: N: P equal to 18:10:18, which contains most of the nutrients needed to increase the performance of the reactor, are used as primary nutrition and then soft drinks, urea and Potash fertilizer was used to continue the pilot feeding. It should be noted that throughout the research period, the ratio of 100 to 5 to 1 for carbon to nitrogen to phosphorus was adjusted by adding urea and potash fertilizer in synthetic wastewater[3].

The present study lasted for 60 days in two periods. The first period for 20 days includes design, pilot construction, commissioning, activation of microorganisms with initial feeding at 0.58 kgCOD/m^3.day, pH and temperature measurement and the second period for 40 days including increasing organic load with final feeding, measurement pH, temperature, dissolved oxygen (DO), study of BOD/COD ratio by measuring BOD twice and evaluation of COD removal efficiency. During the second period, the organic load increased from 1.03 kgCOD/m^3.day to 1.93 kgCOD/m^3.day. All experiments are performed according to the methods mentioned in the book of standard methods[4].

3. Results and Discussion

Inoculation and then the initial feeding of the pilot started with 0.5 kgCOD/m^3.day and remained at the same level until the end of the first period. Organic loading during the second period to 40 days was increased from 1.03 kgCOD/m^3.day to 1.93 kgCOD /m^3.day and the reactor temperature was in the mesophilic temperature range for two periods. The pH changes during the two periods were in the range of 7 to 9. The process of pH changes plays a significant role in the optimal development of an effective biological process in wastewater treatment. Inadequate pH values (less than 6) provide a suitable environment for the growth of filamentous bacteria and the occurrence of bulking phenomenon[5]. COD was measured every 5 days after increasing the load to 1.03 kgCOD/m^3.day which lasted for 15 days. After increasing the load by kgCOD/m^3.day 1.93, the amount of COD was measured every day. The output COD trend decreases over time with a good trend and has a good efficiency of 90-60%. In the present study, factors such as dissolved oxygen, temperature, and the use of anaerobic process at the beginning of the system affect the COD removal efficiency. The concentration of dissolved oxygen in the present study was between 4-2.5 mg/l, which was measured using a DO meter after calibrating the device. The concentration of dissolved oxygen in the aeration tank should be sufficient to maintain aerobic conditions and oxidation of organic matter by aerobic microorganisms. The minimum amount of dissolved oxygen is 1 to 1.5 mg/l and in practice the concentration of dissolved oxygen in all parts of the aeration tank should be maintained at 1.5 to 4 mg/l. Doses above 4 mg/l have little effect on improving system performance, but can greatly increase aeration costs[6]. Due to the fact that the temperature was in the mesophilic range and increased during the research, the removal rate increased to a certain value. Low temperature affects density, sludge volume index, bacterial activity and microbial population of species[7]. Due to the high level of COD in food industry effluents, in addition to temperature and dissolved oxygen, the combination of aerobic and anaerobic methods has also been effective in increasing efficiency. A study by Sadeghi et al. Also showed that combining processes are twice as effective at removing COD as when used alone[8].

1.3. Check hydraulic retention time

In order to investigate the effect of residence time on the COD removal efficiency of the system, under organic loading of COD/m^3.day 1.93, 6, 12, 18 and 24 hours were evaluated. The process of COD removal efficiency increased with increasing hydraulic retention time and the highest removal efficiency occurred at 24 hours retention time equal to 90%. According to studies to make the decision, biological can be done with significant hydraulic life or aeration time[9]. Also in the process of activated sludge with aeration, the best efficiency is to stay between 20 to 30 hours[10].

2.3. Determine the BOD5 / COD ratio

During the research period, the BOD5 value was measured twice by the BOD reactor to obtain the BOD5/COD ratio. Results of 0.62 and 0.50 were obtained under organic loading kgCOD/m^3.day 1.93 and 24 h hydraulic retention time.

By comparing BOD with COD, it can be assessed whether the compound in question is easily degradable or non-degradable. One indication is that a BOD5/COD ratio greater than 100 means that the compound is relatively non-degradable, and if this ratio is less than 10, it is relatively degradable[11].

4. Conclusions

The research results confirm the possibility of biological treatment of food industry effluent by activated sludge process with extensive aeration and sludge return. The best biological removal of food industry effluent in the input COD rate of 1.93 kgCOD/l.d after 90 hours of 90 hours was 90%, which is approximately 20 to 30% of the removal efficiency associated with the use of anaerobic tank was initially pilot. By examining the BOD5/COD ratio, it was found that the wastewater composition is degradable.

The results showed that the combination of aerobic and anaerobic methods was effective in treating food industry effluents due to the high COD of this effluent.

5. References

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