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Comparison of normal and modified UASB reactors for dairy wastewater treatment

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ABSTRACT: The present study was conducted to compare the efficiency of normal and modified UASB reactor for the treatment of dairy wastewater. To conduct research, two reactor units with a height of 120 cm and a volume of 48 liters have been used on a laboratory scale and a tank septic tank and an additional sludge blanket have been used to optimize the UASB reactor. Initial inoculation of the reactor was carried out using sewage treatment sludge (active sludge method) slaughterhouse, along with fresh cow discharges and feeding using dry milk. The research lasted for fourteen periods for 154 days, the first period for 30 days including the design and construction of the reactor, the second period for 40 days including starting, forming granules and measuring PH, the third period for 40 days including the continuation of the process The formation of granules and sludge blankets, pH measurements, and preliminary analysis of the removal efficiency of COD and the fourth period for 44 days include the continuation of granulation sludge measurement, PH and the evaluation of COD removal efficiency. The organic loading during four periods was 5.2-11.4 kgCOD/m3.day, and the reactor temperature was in the second to third period in the mesophilic temperature range and during the fourth period at the mesophilic and psychrophilic temperature range. The retention time in the studied period is 24 hours. The output COD yields four to for normal reactor 75-60% and a modified reactor of 94-60%. Optimization of the UASB reactor increases the efficiency by a factor of 22-18% compared to the normal one.

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1. INTRODUCTION

Iran is among the developing countries. Considering the increasing population growth, increasing water requirements, the presence of dry and dehydrated climatic conditions in most parts of the country, the conservation of limited water resources against pollution and the reuse of refined wastewater, a solution Essential for the present and future water needs[1]. Industrial wastewater treatment methods include physical, chemical and biological methods (aerobic and anaerobic methods). The removal process is costly due to physical and chemical processes, and therefore, biological methods are nowadays more widely considered[2]. Due to increasing costs of aerobic treatment, in recent years, information on the bleaching treatment mechanism, advances in reactor systems and lower sludge production and the use of bleaching systems in industrial wastewater treatment has been increased. One of the significant developments in the technology of the anaerobic filtration process of the UASB[1], developed by the late 1970s in Holland, was by Lingga and colleagues[3]. Extensive laboratory studies have shown that the UASB reactor can be used to clean up urban wastewater[4-6], oil refinery, winery[7, 8], potato waste, and so on.

In the present study, the comparison of the efficiency of dairy wastewater treatment effluent using conventional UASB and modified UASB reactors is considered.

2. MATERIALS AND METHODS

1-2. Chemicals and devices used

Materials needed for this research include slaughterhouse treatment sludge, cow waste, dry milk, 98% sulfuric acid, silver sulfate, mercuric sulfate, potassium dichromate, potassium hydrogen phosphate potassium (KHP) and distilled water. The devices used in the present study include Electrogas model cooler pump, digital scale with precision of 0.001 mg, pH meter, COD reactor, UV2100 and AVON spectrophotometer.

2.2. Construction and commissioning of the normal and modified UASB reactor

In the present study, an anaerobic reactor unit with upstream flow in the form of a rectangular cube, the lower part of which is prism, is made of 6 mm thick glass, 120 cm high and a volume of 48 liters in a laboratory scale. For sampling at 30 cm intervals, the sampling valve reactor body was placed

[1] Up Flow Anaerobic Sludge Blanket

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and two baffles were placed to direct the gas at the top of the reactor at an approximate angle of 45 °. For better formation of cloudy sludge blanket of 2 cm thick, placed above the prism and under the first sampling valve, a cooler pump was used to direct the sewage into the reactor. The modified UASB reactor in the present study was similar to that of a conventional reactor coupled with the addition of a completely anaerobic 20 liter reservoir that was placed higher than the reactor as a septic tank and the use of additional sludge blankets under the second sub-sampling valve. has taken. The research lasted for 154 days in four periods. In order to initiate inoculation of the reactor from sewage treatment sludge (active sludge method), the slaughterhouse was used along with fresh cow distillates. The ratio of mixing sludge and cow waste is 3 to 1. Feeding the reactor using a dry milk that contains most of the nutrients needed to increase the reactor's performance.

3. DISCUSSION

The first period for 30 days includes design and construction of the reactor, the second period for 40 days including start up, the process of forming the granule and measuring the PH, the third period for 40 days including the continuation of the formation of granule and sludge blankets, the measurement of PH and the preliminary examination of the removal efficiency COD and the fourth period for 44 days, including continued granulation sludge measurement, pH and COD removal efficiency. During four periods, the organic loading rate increased from 2.5 kgCOD / m3.day to 4.5 kgCOD / m3.day. The temperature of the reactor during the second to third period was at the mesophilic temperature (25-25 ° C) and during the fourth period in the mesophile and pyrophylic temperature range (> 25 ° C). All experiments in this study have been carried out according to the methods outlined in the standard methods book[9]. After a few days from the beginning of the loading, the granulation began to form and after 15 days the formed granules were measured. The granules are measured every 15 days after the first measurement. The process of changing the size of granule sludge from day 45 to the end of the research was between 1- 6.5 mm. During the second period, after 15 days from the start of loading, the pH of the specimen was measured using a PH meter device after calibrating the device[10] to control and evaluate the acidity of the sludge. PH variations during the second to fourth period were in the range of 7 to 8, which is the process of variation of pH indicating the proper formation of the granule and proper process execution in the reactor. The COD rate has been measured every 5 days in the third and fourth cycles. The removal efficiency of COD during the third period has increased with proper trend over time from day 75 onwards. Due to the fact that the temperature in the above period was in the mesophile range, it has a good efficiency of 60-38% in the usual UASB reactor and 78-60% in the modified UASB reactor. The increase in feed and nutrient in the UASB reactor will increase the efficiency of COD removal and increase the trend in the diagram[11]. The removal efficiency of COD during the fourth period, over the period from 115 days to 130 days, in the MesoFilic and Sichrophylic temperature range, and loaded at 8/6 kg / day of COD / day, has an appropriate increase during days 115 to 125, which is within the mesophile temperature range Has been located. Due to its presence in the mesophile temperature range, it has a good efficiency of 68-59% in the conventional reactor and 88-80% in the modified reactor. But on the 130th day, when both reactors were located in the pyrophylic temperature range, the COD removal efficiency decreased and this decrease in efficiency was due to temperature variation. The UASB reactor at the mesophile temperature range has had the best performance, which reduces the efficiency of the temperature. The COD removal efficiency in the UASB reactor under different loading depends on the amount of suspended solids in the wastewater and temperature[12]. Over time, from day 135 to day 150, the removal efficiency of COD, which is within the cycrofilic temperature range and loaded with 11 kgCOD / m3.day, has been continued, COD removal efficiency has been initially continued towards the decreasing trend in the previous days, and with increasing Loading, reducing efficiency has occurred due to temperature reduction. During 140-150 days, when the granules in the reactor were adapted to the new temperature conditions, the efficiency increased and the COD removal efficiency increased with a proper process. The efficiency in the conventional reactor is 75-61% and in the modified reactor is 94-80%.

4. CONCLUSIONE

The development of human societies and the growth of industry and technology has always led to environmental problems. Dairy industry is one of the high-pollution industries. In the present study, the UASB reactor, which has been modified and modified to treat wastewater from above industries, has been used. The findings of this research can be summarized as follows:

1) Organic load tolerance is different in UASB reactors for different industrial wastewater. The application of organic loading kgCOD / m3.day 4 / 11-2 / 5 in the present study has been beneficial for dairy waste effluents.

2) The removal efficiency of COD from dairy wastewaters is 75% using a conventional UASB reactor and 94% modified UASB reactor.

3) The use of the modified UASB reactor to the conventional reactor for the treatment of dairy wastewaters has increased efficiency between 18-22%.

4) The process of changing the size of the granule sludge from day 45 to the end of the research was between 1.5-5.1 mm.

5) PH changes in the present study range from 7 to 8. The process of pH changes indicates the proper formation of the granule and proper process execution in the reactor.

6) Due to temperature changes, the change from the mesophilic to the cyclophilic temperature range initially reduced the efficiency, and then, after the application of granular sludge with temperature, the efficiency increased uniformly.

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