Research on anaerobic treatment of food processing waste-water based on watershed water protection

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Abstract. Sweetmeat is one of the non-staple foods and a kind of classic non-staple food. It is of great practical significance to study the treatment of candied waste-water from factories along the river basin. Take the digestible sludge from the pipe of the dewatering workshop of the sewage treatment plant and anaerobic treat the high-concentration candie waste-water in the plastic bucket. The results showed that the suspended matter concentration of waste-water decreased to 8.04 g/L and the removal rate reached 22.1% after 60 h treatment. The absorbance of waste-water decreased from 0.835 to 0.598, the color removal rate reached 32.4%, and the chroma of waste-water decreased from 500 times to 80 times, reaching the "secondary standard" of "comprehensive sewage discharge standard (GB8978-1996)".

1. Introduction

Food includes main food and non-staple food, fruit belongs to non-staple food. Fruit processing industry is an important part of agricultural product processing industry. In 1980, the total output of fruits in China was only 6.79 million tons, ranking the 10th in the world. The production of candied fruit has a long history in our country. The yield of candied fruit is very large in China, which can be divided into "north honey" and "south honey" according to the production area [1-2]. In chaoshan area, jie xi county fengjiang town, puning city lake town, Chaozhou Anbu rich in candied, just Jiexi town Fengjiang town a food factory has an annual yield of 400 thousand jin.

The candied fruit industry not only brings economic benefits, but also causes some environmental pollution problems. The waste water, juice and sugar liquid produced in the process of processing of preserved fruit and candied fruit are often dumped as waste water. However, according to the "nearby discharge" principle, the candied waste-water also needs to be discharged to the surface water at a close distance. The environmental problems caused by discharge are more and more serious, so the treatment of candied waste-water is urgent [3].

At present, there are few literatures on the study of candied waste-water, so it is very practical to study the treatment of candied waste-water. In order to protect the river basin, the concentration of the waste water was reduced by anaerobic treatment of the waste water from food production along the river basin. Get some data with a price, push the watershed conservation process.
2. Experiment part

2.1. Principles of anaerobic treatment
Anaerobic biological treatment of waste-water, also known as "anaerobic digestion", is the use of anaerobic microorganisms to degrade organic pollutants in waste-water, waste-water purification method. The mechanism is anaerobic bacteria in the role of the sludge in the decomposition of organic matter, resulting in methane and carbon dioxide and other gases. The process of complete anaerobic digestion can be divided into three stages [4-5]: (1) solid organic compounds in sludge are dissolved by extracellular hydrolytic enzymes secreted from anaerobic bacteria, and enter the cell through the cell wall. Under the catalysis of hydrolytic enzymes, polysaccharides, proteins and fats are hydrolyzed into monosaccharides, amino acids and fatty acids, etc. Under the action of acid producing bacteria, the products of the first stage are further degraded to simpler volatile organic acids, such as acetic acid, propionic acid, butyric acid, etc. Under the action of methanogens, the volatile acid produced in the second stage is converted into methane and carbon dioxide.

2.2. Experimental water sample
The candied fruit production section from the food factory along the river basin. The properties of the original waste-water are shown in Table 1.

| Table 1. Water quality parameters of candied waste-water. |
|----------------------------------------------------------|
| Suspended matter (g/L) | absorbance | Chroma (multiple) | Conductivity (us/cm) |
|-------------------------|------------|-------------------|----------------------|
| 9.08                    | 0.835      | 500               | 0.740*10^4           |

From the above Table 1, we can see that the pH of the original water sample is 3.52, showing strong acidity. Turbidity was 110.8 NTU, which was relatively high. The COD is 3081.4mg/L, and the COD is larger. The main purpose of anaerobic and aerobic waste-water treatment is to reduce the concentration of COD.

2.3. Experimental technology
The original waste-water is placed in a sealed plastic bucket, and a certain amount of digestive sludge is added to seal, prevent and control the entry of oxygen, and ensure the anaerobic working conditions. In the experimental study, a sealed plastic bucket was used for reaction, and a small aerator was added for moderate stirring and reaction heat release.

2.4. Detection method
- Determination of suspended matter: gravimetric method (GB 11901-89);
- Determination of absorbance: spectrophotometry;
- Determination of electrical conductivity: pH meter method;
- Chroma: dilution factor method.

3. Experimental results and discussion

3.1. Experimental results
The sludge used in the experiment was taken from the dewatering plant pipe of a sewage treatment plant (concentrated dehydrated). Remove the sludge 2L, load it into the anaerobic digester, close the digestive reaction system, and place it for 24 hours so that facultative bacteria can consume the oxygen in the digester. Then add waste water 28 L, moderate stir evenly, adjust its pH to 6.5, then add nutrient solution (glutamate + potassium dihydrogen phosphate), according to COD: N: P=200:5:1 ratio of nutrient solution, place the set time period, make sewage and digestion sludge full contact, and then determine the waste-water COD, pH and other water quality indicators. The results are shown in Table 2:
Table 2. Water quality index of waste-water after anaerobic treatment

| Time (h) | 0  | 8  | 16 | 24 | 32 | 40 | 48 | 52 | 60 |
|---------|----|----|----|----|----|----|----|----|----|
| Suspended solids (g/L) | 9.08 | 9.16 | 8.92 | 8.84 | 8.92 | 8.72 | 8.20 | 7.84 | 8.04 |
| Removal rate of suspended matter (%) | - | 11.2 | 13.6 | 14.3 | 13.6 | 15.5 | 20.5 | 24.0 | 22.1 |
| Absorbance | 0.835 | 0.703 | 0.694 | 0.676 | 0.671 | 0.669 | 0.643 | 0.619 | 0.598 |
| Color removal rate (%) | - | 20.6 | 21.6 | 23.6 | 24.2 | 24.4 | 27.3 | 30.1 | 32.4 |
| Chroma (multiple) | 500 | 400 | 400 | 200 | 200 | 200 | 100 | 100 | 80 |
| Conductivity (*10^4/us/cm) | 0.740 | 0.638 | 0.592 | 0.568 | 0.566 | 0.562 | 0.537 | 0.536 | 0.518 |

3.2. Analysis of suspended matter index

The experimental results are as follows Figure 1:

![Figure 1. Removal effect of suspended solids in anaerobic treatment of waste-water.](image)

As can be seen from Figure 1, the suspended solids concentration of waste-water slightly increases at 8 h of reaction, which is due to the turbidity of water caused by the addition of digestive sludge. In the following time, under the action of anaerobic digestion, the suspended matter concentration of waste-water decreased with the passage of time. At 60 h of reaction, the suspended matter concentration of waste-water decreased from 9.08 g/L to 8.04 g/L, and the removal rate of suspended matter of waste-water reached 22.1%.

3.3. Colour removal effect analysis

The absorbance and color removal rate of waste-water after anaerobic treatment are shown in Figure 2.
As can be seen from Figure 2 above, the absorbance of waste-water decreases from 0.835 to 0.598 with the progress of the reaction within 0-60 h of the anaerobic reaction, and the color removal rate reaches 32.4% when the anaerobic reaction is 60 h. The chroma of waste-water was determined by dilution multiple method, and the chroma was reduced from 500 times to 80 times. It can be seen that the anaerobic reaction has a significant chroma removal effect on waste-water.

3.4. Analysis of conductivity

The change of electrical conductivity of waste-water during anaerobic reaction is shown in Figure 3.

As can be seen from Figure 3 above, the conductivity of waste-water decreased from 0.740*10^4 at the reaction starting point to 0.518*10^4 after anaerobic digestion. The conductivity reflects the ion content in the waste-water, and the larger the ion content, the greater the conductivity of the waste-water. As the anaerobic reaction proceeds, some of the ions are degraded by microbes, deposited in the form of activated sludge at the bottom of the plastic bucket, where the solids and liquids are separated, and the ions are removed.
4. Conclusion
The sludge in the dewatering workshop of the sewage treatment plant was digested, the organic pollutants in the candied waste-water were degraded by anaerobic microorganisms, and the high concentration of candied waste-water was anaerobic treated in the plastic bucket. The results showed that the suspended matter concentration of waste-water decreased by 1.04 g/L, and the removal rate reached 22.1%. According to the conductivity, the anaerobic method can effectively remove the conductive ions such as metal in waste-water. The absorbance and color removal rate of the waste-water increased from 0.237 to 32.4%, and the chroma of the waste-water decreased from 500 times to 80 times, reaching the "secondary standard" of "comprehensive sewage discharge standard (gb8978-1996)".

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