Application of Wastewater Treatment from Preserved Egg Production

PANIDA SAMPRANPIBOON *  SATAPaul KAMHOM  PISit CHARNKEITKONG
Department of Chemical Engineering  Department of Chemical Engineering  Faculty of Science and Technology
Rangsit University  Pathumthani  Panyapiwat Institute of Technology
THAILAND  THAILAND  NONthaburi
panida3@hotmail.com  satapaul@hotmail.com  pisitcha@pit.ac.th

Abstract - The preserved egg is one of the popular food and the effective eggs keeping. They are produced and accepted for a long time. Everyone can eat. Ordinary productions of preserved eggs, mixed clay ash and rice husk are used to cover fresh eggs for a fairly long time. The catalyst might be added in the mixing to shorten the time period. One disadvantage is that the lead compound, which is a component of catalyst, may diffuse inside the preserved eggs. This project studies the wastewater treatment for the strong alkaline solution obtained from the preserved eggs production process. The parameters process, i.e., the amounts of sodium hydroxide (NaOH) and sodium chloride (NaCl) and the period of production are investigated. In the experiment 10 duck eggs were added in the solution, which is combined with NaOH 20 g and NaCl 30 g in water 1 liter, for 20 days. The obtained preserved eggs are of good aspect and unleaded, the color of white egg is brown, red egg is light black. The solution could be reused again if there is no broken egg during the process. But when using reused solution, the soaking period increases from 20 to 24 days. If there are broken eggs in process, the solution cannot be reused. The experiment results have show that the production time is less than 50% of that of the ordinary method. However, wastewater obtained from this process is the strong alkaline solution which is pollution and very dangerous to environment if discharged without treatment. For 150 g of white egg for 20 days with pH 7 adjustments by hydrochloric acid (HCl). It is found that the total suspension solid (TSS) decreased from 19,590 ml/L to 2,100 mg/L, the chemical oxygen demand (COD) decreased from 1,200 mg/L to 112 mg/L and biological oxygen demand (BOD) decreased from 198 mg/L to 58 mg/L. The COD and BOD are in the standard wastewater treatment.

Key-words: Wastewater treatment, Preserved egg, TSS, COD, BOD

1. Introduction

The preserved egg is one of the popular food and the effective eggs keeping. They are produced and accepted for a long time. Everyone can eat i.e., main dish made of boiled rice, which Thai people have in the morning and dinner or at night. In general, the preserved egg production industry is small. It can be made extra or primary income, because due to the many preserved egg consumption. Moreover, it extends longer sell fresh eggs, another way is preserved egg. It also makes no excessive amount of fresh eggs in the market, this is to help prevent fresh egg prices fall or spoilage. However, the preserved egg production is also produced a local area and the quality of preserved egg cannot control. Resulting in inconsistency of production is not well preserved egg. Consumers are less satisfied with preserved egg taste difference. Sometimes it can be difficult to find for eating. In addition, if the market needs a lot, preserved egg can not be produced in demand. Because the production used to make the local process, the mask used white clay filler mixed rice husk ash and salt, the catalyst such as zinc oxide (ZnO2) or lead oxide (PbO2) is added a little [1-3] for 50 days. The catalyst might be added in the mixing to shorten the time period. One disadvantage is that the heavy metal such as lead, which is a component of catalyst, may diffuse inside the preserved eggs, when to eat will harm the health. Therefore, the other methods should be used to produce more efficient and quality of products can also be controlled, such as unleaded containing. Produced by the soaking method is an alternative method is used to produce preserved egg. This method used in the production period is less than 50% of the original production. It also can control the quality of preserved egg to be announced by the Ministry of Public Health. After the preserved eggs are produced by soaking in solution, the solution is a strong alkaline and waste. If solution is drained before treatment is dangerous and can cause pollution to the environment is extremely.

Current environmental problems are a major problem that everyone must consider. There are many laws to control the causes of environmental problems from different industry. So the preserved eggs are already produced, and solution from the production process must be considered very much to prevent the environmental problems. Therefore, the study and find out how the wastewater treatment process preserved egg appropriate effluent standards. This is necessary to prevent and reduce environmental pollution.
2. Material and Methods

2.1 Material
- sodium chloride (NaCl)
- sodium hydroxide (NaOH)
- hydrochloric acid (HCl)
- duck eggs
- water
- hot plate
- hot pot
- thermometer
- Atomic Analyze Spectrophotometer (AAS)

2.2 Methods

Preserved egg production can be prepared from sodium chloride (NaCl) and sodium hydroxide (NaOH) the percentage is different NaCl 1.5-3% by weight and NaOH 1.0-2.0% by weight and the fresh duck eggs. Wash and wipe dry and then put into the solution provided, then closed to close the eggs to soak for 20 -28 days for water to boil at 80 °C for 8 minutes, will be preserved egg to eat and want to keep long time for eggs coated with white clay filler. The solution or effluent from the process was treated by pH adjustment with concentrated hydrochloric (HCl) and the water at pH 7 was analyzed to determine salinity, TSS, COD and BOD, respectively.

3. Results and Discussion

3.1 Effects of sodium hydroxide (NaOH)

The study found that the amount of NaOH used in the experiment will affect the color within the preserved egg at different. Figure 1 indicates that when the amount of NaOH increased by the amount of NaCl same (1.5%). and soaking time equal to 28 days, the color of the eggs that are dark brown up since the amount of NaOH increased to make solution conditions as pH increased from pH 13.10 to pH 13.23 when the amount of NaOH increased from 1.0% to 2.0%, respectively. Because of the alkaline is more to react with proteins within the egg. The protein in egg white will content with Ovalbumin Conalbumin Lysozyne and Avidin (to be found only on new fresh egg), the protein in egg yolk will also content with α,β-Lipovitellins Lipoprotein, Phosvitin and Livitin [4], therefore, the color of the eggs that are darker. If the amount of NaOH is too more increased, the preserved egg will taste bitter. Therefore, eggs can increase salty when NaCl has been increased.

3.2 Effect of sodium chloride (NaCl)

The study found that the amount of NaCl used in experiment will affect the taste of varied salty preserved egg. The color within the preserved egg the same as shown in Figure 2 a) NaCl 1.5% and b) NaCl 3.0% by amount of NaOH equal the 1.0% spent in producing the same is 28 days since the amount of NaCl as a cause salinity difference. The amounts of NaCl increased from 1.5% to 3.0%, the salinity will increase from 32% to 46%. Because of the increased NaCl that will diffuse into the egg has increased. Therefore, eggs can increase salty when NaCl has been increased.

![Figure 1](image1.png)
![Figure 2](image2.png)
3.3 Effect of duration of soaking

The study found that preserved eggs at duration of soaking eggs from 20 days to 28 days were darker. The produced preserved egg at the concentration NaOH 2.0% and NaCl 3.0% for 20 days soaking were medium salty and colors available. If time is more 28 days the preserved egg can be too bitter and darker. From the preserved eggs were produced with NaOH and NaCl concentration and soaking in different time, they were found that the suitable concentration of NaOH 2.0% and NaCl 3.0% and the period of 20 days is used to produce the preserved egg, which has good color and taste salty for the large preserved egg production.

From the study of recycle solution can be checked from pH and salinity of the solution both before and after production. It found that pH and salinity were decreased when the solution was used to recycle. From the experiment, the soaking time increased from 20 days to 24 days by using the recycle solution with the concentration of NaOH 2.0% and NaCl 3.0%. Because of soaking eggs in each cycle, pH and salinity will be decreased 1-2% and 3-5%, respectively. If the solution will be reused again, NaOH and NaCl may be added a little bit to the initial pH and salinity (pH 13.23 and salinity 58%) which is the most cost savings possible and also time to produce the same well. But application recovery solution must be the case with no eggs to break during production only.

As in industrial or household, the each preserved egg production will have about 5-10% broken eggs. From the study, the only white eggs will flow out to mix with solution, while the hardened yolk stuck to the outside shell eggs or clotting within the egg shell. Yolk egg will not flow to mix with the solution. These causes thus know that wastewater from the preserved egg production, only white egg are changed the properties solution. Therefore, the experiment is prepared the initial wastewater characteristic by using a different amount of broken eggs for 20 days to produce about 10%, 30% and 50% of all eggs. The equivalent to white egg was added in solution 3.0%, 9.0% and 15.0% by weight, respectively. The results showed that the amount of broken eggs increased the total suspended solids (TSS) were increased, because the TSS could be obtained from the egg white and egg shell reacts with the solution. When the amount of egg white increased that the TSS in solution was also increased. The duration of broken eggs between productions will not affect to TSS in solution changing, but will affect the COD and BOD.

Normally, each preserved egg production takes 20 days although eggs are broken, the new solution will not change in processing. Because of the broken eggs will not affect the quality of preserved egg. (Except at the broken eggs), but will affect only the properties of the solution. From the Experimental COD and BOD values are shown in table 1. It showed that the COD and BOD increased with the amount of broken eggs. Because of the broken eggs were increased that the organic compounds in solution increase, the bacteria will use more oxygen to decompose organic compounds and then BOD are increased. At the same time the oxygen is more used to oxidize the organic compound and become to more CO₂ that COD value is higher.

<table>
<thead>
<tr>
<th>Broken egg (%)</th>
<th>TSS (mg/L)</th>
<th>COD (mg/L)</th>
<th>BOD (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1,730</td>
<td>83</td>
<td>25</td>
</tr>
<tr>
<td>10</td>
<td>19,520</td>
<td>1,091</td>
<td>194</td>
</tr>
<tr>
<td>30</td>
<td>20,060</td>
<td>1,163</td>
<td>206</td>
</tr>
<tr>
<td>50</td>
<td>21,320</td>
<td>1,283</td>
<td>216</td>
</tr>
</tbody>
</table>

Since the wastewater from the preserved egg production containing NaCl 3.0%, NaOH 2% and 10%, 30% and 50% of broken eggs for 20 days will be pH 13.10. From the measured pH values showed that the property of wastewater from the preserved egg production is alkaline. Based on the principles of wastewater treatment should be adjusted pH by adding acid. The normal to adjust pH of the water should be in the range of neutral pH [5-8]. Therefore, in this experiment is to select the HCl for pH adjustment, the NaOH in the effluent of preserved egg production will react with HCl to dissolve the salt in the water at the following equation (1):

NaOH(aq) + HCl(aq) → NaCl(aq) + H₂O(aq)…(1)

The HCl was added to adjust pH from pH 13.10 to pH 7. The wastewater after pH adjustment was obtained to be clear and a lighter color compared with color of wastewater before adding acid to adjust pH as shown in Figure 3.

Before

After

a) 10% b) 30% c) 50% for 20 days

Figure 3 Characteristics of wastewater before and after the pH adjustment at different amount of broken eggs a) 10% b) 30% c) 50% for 20 days
The TSS was analyzed before and after adjusting pH to the amount of eggs broken as shown in Figure 4. It showed that TSS after adjusting pH will decrease that of before adjusting pH at every amount of broken eggs, since white egg can dissolve well in water at pH 7, so that property TSS in water after the pH adjustment was not changed to the amount of broken eggs.

Figure 4 The relationship of TSS before and after pH adjustment with different amount of eggs

From analysis of COD and BOD before and after pH adjustment with different amounts of broken eggs found that COD after adjusting pH will be reduced when compared with before pH adjusted at every amount of broken eggs. Since egg white can dissolve well at pH 7 that means a molecule of white egg which is the organic to surround by water molecules mainly. Therefore, the organic oxidizing by oxygen in the water to CO₂ is less, so the COD has decreased as shown in Figure 5. From the result, oxygen demand was used to decompose of organic compounds by bacteria decreased and BOD was decreased as shown in Figure 6.

Figure 5 The relationship of COD before and after pH adjustment with different amount of eggs

From the results of TSS, COD and BOD after pH adjustment, COD and BOD is in the standard wastewater treatment, TSS is higher than the standard wastewater treatment as shown in Table 2. The salinity was mainly obtained from salt and reaction of alkaline and acid become to soluble salt in water. It can be observed from the experiment, the total solid dissolved (TDS) were 33,000 mg/L, which is close to the salinity of sea is 30,000 mg/L. The water after adjustment at pH 7 should not drain to the natural water sources. But it should be used to advantage in other aspects such as using water mixed with crab, shrimp farms.

Table 2 TSS, COD and BOD standard of wastewater treatment and after pH adjustment

<table>
<thead>
<tr>
<th>Broken egg (%)</th>
<th>Properties (mg/L)</th>
<th>Standard wastewater (mg/L)</th>
<th>After pH adjustment (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>TSS &lt; 150</td>
<td>1,800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COD &lt; 400</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOD &lt; 60</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>TSS &lt; 150</td>
<td>1,950</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COD &lt; 400</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOD &lt; 60</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>TSS &lt; 150</td>
<td>2,100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>COD &lt; 400</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOD &lt; 60</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

4. Conclusion

The preserved egg produced at concentration of NaOH 2.0% and NaCl 3.0% for for 20 days will be a good quality to eat and unleaded. If the process has no broken eggs, the solution can be used again. The NaOH and NaCl may be added a little bit to keep the same time. If the process has the broken egg, the effluent must be treated with pH adjustment the wastewater to neutral by HCl addition. The COD and BOD were obtained in the standards of wastewater treatment. The total solid (TS), mostly in the form of TDS (soluble salt), which is close to the sea.
References:


