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# Optimization Study of Sequencing Batch Reactor (SBR) Poultry Wastewater Operation in Low Influent Flow Rate

**Muhammad Amir Redzuan Mohamad Shukri**[1], **Nor Haslina Hashim**[1*]

[1] *Universiti Tun Hussein Onn Malaysia, Department of Civil Engineering Technology*
*University Tun Hussein Onn Malaysia, Pagoh, 84600, MALAYSIA*

*Corresponding Author: haslina@uthm.edu.my

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**Abstract**

This study examines the effectiveness of Sequencing Batch Reactor (SBR) technology in treating poultry slaughterhouse wastewater. The study monitored the parameters of pH, SV30, DO, AN, MLSS, COD, and BOD to evaluate the efficiency of the biological treatment process. The results suggest that SBR technology can be effective in removing organic matter and nitrogen from poultry wastewater. The comprehensive results reveal the effectiveness of SBR in removing suspended solids, microorganisms, nitrogen, and organic matter from the wastewater. The study underscores the importance of monitoring these parameters for assessing treatment efficacy and highlights the potential of SBR as a promising solution for sustainable poultry wastewater treatment. However, the study also highlights the importance of continuous monitoring and optimization of treatment processes to ensure their effectiveness. The use of Sequencing Batch Reactor (SBR) technology with varying aeration times of 20 and 16 hours showed a decrease in COD levels, indicating the effectiveness of the treatment process. The results of the study suggest that SBR technology can be effective in removing organic matter and nitrogen from poultry wastewater.

## 1. Introduction

Over the past decades, the increase in industrial activities, including pharmaceuticals, dairy, breweries, tanneries, abattoirs, and food processing, has led to a decline in water quality. Among these, abattoirs contribute significantly to wastewater pollution, characterized by high levels of impurities such as organic materials, suspended particles, oil, grease, and nutrients. Improper disposal of untreated slaughterhouse wastewater (SWW) poses environmental threats, causing groundwater pollution and deoxygenation of rivers (Bustillo et al., 2015). The SWW has the potential to escalate contamination, leading to eutrophication and deoxygenation of aquatic systems (Rinquest et al., 2019). This is particularly pronounced in Malaysia, as improper disposal can result in groundwater pollution and river deoxygenation, making SWW the most environmentally harmful (Aziz et al., 2019). Extensive SWW treatment is crucial for environmentally friendly discharge that prioritizes public health.

Globally, treating wastewater from slaughterhouses remains challenging, especially in underdeveloped nations. The step feeding of the Sequencing Batch Reactor (SBR) process with intermittent aeration emerges as a promising option for bio-nitrogen removal. The SBR process, likened to a well-rehearsed dance with five key moves (Fill, React, Settle, Draw, and Idle), combines aerobic and anaerobic processes efficiently, addressing nitrification, denitrification, and phosphorus removal simultaneously (Wang et al., 2021). This approach offers benefits like efficient denitrification, low cost, high stability, and a small footprint.

Various biological processes, including membrane bioreactors, activated sludge processes, SBR, up flow anaerobic sludge blanket reactors, and anaerobic filters, are widely used to treat SWW (Aziz et al., 2019). In the context of this study, special attention is given to the aeration phase within the SBR process, investigating two distinct durations: 20 hours and 16 hours, both with a consistent 2-hour settling time. the decision to use a 16-hour or 20-hour treatment cycle in wastewater depends on specific factors such as treatment goals, pollutant characteristics, and regulatory context. The 16-hour cycle offers enhanced treatment efficiency, making it suitable for industries with moderate pollutant levels and regulatory compliance concerns. On the other hand, the 20-hour cycle provides more comprehensive purification, addressing persistent or complex pollutants and meeting stringent discharge requirements.

The choice between the two cycles involves a trade-off between efficiency, effectiveness, and operational considerations, highlighting the need to balance these factors for sustainable wastewater treatment. While a 14-hour cycle may be operationally efficient, industries in Malaysia may need to assess whether the potential benefits of longer cycles, such as more comprehensive purification, outweigh the associated costs and logistical challenges.

## 1.1 Characteristics of Poultry Wastewater

Poultry wastewater is a complex mix from various operations, including manure, feathers, and processing discharges. It varies based on practices and bird species, with turkeys producing less waste than broilers (Mukhtar, 2005). Untreated poultry wastewater, rich in fat, protein, and nutrients, poses environmental risks like eutrophication. Treating and disposing of it on land can enhance soil fertility and water availability (Arukmetov, 2017). Studies (Gu et al., 2019) highlight pharmaceutical compounds in poultry wastewater, emphasizing the need for specific treatment before discharge. Comparing Malaysia and India's wastewater shows differences in pH and significant variations in COD, highlighting the importance of tailored treatment strategies (Aziz et al., 2018; Manjunath et al., 2023).

**Table 1** *Poultry Wastewater in Malaysia and India Across Decades (Aziz et al., 2018; Manjunath et al., 2023)*

| Parameters | Poultry Wastewater (Malaysia) (Aziz *et al*., 2018) | Poultry Wastewater (India) (Manjunath *et al*., 2023) |
|---|---|---|
| pH | 6.6 ± 8.5 | 6.9 ± 0.3 |
| Chemical Oxygen Demand, COD (mg/L) | 1301 ± 250 | 2500 ± 350 |
| Biochemical Oxygen Demand, BOD (mg/L) | 70.7 ± 30 | 925 ± 10 |
| Total Solids, TS (mg/L) | 720 ± 50 | 3500 ± 50 |
| Total Nitrate, TN (mg/L) | 56.5 ± 70.7 | 85 ± 15 |

Wastewater from chicken processing plants, especially the blood, fats, proteins, and fibers in it, contains a lot of organic matter. These come from different parts of the plant like blood, carcass leftovers, and other organic materials. If not managed well, these components can lead to environmental issues like algal blooms. The primary pollutant in this wastewater is organic matter, mainly from poultry blood. Proper management is crucial to avoid environmental problems.

## 1.2 The Sequencing Batch Reactor

The Sequencing Batch Reactor is a great solution for treating poultry wastewater. It goes through stages like screening, biological treatment, settling, and decanting (Pellegrini, 2019). Operating in cycles, SBR is adaptable, cost-effective, and space-efficient, outperforming conventional methods (AZU Water, 2016). Despite challenges like handling high organic matter, SBR shows impressive pollutant removal, meeting regulatory standards (Rajab et al., 2017). While implementation costs and regulations are hurdles, SBR proves to be a promising technology for reducing environmental impact in poultry production (Admin-Seo, 2021; Rajpal et al., 2022).

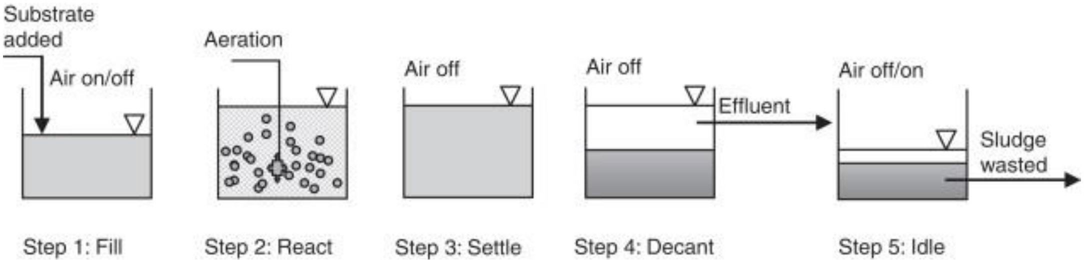

**Fig. 1** *Illustrates the key stages in the Sequencing Batch Reactor (SBR) method, highlighting the major steps involved in the process.*

### 1.2.1 Activated Sludge Process in SBR for Poultry Wastewater Treatment

Using the activated sludge process, especially in the sequencing batch reactor setup, is effective for treating complex poultry wastewater (Mian et al., 2018). Microorganisms in this process break down organic matter in the wastewater, making it simpler. The SBR configuration, with stages like filling, reacting, settling, decanting, and idling, optimizes this process for poultry wastewater treatment (Mian et al., 2018). In scenarios with low water flow, SBR is a viable and efficient option, relying on quality seed sludge for pollutant removal (Sanga et al., 2019). Seed sludge, sourced from existing plants or cultivated in-house, is crucial for the long-term performance and stability of SBR systems (Rayaz, 2023). The composition of microorganisms in activated sludge, like bacteria, fungi, and protozoa, is dynamic and influenced by environmental factors (Weber et al., 2007).

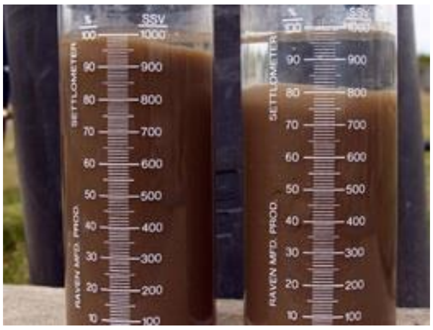

**Fig. 2** *Depicts the activated sludge within the SBR (Mian et al., 2018)*

### 2.4.2 Optimizing SBR Wastewater Treatment Operation

In the Sequencing Batch Reactor process, treating wastewater is like a well-coordinated dance with five key moves. First, in the "Filling" stage, the reactor tank gets filled with poultry wastewater to start the treatment. Next is the "React" stage, where microorganisms break down the organic stuff with a bit of oxygen assistance, acting like a cleanup crew. Then, in the "Settle" stage, heavy particles sink to the bottom, allowing clear water to rise to the top. After the cleanup, it's the "Decant" stage, where the clear water is carefully drawn off for discharge, leaving behind any remaining solids. Finally, there's the "Idle" stage – a bit like a break or pause – before the whole process starts again (Adapted from a general understanding of SBR process steps).

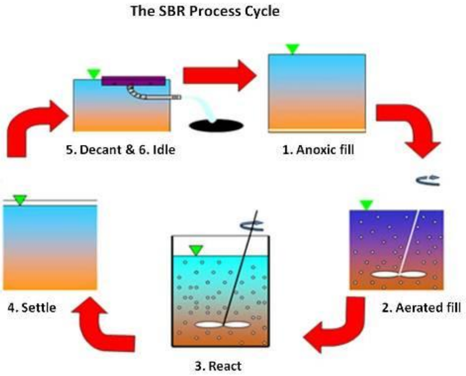

**Fig. 3** *Illustrates the cyclical process of the Sequencing Batch Reactor (SBR) (Mian et al., 2018).*

## 2. Methodology

The methods used for the optimization research of poultry wastewater treatment using a Sequencing Batch Reactor (SBR). The experimental setup, procedures, and parameters examined to accomplish, and this study intends to explore the performance of the SBR process and its capacity to successfully treat poultry wastewater by using a systematic method. Future researchers can replicate the work because of the methods section's detailed explanation of the experimental setup.

### 2.1 Sample Collection (Poultry Wastewater)

In this study, samples of poultry wastewater collected at Ayam Peladang, a business that manages the byproducts of chicken slaughter and is situated in Kampung Parit Lanjut, 84300 Bukit Pasir, Johor. Within the wastewater treatment system, representative sampling points had to be carefully chosen as part of the sampling procedure. A typical sample collected between about 500 ml in every sampling event. This volume minimizes the risk of sample contamination while allowing for a sufficient amount of wastewater to conduct various laboratory tests and analyses. To prevent cross-contamination, the sampling apparatus was thoroughly cleaned and sterilized prior to sample collection. Each sample was collected with the proper documentation of the sampling site, date, and time to enable precise data analysis and interpretation.

### 2.2 Seed Sludge Preparation (Activated Sludge)

In order to effectively prepare seed sludge for wastewater treatment in SBR systems, a step-by-step guide can be followed. Firstly, collect sludge from an existing wastewater treatment plant or SBR system to obtain a microbial-rich sample. Next, it is crucial to filter the collected sludge using a 200-micron sieve to remove any unwanted solids that could hinder the seeding process. To achieve an optimal concentration, dilute the filtered sludge with clean water until it reaches a range of 10-20 g/L of volatile suspended solids (VSS). Thoroughly mix the diluted sludge and allow it to settle for approximately an hour. Once settled, carefully decant the supernatant liquid and retain only the settled sludge as the seed for the SBR system. tore the seed sludge in a cool and dark place until it is ready for use. The ideal storage temperature for seed sludge is 5°C (41°F). Extracted activated sludge from the soy sauce factory of Jalen Sdn. Bhd. To ensure that there is only pure activated sludge left and that any leftover soy sauce is removed, the activated sludge from the soy sauce factory needs to be mixed with regular water and blasted with oxygen using a blower.

### 2.3 Optimal Procedure for Conducting Poultry Wastewater Treatment Using a SBR

In the experiment, a 1 mL sample of poultry wastewater is mixed with 10 mL of tap water until a balanced 30:300 ratio is achieved. Seed sludge is added to create a 600 mL mixture. This mixture undergoes aeration for 20 and 16 hours to enhance microorganism interaction, followed by a two-hour settling phase for suspended solids to separate, forming a layer called the supernatant. The Settleable Volume in 30 minutes (SV30) is checked to assess settling. Then, 40 mL of the supernatant is analyzed for pH, DO, MLSS (10 mL), COD (5 mL), and AN (25 mL). For continued accuracy, a 40 mL diluted sample (1:10) is prepared for subsequent analysis. Lab-scale pH is adjusted between 7.0 and 7.5, ideal for bacterial growth. The experiment follows a Time of Operation schedule, testing different aeration times sequentially, starting with the maximum to boost bacterial growth. The goal is to optimize the SBR system for efficient chicken wastewater treatment at low flow rates. Contaminants like COD and AN are targeted for effective removal while maintaining the desired pH. Throughout the experiment, measurements of pH, DO, MLSS, COD, AN, and BOD are regularly obtained and recorded.

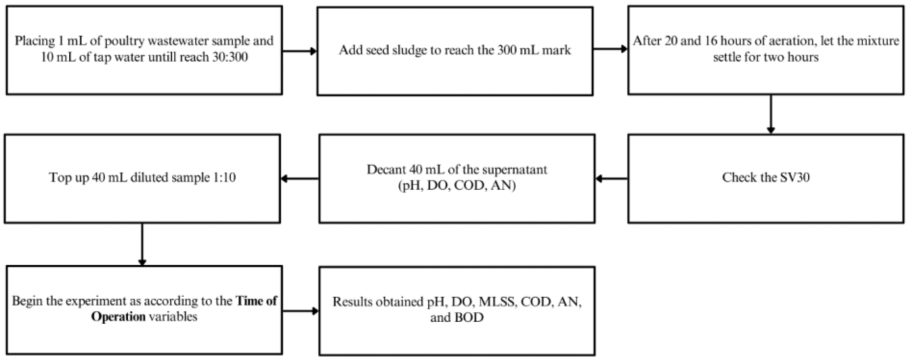

**Fig. 4** *Illustrative Overview of the Sequencing Batch Reactor (SBR) Experimental Procedure*

## 3. Results and Discussion

In Poultry wastewater treatment is a pivotal aspect of sustainable agricultural practices, and the Sequencing Batch Reactor (SBR) has emerged as a promising solution. The performance optimization of treating poultry slaughterhouse wastewater using a SBR with varying aeration times (20 hours and 16 hours), while maintaining a consistent settling time of 2 hours. This chapter delves into the outcomes of our investigation, focusing on key parameters pH, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Ammonium Nitrogen (AN), Biochemical Oxygen Demand (BOD), and Mixed Liquor Suspended Solids (MLSS). These parameters serve as vital indicators in evaluating the efficacy of the SBR process.

## 3.1 Performance of Treating Poultry Slaughterhouse Wastewater Using SBR Between 20- and 16-Hours Aeration

The primary objectives revolve around understanding the impact of variable aeration times on critical parameters, subsequent improvement in water quality, and the alignment of the treated water with Environmental Quality (Sewage) Regulations, 2009. These samples serve as a snapshot of the untreated water, laden with organic pollutants and potentially harmful substances. This experimental design allows for a nuanced exploration of the system's performance under different operational conditions.

The analysis of the treated water post-SBR treatment aims to gauge the success of the system in achieving desired water quality standards. This study presents the outcomes of 20 and 16 hours of aeration; however, the two hours of settling down are the same. The differences between the results of the 20 and 16 hours of aeration of the poultry wastewater treatment, which is improving every day, can be ascertained more clearly through the results of the following parameters: pH, DO, SV30, MLSS, AN, COD, and BOD.

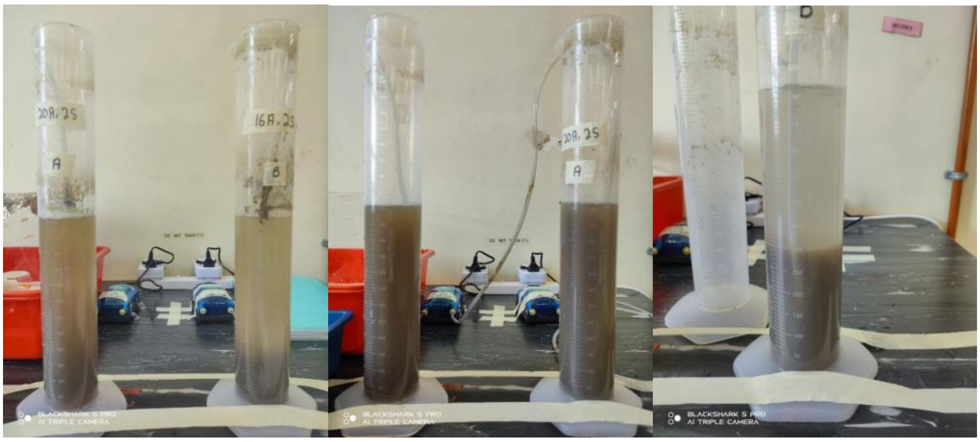

**Fig. 5** *Pre, during and post of the treatment poultry wastewater using SBR*

### 3.1.1 pH Levels of Post-Treatment

The pH level is an important parameter that affects the efficiency of the treatment process. The pH levels of the wastewater samples were found to be higher after 16 hours of aeration compared to 20 hours of aeration. The pH level from the wastewater sample on Day 5 was the highest at 8.30 after 16 hours of aeration. The pH levels of the wastewater after 20 hours of aeration ranged from 5.69 to 7.15 while the pH levels of the wastewater after 16 hours of aeration ranged from 6.06 to 8.30. This indicates that both treatment process was effective in removing and maintaining the acidic components from the wastewater. According to the Environmental Quality (Sewage) Regulations, 2009, the permissible limit for pH in treated effluent discharged into inland waters is 6.0-9.0. The pH levels of the wastewater samples after 16 hours of aeration were found to be within the permissible limit for inland waters. The results are show at Table 4.1:

**Table 2** *The comparison of the pH test results after 16 and 20 hours of aeration.*

| Comparison pH Levels Post-Treatment: 16 vs 20 Hours Aeration | | | | | | |
|---|---|---|---|---|---|---|
| Operation Time | | Days | | | | |
| Aeration Time (hr) | Settling Time (hr) | 1 | 2 | 3 | 4 | 5 |

**Table 2** *Continue*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16 | 2 | 1 | 7.14 | 6.06 | 6.15 | 7.60 | 8.30 |
| | | 2 | 7.15 | 6.06 | 6.15 | 7.60 | 8.30 |
| | | 3 | 7.16 | 6.07 | 6.15 | 7.60 | 8.30 |
| | | Avg | 7.15 | 6.06 | 6.15 | 7.60 | 8.30 |
| 20 | 2 | 1 | 7.14 | 5.70 | 6.15 | 6.52 | 6.43 |
| | | 2 | 7.15 | 5.69 | 6.15 | 6.51 | 6.43 |
| | | 3 | 7.16 | 5.69 | 6.15 | 6.51 | 6.43 |
| | | Avg | 7.15 | 5.69 | 6.15 | 6.51 | 6.43 |

### 3.1.2 Dissolve Oxygen (DO) Levels of Post-Treatment

The DO level is an important parameter that indicates the amount of oxygen dissolved in the wastewater. The DO levels of the wastewater after 20 hours of aeration ranged from 7.03 to 9.38 while the DO levels of the wastewater after 16 hours of aeration ranged from 7.03 to 9.52. The DO levels of the wastewater samples were found to be higher on 16 hours of aeration compared to 20 hours of aeration. The DO level of the wastewater sample on Day 3 was the highest at 9.52 after 16 hours of aeration. The DO level of the wastewater sample on Day 2 was the highest at 9.11 after 16 hours of aeration. This indicates that both treatment process was effective in increasing the amount of oxygen dissolved in the wastewater. According to the Environmental Quality (Sewage) Regulations, 2009, the permissible limit for DO in treated effluent discharged into inland waters is 5-8 mg/L. The results are show at Table 3:

**Table 3** *The comparison of the DO test results after 16 and 20 hours of aeration*.

| Comparison DO Levels Post-Treatment: 16 vs 20 Hours Aeration | | | | | | | |
|---|---|---|---|---|---|---|---|
| Operation Time | | | Days | | | | |
| Aeration Time (hr) | Settling Time (hr) | | 1 | 2 | 3 | 4 | 5 |
| 16 | 2 | 1 | 7.09 | 9.13 | 9.51 | 9.17 | 9.21 |
| | | 2 | 7.11 | 9.11 | 9.53 | 9.17 | 9.21 |
| | | 3 | 6.88 | 9.10 | 9.54 | 9.17 | 9.21 |
| | | Avg | 7.03 | 9.11 | 9.52 | 9.17 | 9.21 |
| 20 | 2 | 1 | 7.09 | 9.02 | 9.38 | 9.16 | 9.43 |
| | | 2 | 7.11 | 9.02 | 9.39 | 9.16 | 9.33 |
| | | 3 | 6.88 | 9.01 | 9.37 | 9.16 | 9.34 |
| | | Avg | 7.03 | 9.02 | 9.38 | 9.16 | 9.34 |

### 3.1.3 SV30 Levels of Post-Treatment

The activated sludge is a mixture of microorganisms that consume the organic matter in the wastewater. The SV30 levels of the wastewater after 20 hours of aeration ranged from 310 to 230 mL while the SV30 levels of the wastewater after 16 hours of aeration ranged from 310 to 159 mL. The SV30 levels decrease as the activated sludge consumes the bacteria in the wastewater. The decrease in SV30 levels indicates that the treatment process was effective in removing the suspended solids from the wastewater. The Environmental Quality (Sewage) Regulations, 2009, specifies the maximum permissible SV30 level for treated effluent to be 30 mg/L. This indicates that the treatment process was effective in removing the microorganism from the wastewater and the treated effluent can be safely discharged into inland waters according to the Environmental Quality (Sewage) Regulations, 2009. The results are show at Table 4:

**Table 4** *The comparison of the SV30 test results after 16 and 20 hours of aeration.*

| Comparison SV$_{30}$ Levels Post-Treatment: 16 vs 20 Hours Aeration | | | | | | | |
|---|---|---|---|---|---|---|---|
| Operation Time | | | Days | | | | |
| Aeration Time (hr) | Settling Time (hr) | | 1 | 2 | 3 | 4 | 5 |
| 16 | 2 | 1 | 310 | 280 | 250 | 220 | 159 |
| | | 2 | 310 | 280 | 250 | 220 | 159 |
| | | 3 | 310 | 280 | 250 | 220 | 159 |
| | | Avg | 310 | 280 | 250 | 220 | 159 |
| 20 | 2 | 1 | 310 | 290 | 270 | 260 | 230 |
| | | 2 | 310 | 290 | 270 | 260 | 230 |
| | | 3 | 310 | 290 | 270 | 260 | 230 |
| | | Avg | 310 | 290 | 270 | 260 | 230 |

### 3.1.4 MLSS Levels of Post-Treatment

The MLSS level is an important parameter that indicates the amount of mixed liquor suspended solids in the wastewater. The MLSS levels of the wastewater after 20 hours of aeration ranged from 0.0262 to 0.0173 g while the MLSS levels of the wastewater after 16 hours of aeration ranged from 0.0325 to 0.0142 g. The MLSS level of the wastewater sample on Day 2 was the highest at 0.0325 after 16 hours of aeration. The MLSS level of the wastewater sample on Day 2 was also the highest at 0.0262 after 20 hours of aeration. In conclusion, the results of the study indicate that decreasing the aeration time from 20 hours to 16 hours in poultry slaughterhouse wastewater treatment using sequencing batch reactor (SBR) technology can increase the MLSS levels of the wastewater samples. This indicates that the treatment process was effective in removing the mixed liquor suspended solids from the wastewater. The results are show at Table 5:

**Table 5** *The comparison of the MLSS test results after 16 and 20 hours of aeration.*

| Comparison MLSS Levels Post-Treatment: 16 vs 20 Hours Aeration | | | | | | |
|---|---|---|---|---|---|---|
| Operation Time | | Days | | | | |
| Aeration Time (hr) | Settling Time (hr) | 1 | 2 | 3 | 4 | 5 |

**Table 5** *Continue*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16 | 2 | 1 | - | 0.0325 | 0.0237 | 0.0143 | 0.0154 |
| | | 2 | - | 0.0325 | 0.0237 | 0.0143 | 0.0154 |
| | | 3 | - | 0.0325 | 0.0237 | 0.0143 | 0.0154 |
| | | Avg | - | 0.0325 | 0.0325 | 0.0143 | 0.0154 |
| 20 | 2 | 1 | - | 0.0262 | 0.0213 | 0.0186 | 0.0173 |
| | | 2 | - | 0.0262 | 0.0213 | 0.0186 | 0.0173 |
| | | 3 | - | 0.0262 | 0.0213 | 0.0186 | 0.0173 |
| | | Avg | - | 0.0262 | 0.0213 | 0.0186 | 0.0173 |

### 3.1.5 Chemical Oxygen Demand (COD) Levels of Post-Treatment

The COD levels of the wastewater after 20 hours of aeration ranged from 2883 to 1013 mg/L while the COD levels of the wastewater after 16 hours of aeration ranged from 2823 to 1766 mg/L. The COD level of the wastewater sample on Day 5 was the lowest at 1013 on the 16 hours of aeration compared to Day 5 20 hours 1766 mg/L. The COD level of the wastewater sample on Day 1 was the highest at 2883 after 20 hours of aeration. This indicates that the treatment process was effective in removing the organic matter from the wastewater. According to the Environmental Quality (Sewage) Regulations, 2009, the permissible limit for COD in treated effluent discharged into inland waters is around 100 mg/L. The results are show at Table 6:

**Table 6** *The comparison of the COD test results after 16 and 20 hours of aeration.*

| Comparison COD Levels Post-Treatment: 16 vs 20 Hours Aeration | | | | | | | |
|---|---|---|---|---|---|---|---|
| Operation Time | | | Days | | | | |
| Aeration Time (hr) | Settling Time (hr) | | 1 | 2 | 3 | 4 | 5 |
| 16 | 2 | 1 | 2690 | 2520 | 2360 | 1520 | 1030 |
| | | 2 | 3100 | 2520 | 2350 | 1520 | 1010 |
| | | 3 | 2860 | 2510 | 2375 | 1520 | 1000 |
| | | Avg | 2823 | 2520 | 2360 | 1520 | 1013 |
| 20 | 2 | 1 | 2690 | 2480 | 2610 | 2030 | 1760 |
| | | 2 | 3100 | 2480 | 2610 | 2020 | 1770 |
| | | 3 | 2860 | 2480 | 2610 | 2020 | 1770 |
| | | Avg | 2883 | 2480 | 2610 | 2020 | 1766 |

### 3.1.6 Ammonia Nitrogen (AN) Levels of Post-Treatment

The AN level is an important parameter that indicates the amount of ammonia nitrogen in the wastewater. The AN level of the wastewater after 20 hours of aeration ranged from 44.10 to 20.50 mg/L while the AN level of the wastewater after 16 hours of aeration ranged from 7.80 to 44.10 mg/L. The AN level of the wastewater samples was found to be lower after 16 hours of aeration compared to 20 hours of aeration. The AN level of the wastewater sample on Day 2 was the lowest at 7.80 after 16 hours of aeration. The AN level of the wastewater sample on Day 2 was also the highest at 28.80 after 20 hours of aeration. According to the Environmental Quality (Sewage) Regulations, 2009, the permissible limit for AN in treated effluent discharged into inland waters is 10 mg/L1. The results are show at Table 7:

**Table 7** *The comparison of the AN test results after 16 and 20 hours of aeration.*

| Comparison AN Levels Post-Treatment: 16 vs 20 Hours Aeration | | | | | | | |
|---|---|---|---|---|---|---|---|
| Operation Time | | | Days | | | | |
| Aeration Time (hr) | Settling Time (hr) | | 1 | 2 | 3 | 4 | 5 |
| 16 | 2 | 1 | 43.40 | 7.76 | 24.10 | 15.70 | 11.40 |
| | | 2 | 44.20 | 7.80 | 23.90 | 15.70 | 11.40 |
| | | 3 | 44.70 | 7.82 | 24.00 | 15.70 | 11.40 |
| | | Avg | 44.10 | 7.80 | 24.00 | 15.70 | 11.40 |
| 20 | 2 | 1 | 43.40 | 28.80 | 39.40 | 23.60 | 21.00 |
| | | 2 | 44.20 | 28.81 | 39.00 | 23.70 | 20.50 |
| | | 3 | 44.70 | 28.78 | 39.10 | 23.50 | 20.49 |
| | | Avg | 44.10 | 28.80 | 39.20 | 23.65 | 20.50 |

## 3.2 Removal Efficiency Percentage of COD & AN

The COD removal efficiency percentage for 16 hours of aeration in one measuring cylinder was 88%, while the COD removal efficiency percentage for 20 hours of aeration in another measuring cylinder was 89%.

**Table 8** *Shows the removal efficiency percentage of COD*

| Sample Aeration of Treating Poultry Wastewater | | COD | Removal Efficiency |
|---|---|---|---|
| 16 | 1 | 2360 | 88% |
| | 2 | 2350 | |
| | 3 | 2370 | |
| | Avg | 2360 | |
| 20 | 1 | 2610 | 89% |
| | 2 | 2610 | |
| | 3 | 2610 | |
| | Avg | 2610 | |

The AN removal efficiency percentage for 16 hours of aeration in one measuring cylinder was 87%, while the AN removal efficiency percentage for 20 hours of aeration in another measuring cylinder was 91%.

**Table 9** *Shows the removal efficiency percentage of AN*

| Sample Aeration of Treating Poultry Wastewater | | AN | Removal Efficiency |
|---|---|---|---|
| 16 | 1 | 24.10 | 87% |
| | 2 | 23.90 | |
| | 3 | 24.00 | |
| | Avg | 24.00 | |
| 20 | 1 | 28.80 | 91% |
| | 2 | 39.40 | |
| | 3 | 39.10 | |
| | Avg | 39.20 | |

## 3.3 Monitoring Parameters of Untreated Poultry Slaughterhouse Wastewater

The study measured parameters of the pH, DO, AN, COD, and BOD levels of the poultry slaughterhouse wastewater for three weeks. It is important to note that the difference in the levels of pH, DO, AN, COD, and BOD between the three weeks could be due to various factors such as the difference in the initial levels of the wastewater, the difference in the amount of organic matter and nitrogen present in the wastewater, and the difference in the amount of oxygen supplied during the aeration process.

### 3.3.1 pH of Untreated Poultry Wastewater

Based on the pH readings, it can be observed that the pH level of the wastewater decreased from week 1 to week 3 and then decreased further by week 6. The pH readings of the wastewater for weeks 1, 3, and 6 were 7.40, 6.11, and 3.68, respectively. The decrease in pH levels could be due to various factors such as the accumulation of acidic components in the wastewater, the decrease in the amount of oxygen supplied during the aeration process, and the decrease in the efficiency of the biological treatment process.

**Table 10** *Shows the pH readings obtained from the poultry wastewater by weekly*

| Wastewater Sample Test pH | | Week 1 | Week 3 | Week 5 |
|---|---|---|---|---|
| Poultry Wastewater | 1 | 7.32 | 6.10 | 3.71 |
| | 2 | 7.43 | 6.08 | 3.65 |
| | 3 | 7.44 | 6.15 | 3.68 |
| | Avg | 7.40 | 6.11 | 3.68 |

### 3.3.2 Dissolve Oxygen (DO) of Poultry Wastewater

Based on the DO readings, it can be observed that the DO level of the wastewater decreased from week 1 to week 3 and then decreased further by week 6. The DO level of the wastewater in week 1 was 8.42 mg/L, which is within the permissible range of DO levels for treated effluent. However, the DO level of the wastewater in week 3 was 1.82 mg/L, which is significantly lower than the permissible range of DO levels for treated effluent. The DO level of the wastewater in week 6 was 0.29 mg/L, which is also significantly lower than the permissible range of DO levels for treated effluent. The decrease in DO levels could be due to various factors such as the decrease in the amount of oxygen supplied during the aeration process, the accumulation of organic matter in the wastewater, and the decrease in the efficiency of the biological treatment process.

**Table 11** *Shows the DO readings obtained from the poultry wastewater by weekly*

| Wastewater Sample Test DO (mg/L) | | Week 1 | Week 3 | Week 5 |
|---|---|---|---|---|
| Poultry Wastewater | 1 | 8.46 | 1.96 | 0.30 |
| | 2 | 8.40 | 1.72 | 0.29 |
| | 3 | 8.41 | 1.83 | 0.29 |
| | Avg | 8.42 | 1.82 | 0.29 |

## 3.3.3 AN of Untreated Poultry Wastewater

The AN reading can be observed that the AN level of the wastewater decreased from week 1 to week 3 and then decreased further by week 6. The AN level of the wastewater in week 1 was 4.41 mg/L, which is higher than the permissible range of AN levels for treated effluent. The AN level of the wastewater in week 3 was 2.01 mg/L, which is still higher than the permissible range of AN levels for treated effluent. The AN level of the wastewater in week 6 was 0.99 mg/L, which is within the permissible range of AN levels for treated effluent. AN level could be due to various factors such as the decrease in the amount of organic matter present in the wastewater, the increase in the efficiency of the biological treatment process, and the decrease in the amount of nitrogen supplied during the aeration process.

**Table 12** *Shows the AN reading obtained from the poultry wastewater by weekly*

| Wastewater Sample Test AN (mg/L) | | Week 1 | Week 3 | Week 5 |
|---|---|---|---|---|
| Poultry Wastewater | 1 | 4.34 | 2.00 | 1.01 |
| | 2 | 4.42 | 2.01 | 0.96 |
| | 3 | 4.47 | 2.01 | 1.00 |
| | Avg | 4.41 | 2.01 | 0.99 |

## 3.3.4 COD of Untreated Poultry Wastewater

Based on the COD readings, it can be observed that the COD level of the wastewater increased significantly from week 1 to week 3 and then increased further by week 6. The COD level of the wastewater in week 1 was 314 mg/L, which is within the permissible range of COD levels for treated effluent. However, the COD level of the wastewater in week 3 was 2330 mg/L, which is significantly higher than the permissible range of COD levels for treated effluent. The COD level of the wastewater in week 6 was 4330 mg/L, which is also significantly higher than the permissible range of COD levels for treated effluent. The increase in COD levels could be due to various factors such as the accumulation of organic matter in the wastewater, the decrease in the efficiency of the biological treatment process, and the decrease in the amount of oxygen supplied during the aeration process.

**Table 13** *Shows the COD reading obtained from the poultry wastewater by weekly*

| Wastewater Sample Test COD (mg/L) | | Week 1 | Week 3 | Week 5 |
|---|---|---|---|---|
| Poultry Wastewater | 1 | 331 | 2040 | 4300 |
| | 2 | 296 | 2090 | 4350 |
| | 3 | 315 | 2860 | 4342 |
| | Avg | 314 | 2330 | 4330 |

## 3.3.5 BOD of Untreated Poultry Wastewater

Based on the BOD readings, it can be observed that the BOD level of the wastewater increased significantly from week 1 to week 3 and then decreased slightly by week 6. The BOD level of the wastewater in week 1 was 441 mg/L, which is within the permissible range of BOD levels for treated effluent. However, the BOD level of the wastewater in week 3 was 3260 mg/L, which is significantly higher than the permissible range of BOD levels for treated effluent. The BOD level of the wastewater in week 6 was 3100 mg/L, which is also significantly higher than the permissible range of BOD levels for treated effluent. the increase in BOD levels could be due to various factors such as the accumulation of organic matter in the wastewater, the decrease in the efficiency of the biological treatment process, and the decrease in the amount of oxygen supplied during the aeration process.

**Table 14** *Shows the BOD reading obtained from the poultry wastewater by weekly*

| Wastewater Sample Test BOD (mg/L) Week 2 | | | |
|---|---|---|---|
| Week | 1 | 3 | 5 |
| BOD | 441 | 3260 | 3100 |

## 4. Conclusion

In summary, the study on poultry slaughterhouse wastewater in Malaysia emphasizes the effectiveness of Sequencing Batch Reactor (SBR) technology in reducing organic matter and nitrogen levels. Continuous monitoring and optimization of treatment processes are crucial for ensuring efficiency. The untreated wastewater poses environmental risks due to acidic components, high organic matter, and nitrogen, underscoring the need for effective treatment to prevent adverse effects on water quality and aquatic ecosystems. Overall, the insights gained from this study can guide improvements in the biological treatment process, promoting sustainability in the poultry industry.

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