



Study of the effectiveness of bioabsorbent
to absorb wastewater from rubber factories.

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Abstract

This project, " Study of the effectiveness of bioabsorbent to absorb wastewater from rubber factories," aimed to investigate the efficiency of bioadsorbent made from water hyacinth and azolla in absorbing wastewater from rubber factories. Seven ratios of water hyacinth:azolla were tested: 100:0, 90:10, 70:30, 50:50, 30:70, 10:90, and 0:100. The experiment was divided into three stages: Stage 1 creating bioabsorbent; Stage 2 study the effectiveness of bioadsorbent by measuring DO, pH, ammonia, and nitrite at various times within 24 hours; and Stage 3 testing the effectiveness of bioabsorbent. The results showed that the bioadsorbent with a 50:50 water hyacinth:azolla ratio exhibited the highest efficiency in absorbing wastewater from rubber factories. This efficiency was significantly correlated with an increase in DO ($p < .05$) and a continuous decrease in nitrite and ammonia ($p < .05$). The findings are consistent with the biological nitrification process. Furthermore, the 50:50 ratio bioadsorbent was found to have a degradation rate of up to 61.85% within 24 hours. Therefore, the 50:50 ratio bioadsorbent is suitable for development as an bioabsor for wastewater from rubber factories and possesses the best biodegradability.

Keywords: Bioabsorbent, Degradation rate

Research Question

1. Do different ratios of bioabsorbent affect the absorption of wastewater from rubber factories? If so, how?
2. Does the degradation rate of bioabsorbent affect the absorption of wastewater from rubber factories? If so, how?

Hypothesis

1. Different ratios of bioabsorbent affect the absorption of wastewater from rubber factories.
2. The degradation rate of bioabsorbent affects the absorption of wastewater from rubber factories.

Introduction

Rubber is an important cash crop that plays a major role in Thailand's economy. Thailand ranks first in rubber export and second in rubber plantation area (Rubber Research Institute, B.E. Prof. 2018). Latex from rubber trees is a key raw material used in the rubber industry. The rubber industry has continuously expanded, especially in southern Thailand, due to the suitable climate and environmental conditions. In Trang Province, the raw rubber industry accounts for 6.73 percent of total factories.

However, rubber processing generates highly polluted wastewater with strong odors, mainly caused by the use of formic or sulfuric acid in latex coagulation. This wastewater contains ammonia, nitrates, nitrites, suspended solids, and high levels of organic matter, indicated by high BOD and COD values, which negatively affect human health, the environment, and nearby communities.

Previous studies have shown that aquatic plants such as azolla and water hyacinth are effective in wastewater treatment. Azolla can reduce BOD by 6.98 percent within three weeks, while water hyacinth can reduce BOD and COD by up to 86 percent and 79 percent, respectively. However, direct use of aquatic plants is inconvenient. Therefore, this study aims to develop bioabsorbents from water hyacinth and azolla to improve wastewater treatment efficiency in rubber factories.

Materials

- | | |
|--|------------------------|
| 1) Water hyacinth | 10) DO test kit |
| 2) Azolla | 11) pH meter |
| 3) Chitosan | 12) 250 ml beaker |
| 4) Citric acid | 13) Thin white cloth |
| 5) Waste water from the rubber factory | 14) Aluminum tray |
| 6) Hot Air Oven | 15) Volumetric bottle |
| 7) Sodium hydroxide | 16) Measuring cylinder |
| 8) Hydrogen peroxide | 17) Hydrochloric acid |
| 9) Nitrite and Ammonia test kit | 18) Petri Dish |

Methods

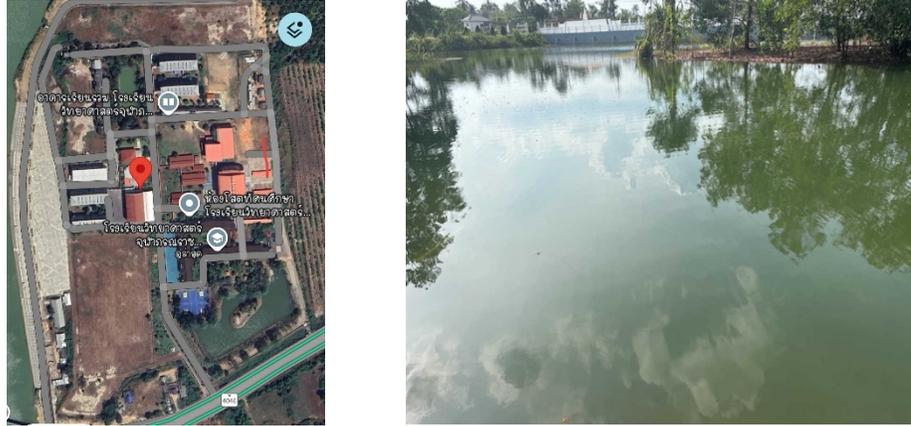
Study site

The study was conducted in two locations as follows:

1. A rubber factory located in Na Mueang Phet Subdistrict, Sikao District, Trang Province (coordinates: 7.513361°N, 99.738722°E).
2. Princess Chulabhorn Science High School Trang, located in Bang Rak Subdistrict, Mueang Trang District, Trang Province (coordinates: 7.551903°N, 99.558380°E).



Picture 1: A rubber factory located in Na Mueang Phet Subdistrict, Sikao District, Trang Province.

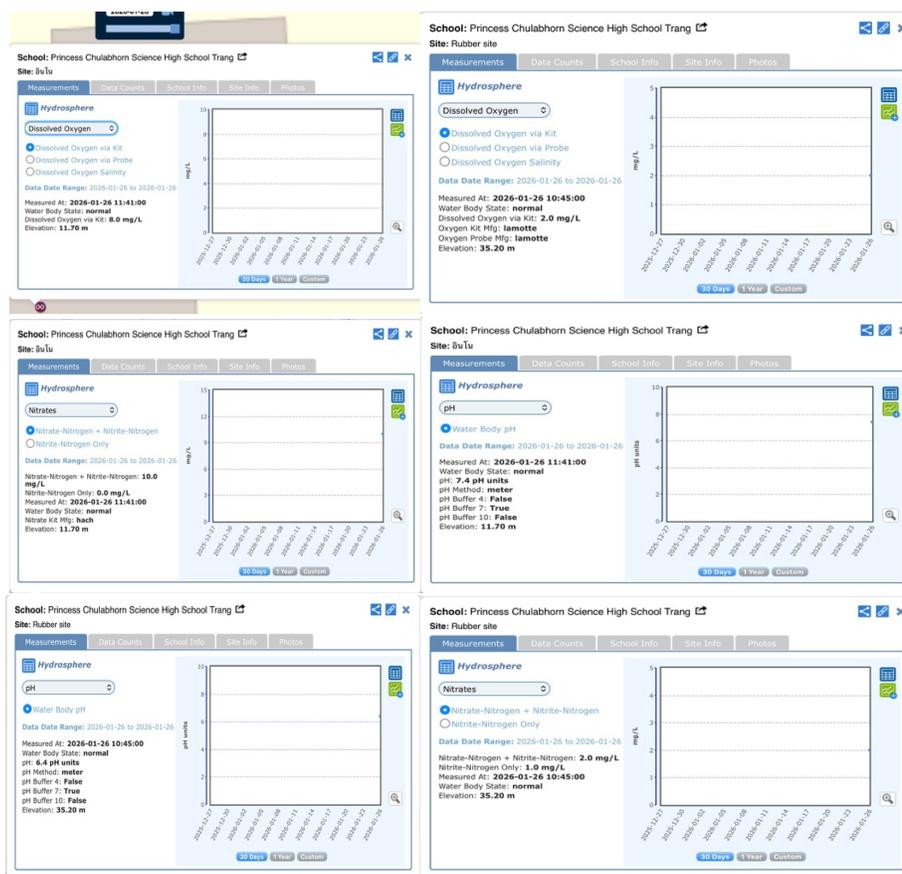


Picture 2: Princess Chulabhorn Science High School Trang, located in Bang Rak Subdistrict, Mueang Trang District, Trang Province.

Research Method

1. Determining the sampling points and collecting wastewater samples.
2. Recording information on water usage at the sampling sites using the GLOBE Observer application.
3. Analyzing chemical properties, including pH, dissolved oxygen (DO), ammonia concentration, and nitrite concentration.
4. Conducting measurements three times in accordance with GLOBE measurement principles, and calculating the mean and standard deviation.

5. Submit the collected data to the GLOBE Data Entry system.



Picture 3: The area where the research was conducted.

Experimental process

Part 1: Study the ratio of bioabsorbent.

1.1 Produce bioabsorbent.

1. Collect water hyacinths and azolla.
2. Clean the dirt from the water hyacinth and azolla with water at 60 °C.
3. Dry the azolla and water hyacinth in a hot air dryer to dry completely.
4. Extract cellulose from azolla.
 - Grind the completely dried azolla with a blender.
 - Extract cellulose from azolla with 17% NaOH solution w/v at 60°C for 1 hour.
 - Wash the cellulose extract of the azolla until it is neutral.
 - Bleach the cellulose extract of the azolla with a 10% w/v solution

H₂O₂ temperature 60°C for 24 hours.

- Wash the cellulose extract of the azolla until it is neutral.
- Take the cellulose extract of the azolla obtained to hydrolyze the bleached with a solution of 2 M HCl at 60°C for 2 hours.
- Take the cellulose fibers of the obtained azolla and wash them until neutral.

5. Extract cellulose from water hyacinth.

- Grind the completely dried water hyacinths with a blender.
- Extract cellulose from water hyacinth with 17% NaOH solution w/v at 60°C for 1 hour.
- Wash the cellulose extract of the water hyacinth until it is neutral.
- Bleach the cellulose extract of the water hyacinth with a 10% w/v solution

H₂O₂ temperature 60°C for 24 hours.

- Wash the cellulose extract of the water hyacinth until it is neutral.
- Take the cellulose extract of the water hyacinth obtained to hydrolyze the bleached with a solution of 2 M HCl at 60°C for 2 hours.
- Take the cellulose fibers of the obtained water hyacinth and wash them until neutral.

6. Divide the ratio set of the treatment plate into 7 sets, consisting of 2 control sets and 5 more test kits.

7. Weigh 0.5 grams of chitosan mixed with a citric acid solution with a concentration of 1 percent volume per volume. Heat for 1 hour under constant stirring at 60 degrees Celsius. The plate of citric acid and chitosan solution is mixed into one. And add cellulose extracts of azolla and water hyacinth according to the ratio that has been divided.

Part 2: Study the effectiveness of bioabsorbent.

2.1 Study the appropriate ratio of bioabsorbent.

2.2 Measure water quality after using bioabsorbent.

Take a sample of absorbent to check the water quality, nitrite, and ammonia content. The method of checking water quality is as follows.

1. Water quality inspection

Nitrite content test

1. Wash the test tube with the sample water several times and fill it up to 5 ml.
2. Drop 3 drops of the test medicine and shake gently.

3. Leave for 1 minute, compare the color in the test tube with the color calibration sheet and read the nitrite value.

Ammonia content test

1. Wash the test tube with the sample water several times and fill it up to 5 ml.
 2. Drop 4 drops of test medicine # 1 and shake well.
 3. Drop the test drug # 2, 4 drops and shake well.
 4. Leave for 3 minutes, compare the color in the test tube with the color comparison sheet and read the total ammonia value.
2. Measure the acidity-base of water.
1. Prepare the water you want to measure the pH-base of the water.
 2. Turn on the power and the LCD screen will be in pH measurement mode.
 3. Remove the cap on the probe and dip it into the sample solution that needs to be measured about 2 centimeters deep.
 4. Wait for the number to be stable and then read the obtained value.
 5. Clean the probe with clean water and store it with preservation solution.
3. Checking the amount of oxygen in the water
1. Rinse the sample bottle with sample water 3 times before collecting the sample.
 2. To collect water, immerse the sample bottle completely in water and close the cap.
 3. If you invert the bottle and see gas bubbles, pour out the water and begin collecting the sample again.
 4. Collect the water immediately and perform the test within 2 hours.
 5. Perform a total of 3 replicates, with the average value falling within the range specified in the test kit.

Part 3: Test the effectiveness of the absorbent.

Data Analysis

The data were analyzed using the following methods:

1. Two-Factor Analysis of Variance (ANOVA) with replication.
2. Standard Deviation (S.D.).
3. Mean (\bar{x}).

Results

From the study project on " Study of the effectiveness of bioabsorbent to absorb wastewater from rubber factories," the study results are divided into two parts as follows:

Part 1: Study of the Ratio of Bioabsorbent

1.1 Production of bioabsorbent

Produced 7 sets of bioabsorbent, including:

Experimental set	bioadsorbent
Ratio of water hyacinth to azolla: 100:0	
Ratio of water hyacinth to azolla: 90:10	
Ratio of water hyacinth to azolla: 70:30	
Ratio of water hyacinth to azolla: 50:50	

Experimental set	bioadsorbent
Ratio of water hyacinth to azolla: 30:70	
Ratio of water hyacinth to azolla: 10:90	
Ratio of water hyacinth to azolla: 0:100	

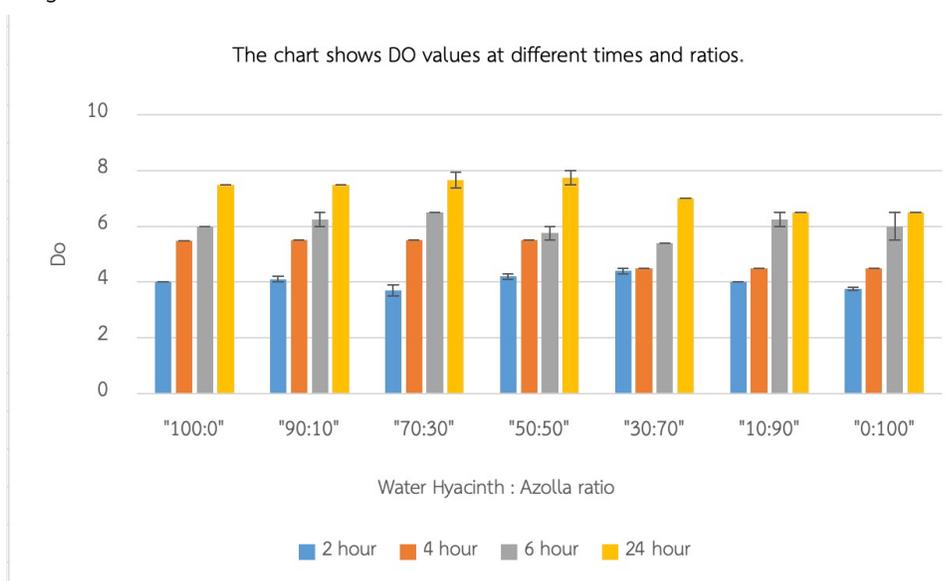
Part 2: Studying the efficiency of bioadsorbent.

2.1 Study the ratio of bioadsorbent.

From the study of the optimal ratio, it was found that the 50:50 ratio is the most suitable ratio. The 50:50 ratio at 16:00, 18:00, 20:00, and 14:00 had NH_3 values of 10, 10, 8, and 3, respectively; NO_2^- values of 1, 1, 0.75, and 0.45, respectively; and DO values of 4.2, 5.5, 5.75, and 7.75, respectively. In the 30:70 ratio at 16:00, 18:00, 20:00, and 14:00, the NH_3 values were 10, 10, 8, and 3.5, respectively; and the NO_2^- values were as follows: The values for DO were 1, 1, 0.75, and 0.667, respectively, and for NH_3 , 4.4, 4.5, 5.75, and 7.75, respectively. These showed a greater reduction in NH_3 and NO_2^- compared to the set using only one type of plant, while simultaneously showing a continuous increase in DO.

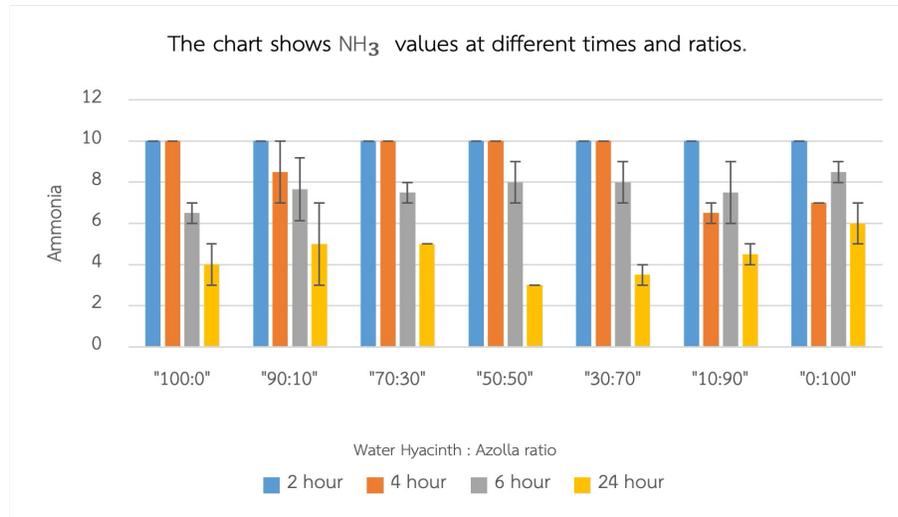
2.2 Assessing water quality after using bioadsorbent.

From the water quality study, NH_3 , NO_2^- , DO, and pH values were measured, yielding the following results



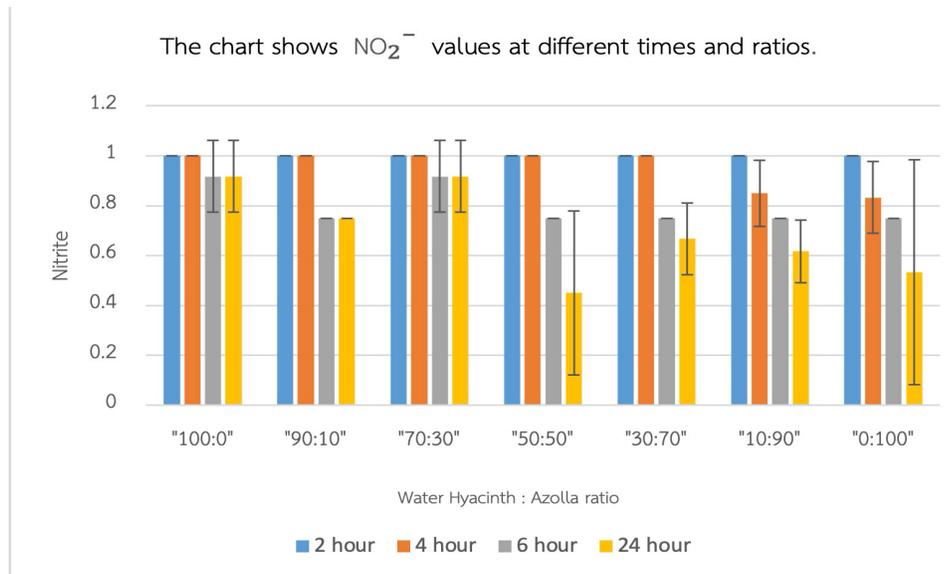
Picture 4 shows DO values at different ratios and time periods, $p < .05$.

From Picture 4, dissolved oxygen (DO) values tend to increase over time in all ratios of bioadsorbent, indicating that time is a significant factor affecting DO values at the .05 significance level. When considering the ratios of bioadsorbent, it was found that the ratios combining water hyacinth and azolla, especially the 50:50 ratios, resulted in higher DO values than using a single plant species, demonstrating better efficiency in improving water quality.



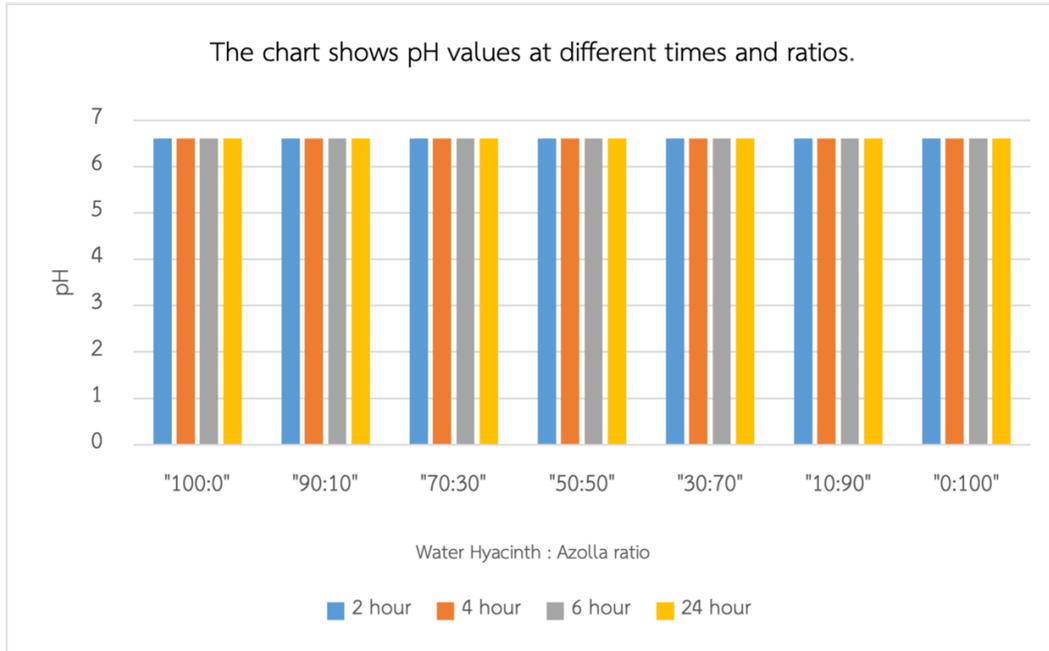
Picture 5 shows ammonia values at different ratios and time periods, $p < .05$.

From Picture 5, ammonia (NH_3) values tend to decrease continuously over time across all ratios of bioadsorbent, indicating that time is a significant factor affecting ammonia reduction in wastewater at a significance level of .05. When considering the ratios of bioadsorbent, the ratios containing a mixture of water hyacinth and azolla, especially the 50:50 ratios, showed the lowest NH_3 values.



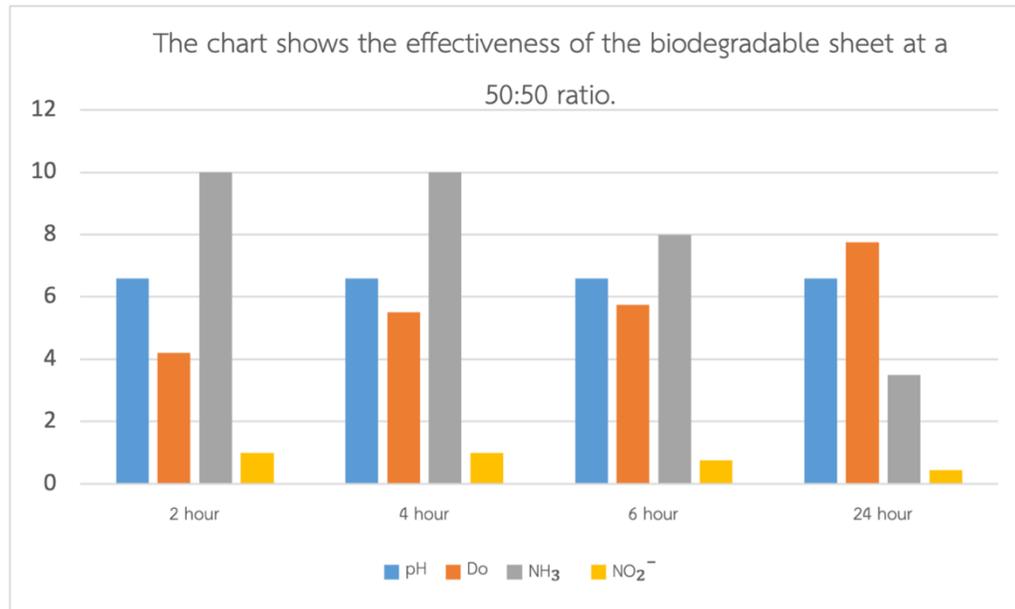
Picture 6 shows nitrite values at different ratios and time periods ($p < .05$).

From Picture 6, nitrite values tended to decrease continuously over time across all ratios of bioadsorbent, indicating that time is a significant factor affecting nitrite reduction in wastewater at a significance level of .05. Considering the bioadsorbent ratios, the ratios combining water hyacinth and azolla, especially 50:50, yielded the lowest nitrite values.



Picture 7 : shows pH values at different ratios and time periods. ($p > .05$).

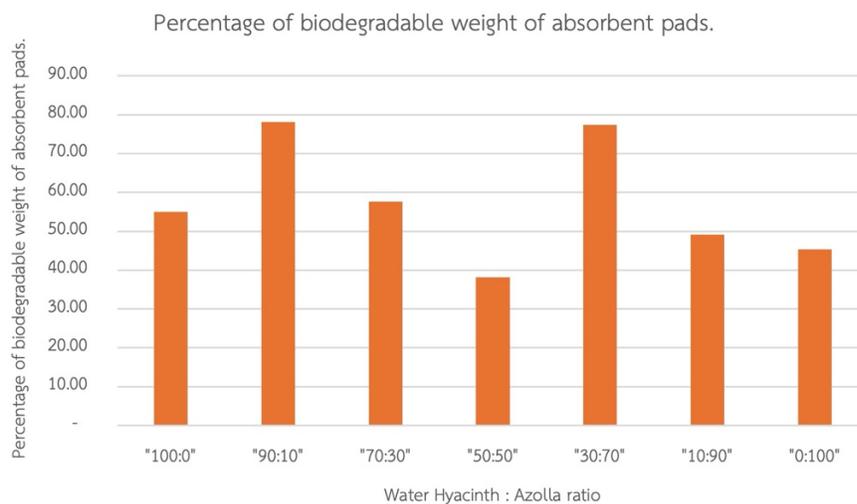
From Picture 7 The pH values of bioabsorbent made from water hyacinth and azolla at different time periods were not significantly different ($p > 0.05$).



Picture 8 : shows the effectiveness of the bioadsorbent at a 50:50 ratio

From Picture 8 : The performance of the bioadsorbent at a 50:50 ratio showed a continuous decrease in ammonia and nitrite concentrations, while dissolved oxygen (DO) levels increased. These results indicate that the bioadsorbent at a 50:50 ratio was the most effective for absorbing wastewater from rubber factories.

2.3 testing the effectiveness of bioabsorbent.



Picture 9 : shows the percentage of biodegradation of bioabsorbent at different ratios.

From Picture 9, the percentage of bioabsorbent degradation at different ratios varies, demonstrating the absorption quality. The ratio of water hyacinth to azolla with the highest to lowest percentage of bioabsorbent degradation is as follows: 90:10, 30:70, 70:30, 100:0, 10:90, 0:100, and 50:50

Discussion and conclusion

The experiment showed that the 50:50 ratio resulted in a greater reduction of NH_3 and NO_2^- than the set using a single plant species, while simultaneously increasing DO levels. The different trends in NH_3 , NO_2^- , and DO levels across the various ratios demonstrate that both the duration and ratio of the bioabsorbent affect the overall wastewater treatment efficiency. In the early stages of the experiment, NH_3 and NO_2^- levels did not decrease significantly because the microorganisms were still adapting. As time passed, the microorganisms multiplied and became more efficient, resulting in a significant decrease in NH_3 and NO_2^- levels between 8:00 PM and 2:00 PM the following day, while DO levels increased, consistent with the operation of a biological wastewater treatment system.

From the experimental results, it can be concluded that bioabsorbent made from water hyacinth and Azolla is effective in improving the quality of wastewater from rubber factories by reducing NH_3 and NO_2^- levels while increasing DO levels. The mixed bioabsorbent ratio showed the most effective results. In particular, the 50:50 ratio demonstrates the highest efficiency in supporting such processes.

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GLOBE's Database



(Optional) Badges

I make an Impact

Communities living near rubber factories are affected by industrial wastewater, as some factories have inefficient wastewater treatment systems that allow chemical contaminants to remain in the discharged water. Water hyacinth and azolla are highly effective in treating wastewater. Therefore, this study has a positive social impact by helping reduce environmental harm. Properly treated wastewater from rubber factories will not negatively affect local ecosystems or nearby communities.

I am a data scientist

In this study, we evaluated the suitability of cellulose and its ratio for use in a wastewater treatment plan. And collect statistical data before and after using the bioadsorbent to find the difference in water after using the bioadsorbent, including conducting previous research to discuss and summarize the results of the experiment, to lead to solving problems in the community.

I am a problem solver

From this research, there are many problems. 1. The problem with the cellulose of azolla is not enough, and the cellulose of water hyacinths is discarded because it is not stored as well as it should be. Therefore, we have to solve the problem by re-extracting within the upcoming deadline. This allows us to manage our time better. We can extract cellulose from azolla and water hyacinth again within 1 week from the original need to 2 weeks, and schedule according to the planned time. 2. The problem with the bioabsorbent cannot be peeled off the mold. Therefore, we have tried to use a secondary heat-resistant plastic sheet before the next sheet.

This makes it easier for us to peel the bioabsorbent from the mold. 3. The problem is that the bioabsorbent is too thin, making it impossible to peel off easily. Therefore, next time, We will adjust the ratio of the absorbent to increase the cellulose content. As a result, We get an bioabsorbent with a thicker thickness. And we also encountered many more problems, such as hot air dryers, not enough for baking, using the wrong substances, and all the substances that need to be used. The water quality test kit is not effective.