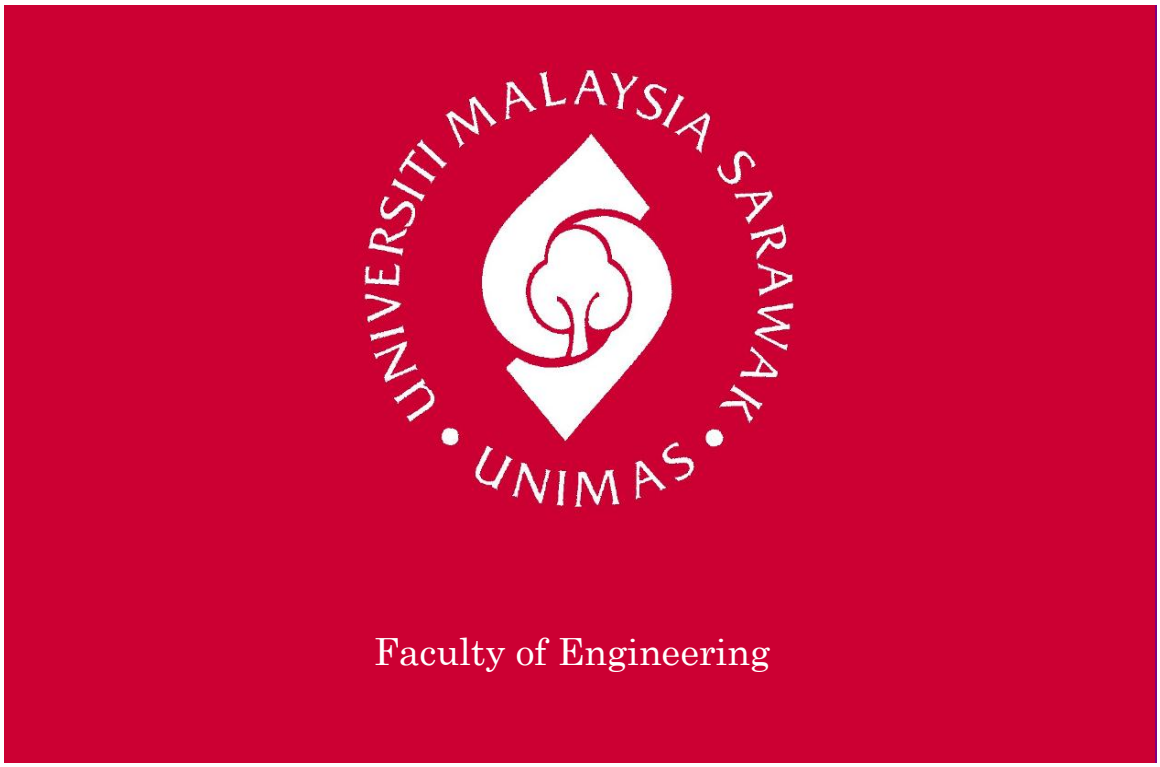

Faculty of Engineering

REMOVAL COLOR OF DYES FROM TEXTILE INDUSTRIAL WASTEWATER BY SAGO WASTE AS A COAGULANT

RICKY ANAK TUBAM

Bachelor of Engineering with Honours

(Chemical Engineering)

2016/2017

UNIVERSITI MALAYSIA SARAWAK

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This declaration is made on the 26 day of May 2017.

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This final year report which entitled **"Removal Color of Dyes from Textile Industrial Wastewater by Sago Waste as a Coagulant"** was prepared by Ricky anak Tubam (43823) is hereby read and approved by:

_____

SITI HAZIRAH ADAM
(Final Year Project Supervisor)

26 MAY 2017
Date

REMOVAL COLOR OF DYES FROM TEXTILE INDUSTRIAL WASTEWATER BY SAGO WASTE AS A COAGULANT

RICKY ANAK TUBAM

A dissertation submitted in partial fulfillment
of the requirement for the degree of
Bachelor of Engineering with Honours
(Chemical Engineering and Energy Sustainability)

Faculty of Engineering
Universiti Malaysia Sarawak

2017

Dedicated to my beloved parents, who always there for me give me sustainable motivations, support and encouragements

ACKNOWLEDGEMENT

The author wishes to thanks to all individuals, parties and organizations that have contributed and cooperated throughout this project especially to Ms. Siti Hazirah Adam, lecturer of Department of Chemical Engineering and Energy Sustainability because of her guidance, knowledge, support, and experiences as well as for her invaluable supervision towards the completion of this report. Last but not least, special gratitude is dedicated to all family members and fellow friends for help, support and contribution.

ABSTRACT

The aim of this study was to remove the color of dyes from textile industrial wastewater by sago waste acted as a coagulant. The low-cost, easily available and naturally prepared coagulant like sago waste was chosen to remove color of Congo Red. The experiment was carried out by using jar test experiment. Jar test was used to perform coagulation process. Factors affecting the coagulation and flocculation process, such as pH and dosage were assessed. Fourier Transform Infrared (FT-IR) was used in this study. The purpose of using FT-IR was to examine the formation dyes molecule on the surface of the sago waste before the coagulation process. Three types of coagulant were prepared; untreated sago waste, treated sago waste with sodium hydroxide and treated sago waste with sodium hypochlorite. Next, for data analysis, the dyes percentage removal was measured by using UV-visible spectrophotometer. The optimum condition of each parameter was analyzed. The data was tabulated and discussed.

ABSTRAK

Tujuan kajian ini adalah untuk menyinkirkan pewarna daripada air sisa industri tekstil dengan menggunakan sisa sagu sebagai *coagulant agent*. Sisa sagu ialah berkos rendah, mudah didapati dan disediakan secara semula jadi telah menjadi pilihan sebagai *coagulant agent* untuk meyinkirkan warna *Congo Red*. Ekperimen akan dijalankan dengan menggunakan *jar test*. Jar test akan digunakan untuk mengkaji process penggumpalan. Fourier Transfrom Infared (FT-IR) akan digunakan dalam kajian ini. Tujuan penggunaan FT-IR ini adalah untuk menkaji pewarna pembentukan melekul di permukaan sisa sagu sebelum proses penggumpalan. Terdapat tiga jenis koagulan digunakan dalam kajian ini iaitu sisa sagu yang tidak dirawat, sisa sagu yang dirawat menggunakan natrium hidroksida dan sisa sagu yang dirawat dengan natrium hipoklorit. Seterusnya, untuk analisis data, kecekapan pewarna penyingkiran akan diukur dengan menggunakan spektrofotometer UV-visible. Keadaan optimum bagi setiap parameter dianalisis. Data ini akan dijadualkan dan dibincangkan.

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ABBREVIATIONS

DOE	Department of Environment
COD	Chemical Oxygen Demand
SEM	Scanning Electron Microscope
FTIR	Fourier Transform Infrared
UNIMAS	Universiti Malaysia Sarawak
NaOH	Sodium Hydroxide
NaClO	Sodium Hypochlorite
KBr	Potassium Bromide

NOMENCLATURE

ml	Millimeter
Rpm	Revolutions per minute
cm	Centimeter
Ppm	Parts per million

CHAPTER 1

INTRODUCTION

1.1 Introduction

According to the Malaysia Environmental Quality Report (2014) regulated by Department of Environment (DOE) Malaysia, analyzed based on 473 rivers, it is found that 244 (52%), were cleaned, 186 (39%) were polluted and 43 (9%) were in serious polluted condition. The textile industry has drawn the attention of environment that posed a high demand on water supply and produced large amount of wastewater. The most used dyes in textile industries are Remazol and Vinyl Sulphone fibre reactive dyes (Rashidi et al., 2012). Most reactive dyes in wastewater are usually difficult to biodegrade with high pH, high COD and strong color. Thus, many processes are studied for the removal of reactive dyes by conventional treatment technologies including biological and chemical oxidation, chemical coagulation, photocatalysis and adsorption processes.

There are numerous method to treat dye bearing effluents. In spite of the availability of many techniques to remove dye contaminants from wastewaters, such as coagulation, chemical oxidation, membrane separation process, electrochemical and aerobic and anaerobic microbial degradation, each of these methods have inherent limitations. The technologies can be divided into three categories: physical, chemical and biological. All these method have their own advantages and disadvantages. Table 1.1 shows the advantages and disadvantages of different dye removal methods.

Table 1.1: Advantages and disadvantages of dye removal methods (Akshaya et al., 2011)

Method	Advantages	Disadvantages
Ozonation	Available used in gaseous state	High capital cost and short half-life which is 20 minutes
Adsorption	Excellent in removing of wide variety of dyes	Difficult to regeneration, costly disposal of adsorbent
Membrane filtration	Able to remove all type of dye	Produce high concentration of sludge and high operating cost
Ion exchange	Easy regeneration	Not effective for all type of dyes
Electro-coagulation	Good in removing dyes	Highly cost and less electrode reliability
Biological process	Environmental friendly	Slow process, need nutrients
Chemical coagulation and flocculation	Excellent color removal and economically feasible	Produce sludge

In this study, the coagulation method will be used to remove the dyes molecules from textile wastewater. Coagulation is one of the most popular unit operation in water and wastewaters treatment trains. It is one of the most effective methods for dye removal from industrial wastewater. Coagulation is easily applied, bulky treatment and low capital and operating costs, being usually employed as pre-treatment (Elizalde and Hernandez, 2009). In industrial effluent applications, two most important parameters which influence the coagulation process are pH, alkalinity and temperature. The optimum pH range varies depending on the coagulants used and is typically determined by laboratory testing commonly known as jar test experiments.

The following are examples of waste materials used in dye removal: coconut shell, corncob wastes and avocado kernel seeds. These were used to remove acid, basic, and reactive dyes. Powdered peanut hull was used as a biosorbent for anionic dyes, guava seeds were tested as an adsorbent for the removal of acid dyes and palm fruit bunch wastes were used for basic dyes, alongside others. However, locally available and

abundant low-cost coagulant agent are still necessary in order to remove industrial textile wastewater.

Sarawak is the main producer of sago flour in Malaysia. The Sarawak state is recognized not only as one of the world's biggest sago growing area but also the biggest exporter of sago products mainly in the form of starch, sago flour and sago pith - totalling about 47,000 metric ton (~ 80 RM Million) are export annually to Peninsular Malaysia, Japan, Singapore, Thailand, Taiwan, United States, and other countries (Zayas et al., 2007). Now, the agricultural waste, such as that produced from the sago processing plant contains cellulose that may be exploited to be a new value added product. Work on the potential of sago waste to be converted as a coagulant agent is still considered limited including the study on its physicochemical properties, its structure and its behavior/capability in absorbing the different kind of Textile dyes.

This project is aimed to treat wastewater from textile industries using sago waste coagulant by jar test experiment. Sago waste were dried and blended into powder with particular size between 60-100 micrometer. Dried sago waste was dissolved in distilled water, and then mixed with wastewater to allow the coagulation process. Factors affecting the coagulation and flocculation process, such as pH and dosage will be assessed. The performance of coagulation will be assessed based on the quality of treated wastewater, red in term of reduction dyes removal and Turbidity.

1.2 Problem Statement

Malaysia is one of the countries in the world that consist of highest local sources of sago especially in Sarawak. Sarawak exporting tons of sago products annually to Peninsular Malaysia, Taiwan, Singapore, Japan and other countries. This abundant sago waste can be converted becomes a new value-added product which may become another option to vary the use of sago. The outcome of this study may contribute to the development of sago industries in Sarawak.

Dyes is one of the chemical that was used in textile industry and considered as important pollutant. In Malaysia, batik industry is one of the best textile industry. Unfortunately, the dye wastewater produced from the industry is usually being direct discharge into waterways without any treatment (Khai Ern Lee et al., 2015). Water is one of the raw materials needed in many industries such as textile industry. Textile industry is one of the industries that consumed a huge amount of water. Therefore, the probability of these industry to produce water pollution is higher. The escalating

demand of textile products cause the wastewater produce from the textile industry increasing. Textile industry can be known as industry that is focused on the design and production of yarn and cloth. These industry commonly produced wastewater that contain both chemical and dyes.

The chemical used in textile industry cause damage in environment and ecosystem. Therefore, the removal color of dyes from textile industrial wastewater is important to reduce and avoid pollution which can damage the environment. Hence, the treatment color of dyes from textile industrial wastewater by sago waste (solid) act as coagulant is studied in this research.

1.3 Objectives

The aim of this study is to remove the color of dyes from textile industrial wastewater by sago waste as a coagulant. From this aim, there are three objectives that will be focused to achieve the aim of the study:

i. To evaluate the performance of the treated and untreated sago wastes as a coagulant to remove the color of dyes from textile industry.
ii. To characterize physical-chemical properties of the sago waste as a coagulant agent
iii. To analyze the optimum condition and the capability of sago waste to treat color of dyes by coagulation method.

1.4 Scope of Study

The following scopes for this research were identified in order to achieve the objectives.

i. Characterization of the Sago Waste Coagulant by Fourier Transform Infrared (FTIR).
ii. Evaluate the performance of the sago waste (coagulant) on industrial textile dye wastewater under various parameters such as pH and coagulant agent dosage.

1.5 Expected outcome

i. Abundant Sago waste will be converted become a new value-added product, coagulant agent, which may become another option to vary the use of sago. The outcome of this study may contribute to the development of sago industries in Sarawak.

ii. Sago wastes coagulant can be adopted as a low-cost coagulant agent by coagulation method in removal of industrial textile wastewater.

iii. Replace the existing chemical used in industrial textile wastewater by introducing low-cost abundant Sago waste coagulant.

iv. Propose a cost effective method of treating industrial wastewater containing dyes color, and hope it will help in industry textile Malaysia to meet the standard of sewage discharged set by Department of Environment (DOE), Malaysia.

1.6 Schedule and Gantt chart

Table 1.2**:** Schedule for completing Final Year Project I

TASK	START	FINISH	DURATION
Introduction to FYP 1	05/09/2016	09/09/2016	5 days
Chapter 1	12/09/2016	23/09/2016	10 days
Chapter 2	26/09/2016	21/10/2016	20 days
Chapter 3	24/10/2016	18/11/2016	20 days
Preparation for presentation FYP 1	21/11/2016	30/11/2016	8 days

Table 1.3 **:** Schedule for completing Final Year Project II

TASK	START	FINISH	DURATION
Experiment s and Analysis	09/03/2017	09/05/2017	2 months
Chapter 4 writing	09/05/2017	24/09/2017	15 days
Chapter 5 writing	24/05/2017	25/05/2017	1 day
Preparation for presentation FYP II	26/05/2017	29/05/2017	3 days

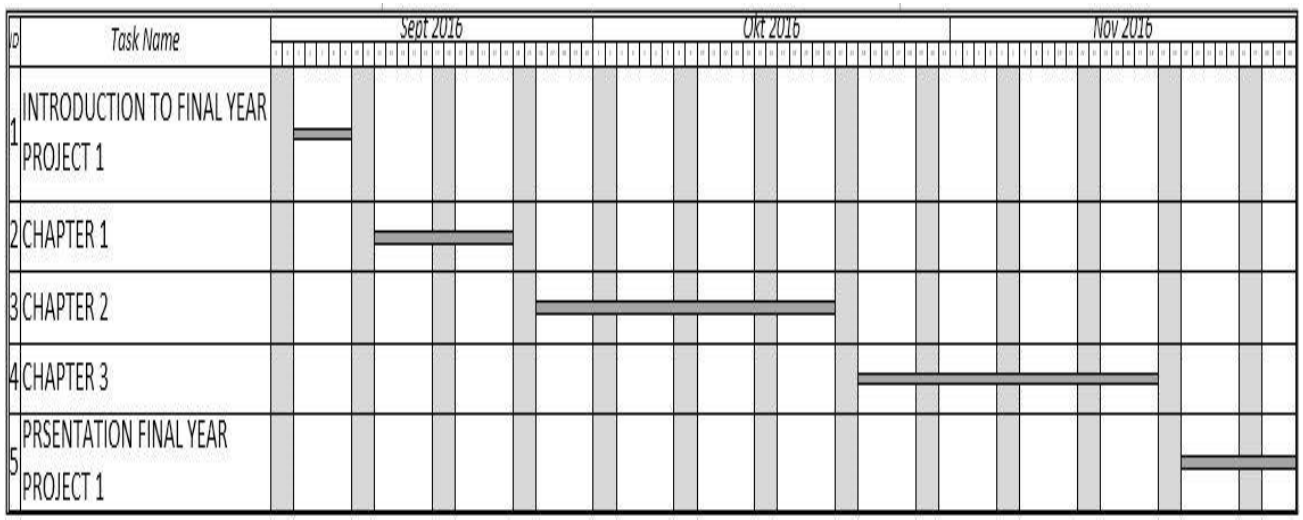

Figure 1.1 : Gantt chart for completing the Final Year Project 1

CHAPTER 2

LITERITURE REVIEW

2.1 History of Textile Wastewater

In Malaysia, Batik industry is one of the most common textile industry. Textile industry basically used cotton, wool, silk, and polymer fibers as their main raw materials. In order to fulfill human standard of living and fashion, textile industry tends to produce and release more hazardous compounds. Textile industry is one of the most environmentally unfriendly industrial due to the colored wastewater produced that are heavily polluted with dyes and chemicals. According to Azam and Mohammad (2013), it is approximated that 5000 tons of dyeing material from textile industry are released into environment every year and the contaminated materials are absorbed by the oxygen of the water. The wastewater released from the textile industry can pollute the underground water. The wastewater was contained of toxic substances such as cyanides, alkaline cleaning agent, degreasing solvent, fat, oil and metals which can threatens human life and the environment.

Wastewater treatment methods can be classified into physical, chemical and biological methods according to the nature of the treatment process that is used as shown in Table 2.1. Physical methods are generally processes that do not show any chemical or biological changes and used to enhance the wastewater. Chemical method generally involve in some chemical reactions to improve the quality of wastewater. Biological method use microorganisms to treat the wastewater but usually biological method not able to degrade complicated dyes and take a long period of time.