Tapioca Starch Coagulant for Landfill Leachate Treatment

Authors:
Nur Shaylinda Mohd Zin
Siti Nor Aishah Mohd Salleh
Hamidi Abdul Aziz

E-mel:
nursha@uthm.edu.my

Coagulation-flocculation is applied for various wastewater such as sewage, industrial, and leachate, which has the proven ability to remove pollutants through a solid-liquid separation process. Coagulant is a material added during coagulation with chemical coagulants used conventionally. However, using natural coagulants to replace chemical coagulants is widely studied. This book highlights the application of natural tapioca starch coagulant for the coagulation-flocculation of stabilised leachate. This book's content is also regarded as an alternative solution for leachate treatment for landfill management. This book first presented information on landfills and leachate, followed by starch as a natural coagulant from a previous study. It compiles the research study and highlights the application of natural coagulants made from starch tapioca flour and tapioca peel in the form of single, dual and composite coagulants. Finally, it helps academics, researchers, and students better understand the application of natural starch-root coagulant for treating landfill leachate.

keyword: landfill management,natural coagulants, starch tapioca flour and tapioca peel

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Hamidi Abdul Aziz

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PREFACE

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CHAPTER ONE

Landfill

1.1 INTRODUCTION

Due to the rapid urbanisation taking place, it is anticipated that the global rate of garbage production will increase by 72%, rising from 2.0 billion tonnes in 2016 to 3.50 billion tonnes in 2050. The United States currently stands as the largest producer of municipal solid waste (MSW), generating 0.63 million tonnes per day, followed by China with 0.52 million tonnes per day (Zaini et al., 2022). An incrementing number of landfills in Malaysia is expected in order to cater to the growth of the population and economic activities that contributed to generations of solid waste (Radhi, 2020). Most of the solid waste generated was disposed into landfills around Malaysia since this waste disposal method is economical and simple (Mohd-Salleh, 2021 & SWCorp, 2019). However, this preferred method generates leachate that is highly polluted and causes 57% of Malaysia's local authorities to face a leachate management problem in their locality (Muhammad-Hanafi, 2015). Furthermore, removal of the pollutant from leachate is crucial and highly compulsory (Teng et al.,2021), as stated in the Environmental Quality Act 1974 (Control of pollution from Solid Waste Transfers Station and Landfill) Regulation 2009.

CHAPTER TWO

Natural Coagulant

2.1 INTRODUCTION

The particular impurities in highly polluted wastewater are almost impossible to be removed without the addition of coagulating agents. According to Saharudin and Nithyanandam (2014), a coagulant is known as the chemical material added to water and wastewater to withdraw forces, causing the colloidal particles to suspend by stabilising them. Colloidal or suspended particles are negative loads that require destabilisation to flocculate as stability causes them to float. The repellence between the colloidal particles is reduced after the addition of a coagulant, which results in small floccules. Continuous gentle stirring allows the individual colloids and floccules to grow and are further clustered together, settled down at the bottom and separated from the water suspension itself (Saharudin & Nithyanandam, 2014; Saravanan et al., 2017; Zainol et al., 2011; Cheng et al., 2021). The understandable mechanisms of the process have made coagulation an uncomplicated method for water purification since the 19th century (Choy et al., 2014; Jiang, 2001). There have been many debates among researchers previously regarding the mechanisms of coagulation as they determined the best conditions for the process.

CHAPTER THREE

Tapioca Flour Coagulant

3.1 INTRODUCTION

Source of tapioca starch can be produced from its raw material or processed flour. Tapioca flour has high starch purity and is easy to obtain as it is available on the market further. High molecular weight, high polymer, less sludge, no residual metal and unchanged pH have made tapioca starch suitable to be used as coagulant (Haq et al., 2019; Alazaiza et al., 2022). Starch flour-based coagulant was not as good as a chemical coagulant when applied to leachate (Kamaludin, 2005). However, starch can be used as an aid for chemical coagulants that are able to improve the coagulation performance and able to increase the removal rate of a certain pollutant in leachate.

3.2 TAPIOCA FLOUR (TF) AS SINGLE COAGULANT

A series of laboratory tests of tapioca flour (TF) as a single coagulant was conducted to determine the optimum condition for rapid mixing speed, rapid mixing duration, slow mixing speed, slow mixing duration, settling time, pH and dose. TF was applied on partially stabilised leachate, and the performance was evaluated

CHAPTER FOUR

Tapioca Peel Starch as Coagulant

4.1 INTRODUCTION

In this chapter, a natural coagulant made from agro-waste of tapioca peel was developed, and its performance was tested by applying it to the polluted leachate. The tapioca peel starch (TPS) was extracted from the white flesh of the peel itself. After several processes, the next step was to sundry the solution and ground the dried tapioca peel until it became a fine powder. The effectiveness of TPS as a natural coagulant was also studied as a coagulant aid and composite coagulant to polyaluminium chloride (PAC).

4.2 TAPIOCA PEEL STARCH AS SINGLE COAGULANT

An optimisation study was done by considering the concentration of the solution, the coagulant dosage, and the pH of leachate. TPS was applied on stabilised leachate, and the performance was evaluated based on the percentage removal of COD, ammonia, turbidity, colour, and suspended solids. Series of jar tests were used to

CHAPTER FIVE

Comparison of Tapioca Flour and Tapioca Peel Starch

5.1 INTRODUCTION

Tapioca flour and tapioca peel are originated from tapioca root. Natural coagulants made from flour and peel can be used as a single coagulant, coagulant aid, or composite coagulant. The performance of both components as coagulants was evaluated in this topic to determine the effectiveness of each coagulant in treating leachate and complying with the leachate effluent discharge standard.

5.2 EFFECTIVENESS COMPARISON OF TAPIOCA FLOUR AND TAPIOCA PEEL STARCH AS SINGLE COAGULANT

Based on Table 5.1, tapioca flour (TF) used a higher dose and slightly higher pH to have the optimum removal of ammonia, suspended solids, and colour as a single coagulant. Meanwhile, tapioca peel starch (TPS) managed to obtain high removal of COD, suspended solids, and colour with a lower dose and due to the alteration of leachate pH to pH 3. In terms of removal, it could be concluded that

CHAPTER SIX

Conclusion and Recommendation

6.1 CONCLUSIONS

Tapioca flour (TF) has the ability to remove pollutants from leachate. However, TF as a single coagulant produced the lowest pollutant removal. While as coagulant aid in dual coagulant as well as a composite coagulant, integration of TF produced good removal of pollutant from leachate. However, integration of TF must be within the suitable amount as it will affect the removal mechanism as well as the efficiency of the coagulation-flocculation process of leachate. Meanwhile, tapioca peel starch (TPS) shows its better ability as a coagulant aid and composite coagulant compared to a single coagulant. TPS has the potential to be developed as a natural coagulant with extensive depth research needed to commercialise it. Overall, this study concluded a distinctive conclusion that natural coagulants isolated from commercial flour and agro-waste could also enhance the treatment of highly polluted wastewater like leachate, which most other scholars did not prefer for a treatment.

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List of Authors

Prof. Madya Dr. Nur Shaylinda Mohd Zin is a lecturer in the Faculty of Civil and Built Environment at Universiti Tun Hussein Onn Malaysia. She received her PhD degree in civil engineering (Water and Wastewater Treatment) from Universiti Sains Malaysia in 2015. Her research interest is application of coagulation for water and wastewater treatment.

Dr. Siti Nor Aishah Mohd Salleh is a Lecturer and Programme Coordinator for Environmental Technology Programmes (Bachelor and Diploma) at Quest International University, Ipoh, Perak. She graduated with a PhD in Civil Engineering (Environment) from Faculty of Civil Engineering and Built Environment, Universiti Tun Hussien Onn Malaysia (UTHM) focusing on the development of a new composite coagulant using recycled agro-waste and commercial coagulant for wastewater treatment. Her research interests involve water and wastewater treatments, waste management, green and sustainable campus, and also natural and composite coagulants.

Prof. Dr. Hamidi Abdul Aziz is a Professor in Environmental Engineering in the School of Civil Engineering of Universiti Sains Malaysia. Professor Aziz received his PhD degree in civil engineering (Environmental Engineering) from the University of Strathclyde in Scotland in 1992. Professor Aziz's research focuses on alleviating problems associated with water pollution issues from industrial wastewater discharges and from solid waste management via landfilling, such as landfill leachate.

Tapioca Starch Coagulant for Landfill Leachate Treatment

Coagulation-flocculation is applied for various wastewater such as sewage, industrial, and leachate, which has the proven ability to remove pollutants through a solid-liquid separation process. Coagulant is a material added during coagulation with chemical coagulants used conventionally. However, using natural coagulants to replace chemical coagulants is widely studied. This book highlights the application of natural tapioca starch coagulant for the coagulation-flocculation of stabilised leachate. This book's content is also regarded as an alternative solution for leachate treatment for landfill management. This book first presented information on landfills and leachate, followed by starch as a natural coagulant from a previous study. It compiles the research study and highlights the application of natural coagulants made from starch tapioca flour and tapioca peel in the form of single, dual and composite coagulants. Finally, it helps academics, researchers, and students better understand the application of natural starch-root coagulant for treating landfill leachate.

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