

RESEARCH ARTICLE | MARCH 07 2024

Effectiveness of banana peels and papaya seeds as alternative coagulants in water treatment

Nur Syahira Syamimi Razali; Noor Hasyimah Rosman ✉; Inawati Othman; Hasnida Harun



AIP Conf. Proc. 3041, 040005 (2024)

<https://doi.org/10.1063/5.0194576>



CrossMark

Boost Your Optics and Photonics Measurements

Lock-in Amplifier

Find out more

Boxcar Averager

Effectiveness of Banana Peels and Papaya Seeds as Alternative Coagulants in Water Treatment

Nur Syahira Syamimi Razali¹, Noor Hasyimah Rosman^{1, a)}, Inawati Othman², and Hasnida Harun³

¹*Department of Civil Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.*

²*Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.*

³*Department of Civil Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn, 84600 Pagoh, Johor, Malaysia.*

a) Corresponding author: nhasyimah.rosman@ukm.edu.my

Abstract. The use of natural coagulant as an alternative coagulant, compared to chemical coagulant are due to environmentally friendly, readily available, cost effective and easy to find in the community. Banana peels and papaya seeds are usually considered as waste which these wastes are maybe useful in improving the quality of river water. Therefore, this study aims to evaluate the effectiveness of banana peels and papaya seeds for river water turbidity removal in which Sungai Langat was used as water sample. Using a simple synthesis process, a natural coagulant derived from banana peels and papaya seeds was created in a powder form. The pH, coagulant dosage, and extraction solvent are the variables that varied in the jar test experiment and based on the decrease in turbidity, the effectiveness of natural coagulants was evaluated. The treatment of river water using banana peels coagulant was found to be most effective at pH 4 while papaya seeds at pH 12, with the optimum dose of both coagulants was 180 mg/L. Banana peel coagulant recorded the highest removal percentage of 95.76 % from the initial turbidity of 107 NTU. Meanwhile, the removal percentage of papaya seed coagulant was 94.35 % from the initial turbidity of 110 NTU. A comparison of the use of this alternative coagulant was made with aluminium sulphate (alum). Alum recorded a lower turbidity removal percentage which was 75.66 % at pH 12. The most effective solvent to synthesis banana peels and papaya seeds was sodium hydroxide (NaOH) with a concentration of 2 M. Results showed the possibility and effectiveness of using alternative coagulant in the water treatment process and both natural coagulants (i.e., banana peels and papaya seeds) can enhance the coagulation activity as a green modification approach.

INTRODUCTION

Water is a valuable resource that has a significant influence on the quality of our lives. Water is a critical aspect in global economic growth since it is widely employed in a variety of productive sectors such as manufacturing, agricultural production, livestock, and urban supplies [1]. Hence, maintaining the water quality is very important to all human beings. Water from Sungai Langat is use in this investigation. Sungai Langat is one of the important water sources in Selangor state. In Selangor, Malaysia, Sungai Langat is one of the most crucial supplies of raw water for agriculture, industry, fisheries, recreation, and drinking water. The river's water quality degrades as it runs from Kuala Langat, which is located at the base of Gunung Nuang's tallest peak at 1493 meters, across the Langat Basin. Industrial discharge (58 %), residential sewage from treatment facilities (28 %), building projects (12 %), and pig farming are the main causes of pollution in the Langat River (2 %) [2].

Chemical coagulants such as alum or also known as conventional coagulants are frequently used in traditional coagulation processes. Despite their usage in water and wastewater treatment, these chemical coagulants have several negative side effects due to residual coagulants in the treated water [3]. The use of chemical coagulants has

an adverse effect on both human and other living things' health, in addition to creating a considerable amount of harmful sludge. Since chemical coagulants are imported, the traditional technique of water purification using aluminium sulphate (alum) make the treated water expensive compared to the application of natural coagulants [4]. The various coagulants used in water treatment have a significant impact on how turbidity and bacteria are reduced. Natural coagulants often have no negative effects when used in water treatment at the right dose. Other advantages of using natural coagulants include their cost and ability to be used with environmentally acceptable materials [5].

The coagulant is introduced to water or wastewater during the coagulation process to destabilize the colloidal suspensions. Unlike flocculation, which is a physical process, coagulation includes the neutralization of charge [6]. Coagulation is a physical-chemical method for purifying wastewater and drinking water. The turbidity of water is often removed using chemical-based coagulants like alum (AlCl_3) and ferric chloride (FeCl_3) [7]. Despite the effectiveness of chemical coagulants in the water treatment process, it is not an environmentally sustainable coagulant. The natural coagulant is more environmentally friendly and a long-term solution to turbidity reduction [8]. A study conducted by [9], conclude that the citrus fruit peels waste has a potential to be used as a chemical-free coagulant in near future for water treatment. The citrus peels extract performed well by improving the water quality in terms of turbidity reduction. According to the findings, it shows using the *Citrus Aurantiifolia* peels extract can reach about 70.2 % removal efficiency.

An important step in developing a green and sustainable technology is the extraction of plant-based bio flocculants for water treatment. It has viscous colloidal dispersion properties in water. Some plants can act as coagulants because they can carry out several coagulation processes, such as neutralizing the charge of colloidal particles and carrying out the linking of polymers [10]. Natural coagulant derived from plant-based or renewable resources have received much attention because of its various advantages compared to chemical coagulants [11].

Thus, this paper highlights the use of banana peels and papaya seeds in a form of powder as natural coagulants for the treatment of river water from Sungai Langat. Using a straightforward synthesis process [12], the natural coagulants created from banana peels and papaya seeds are obtained. The aim of this study is to determine whether these natural coagulants might be used to treat water instead of alum or other synthetic chemical compounds. The parameters and variables examined in this study include pH, coagulant dose, and extraction solvent. Based on the decline in turbidity, the effectiveness of the natural coagulant is evaluated.

MATERIALS AND METHODS

Collection of Water Sample

For this study, the water sample was taken from Sungai Langat, which is located at the Denai Kebangsaan near Universiti Kebangsaan Malaysia (UKM), Bangi, Selangor as illustrated in Figure 1. The initial reading of turbidity and pH value was taken and recorded in the laboratory right after the water sampling process using the Eutech TN-100 which is a thermo scientific turbidity meter and the Eutech Instrument pH510 as for pH meter. The turbidity and pH readings were recorded before and after the jar test experiment.



FIGURE 1. Water samples were collected from Sungai Langat