

UNIVERSITI TEKNOLOGI MARA

**DEVELOPMENT OF FILTER MEDIA FROM
KENAF FIBER**

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Thesis submitted in fulfilment
of the requirements for the degree of
Bachelor of Engineering (Hons) Chemical and Bioprocess

Faculty of Chemical Engineering

July 2017

ABSTRACT

This study focused on developing filter media from kenaf fiber to be used in filtration of anaerobic digestion effluent. The use of low cost kenaf fiber as the filter media is a good replacement for the expensive conventional filter. The kenaf fiber is tested for its capability in post-treating the palm oil mill effluent (POME) which is a type of wastewater produced from production of palm oil. Neutral and alkali effluent were prepared to study the effect of different pH towards water quality parameters and particle size distribution of the effluent. Calcium carbonate was used to modify the pH into alkali. Neutral effluent referred to the original pH of the sample collected without any chemical addition.

Suspended solids, colour, turbidity, chemical oxygen demand (COD) and heavy metals were the parameters for water quality that need to be measured. Spectrophotometer is used to measure suspended solids, colour, COD while turbidity meter is used to measure turbidity. Heavy metals are traced using inductively coupled plasma optical emission spectrometry (ICP-OES) and the particle size distribution was analyzed using particle size analyzer. The result shown that chemical modification towards the effluent caused membrane fouling to the kenaf filter and resulted in low water quality of the filtered effluent for pH 8. Hence, chemical modification by using calcium carbonate is not a promising alternative to further treat the anaerobic digestion effluent.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND STUDIES

Malaysia uses palm oil as an alternative to vegetable oils in daily life application. Malaysia is known among the largest exporter for palm oil. As reported by Malaysian Palm Oil Board (MPOB), in 2011, the plantation area for oil palm in Malaysia reached 5 million hectares due to an increase in world's demand for fats and oils (MPOB, 2014). Palm oil is regarded as the major player for fats and oils trade due to its highest yield per hectare as compared to soya bean, sunflower seed and rapeseed (MPOB, 2014). The palm oil is extracted from oil palm fruits at the palm oil mills which then produces crude palm oil (CPO). The production of CPO resulted in waste production such as empty fruit bunches, palm press fiber, palm kernel cake and palm oil mill effluent (POME).

Several treatments have been employed in treating POME. In Malaysia, the most employed treatment for POME is the anaerobic digestion (AD) in which the complex organic matters in POME is degraded under the absence of oxygen (Poh & Chong, 2009). Anaerobic digestion utilized the bacteria to consume the organic matters which then led to the production of value-added product known as biogas. Other alternatives for POME treatment methods include aerobic treatment, membrane treatment system and evaporation methods (Poh & Chong, 2009).

The wastewater resulted from AD is referred as the anaerobic digestion effluent. The post-treatment of this effluent is crucial to meet the discharge standard. One of the ways is to treat this effluent using membrane filtration. The use of expensive filter media such as activated carbon, silica gel and polyacrylamide require the need for low cost filter media derived from biological sources. This is also in accordance to the growing interest of using agriculture by-products as a filter media. One potential filter media is derived from kenaf fiber which has been demonstrated in recent studies to show good capacity in absorption for POME filtration.

Kenaf (*Hibiscus cannabinus* L.) is annual herbaceous crop of the Malvaceae family that also include cotton and okra (Janick & Whipkey, 2002). The kenaf fiber was obtained from the stalk which is composed of many individual smaller fibres known as bast fibers (Janick & Whipkey, 2002). In the older days, the kenaf fibers were primarily used as a cordage crop and livestock feed. Through recent research and development, the kenaf fibers were exploited to be used in pulp and paper industry, for oil absorption and to date, in the filtration. Kenaf fibers were chosen as it is a good replacement for synthetic adsorbents such as activated carbon and silica gel. The cost for kenaf is lower compared to the conventional synthetic ones (Mahmoud *et al.*, 2012). Kenaf fiber is classified as non-toxic as it is obtained from natural resource and will not appear in toxic form after adsorption as compared to activated carbon (Mahmoud *et al.*, 2012).

In this research, the filtration membrane system was used to filter the anaerobic digestion effluent by utilizing the kenaf fiber as the filter media. The effluent discharge from the filtration will be tested for its water quality. Color, turbidity, suspended solids, chemical oxygen demand (COD) and heavy metals are the aspects that need to be analyzed for the water quality. Besides, particle size distribution will also be analyzed to estimate the average size of the particles in the effluent before and after the filtration. The analysis was conducted to test the potential of kenaf fiber as filter media in filtrating the anaerobic digestion effluent. In the experiment, the pH of the effluent was adjusted to reach pH 8 prior to filtration to test the effectiveness of alkali-treated effluent in filtration through the filter media. The result is then compared with the filtration carried out for the original pH of the effluent which is determined to be pH 7.

1.2 PROBLEM STATEMENT

The use of expensive conventional filter media as the most commonly used filter media require the need for low cost filter media derived from biological source. By using filter media derived from plant such as kenaf fibers, it can help to reduce the operating cost. The development will be based on testing the capability of kenaf fibers as the filter media to filter the POME. The capability of filter media to filter the POME is important to ensure proper discharge into the environment.

1.3 OBJECTIVES

1. To develop filter media from kenaf fiber to be used in filtration of anaerobic digestion effluent
2. To conduct water quality measurement and particle size analysis for the filtered effluent
3. To study the effect of different pH of anaerobic digestion effluent towards kenaf filter

1.4 SCOPE OF STUDY

To achieve the objectives, research and experiments will be carried out. The experiment is based on using natural fiber to filter the effluent. The natural fiber used is kenaf fiber. The kenaf fiber is then developed into kenaf filter. The different pH of the effluent is prepared to be filtered and water quality of the filtered effluents are measured to study its effect towards kenaf filter. Particle size analysis is also conducted to measure the average size of particles in the effluent.