CHEMICALLY TREATED MICROWAVE BIOCHAR FROM SAGO BARK WASTE

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Abstract— Sago bark waste was used to produce biochar via microwave pyrolysis technique. The sample was pyrolyzed in modified household microwave oven in the presence of inert gas for 15 minutes. The biochar obtained was further treated via acid-base modification by using HCl and NaOH. The acid-base treated microwave biochar ($M\text{-}B_{ab}$) were further characterized to identify the physicochemical properties. BET analysis showed improvement in surface morphology and surface are of acid-base treated biochar from microwave biochar. BET analysis showed that the surface area of microwave biochar and acid-base treated biochar were 29.547 m^2/g and 119.040 m^2/g, respectively.

Index Terms—Microwave Pyrolysis, Biochar, Acid-Base Modification, Characterization.

I. INTRODUCTION

Biochar quality and its ability as an adsorbent depends on how carbonization processes to obtain biochar is conducted. Conventionally, biochar is produced via high temperature of carbonization through electrical and external heating [1], which consumed more energy and longer time production is needed. To overcome the problems, new technologies which is microwave pyrolysis has become one of the focus in carbonization technologies. Microwave pyrolysis is more preferable due to the time, energy and cost saving for production of biochar [2].

Microwave-induced biochar is a biochar obtained from the microwave pyrolysis process of the feedstock. Biochar produced from microwave pyrolysis shows better porosity and larger surface area compared to the biochar produced from any other process [3]. The results from a study conducted by [4] demonstrated that better pore structures and higher surface area were identified from biochar produced via microwave pyrolysis compared to the biochar obtained by slow pyrolysis. Due to properties of microwave-induced biochar, recent researches showed that microwave-induced biochar appears to be a new potential low cost and effective adsorbent for heavy metals removal.

Although biochar provides has been widely used for wastewater treatment due to its large surface are and stability, these biochar are very selective in adsorbing pollutants [5]. To improve and enhance the removal capacity and selectivity of biochar towards pollutants, chemical modification of biochar has gained attentions in this few years. Most common chemical modification is conducted by using acids or bases. Several studies conducted showed that the usage of acid and base for modification of biochar helps to enhance the porosity and surface area, improving the functional group thus enhance the performance of active sites for heavy metals removal [6]–[8].

In this study, sago bark waste, the most abundant agricultural waste in Sarawak was used as biochar precursor material for the production of biochar via microwave pyrolysis. The biochar obtained was modified by using acid and base. The physicochemical properties of the sago bark waste, microwave biochar and acid-base modified biochar were further examined to evaluate the properties and potential applications.

II. MATERIALS AND METHODOLOGY

A. Material

Sago bark waste (SBW) was collected from Sago Ubom Factory, Mukah, Sarawak. SBW was washed with tap water to remove any impurities and allowed to dry at room temperature. The sample was ground into particle size of 1.0 – 4.0 mm prior use. Chemicals used were purchased from Merck and used without any further purification.

B. Production of biochar via microwave pyrolysis

To obtain biochar, the sample was allowed to undergo microwave pyrolysis. The sample was placed in quartz reactor. The quartz reactor was placed in the modified household microwave oven and the nitrogen gas was continuously purged into the quartz reactor at 500 mL/min to provide inert environment inside the quartz reactor, 30 minutes prior to pyrolysis [1]. Then, the sample was allowed to be pyrolyze at temperature of 400 °C for 15 minutes. The solid-carbon residue, microwave biochar (M-B) was collected from the process.

C. Acid-base modification of microwave biochar

M-B was further chemically modified by using NaOH and HCl. M-B was soaked with 20 % NaOH at 1:20 w/v ratio for 2 hours at 60 °C before dried the sample