CHARACTERIZATION OF FTIR IN GRAPHITE FROM PALM OIL WASTE WITH FERRIC CHLORIDE CATALYST

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PAPER INFO

Received: August 2022
Revised: August 2022
Approved: August 2022

ABSTRACT

Background: Indonesia has various sources of graphite in large quantities. One of them is palm oil waste. Palm oil is a horticultural crop that acts as the largest non-oil and gas foreign exchange contributor in Indonesia.

Aim: This study aims to synthesize graphite from oil palm trunks with a catalyst through the pyrolysis method.

Method: This is an experimental research which eventually generated qualitative data to be analyzed. Oil palm trunks are dried in the sun, then crushed into powder with a grinder and sieved to 200 mesh. Graphite was synthesized using a carbonization step at 500°C. Impregnation using 3M ferric chloride (FeCl₃), with a concentration variation of 10% and 30%. Further activation at a temperature of 900°C for 3 hours.

Findings: The results synthesis of graphite powder were washed with hydrochloric acid (HCl) and distilled water repeatedly to obtain relatively pure graphite. Graphite characterization includes Fourier Transform Infrared Spectroscopy (FTIR). The results of FTIR analysis showed that graphite contains functional groups O–H, C–H, C–O, C≡C, and C=C.

KEYWORDS carbonization, ferric chloride, FTIR, oil palm trunks, pyrolysis

INTRODUCTION

Indonesia has a variety of sources of graphite in large quantities. One of them is palm oil waste. Palm oil is a horticultural plant that acts as the largest contributor to non-oil and gas foreign exchange in Indonesia (Darmawan et al., 2021). Graphite can be categorized into two types, namely natural graphite and synthetic graphite (Chung, 2002). Natural graphite is usually a result of the processing of carbon compounds during metamorphosis and occurs in sedimentary metamorphic rocks. Synthetic graphite can be processed from high processing temperatures of amorphous carbon (Dovbeshko et al., 2002).

Palm trunks contain organic compounds such as cellulose, lignin, and hemicellulose (Saputri & Sukmawan, 2020). Organic compounds can be used as a source of graphite with further processing processes (Kusumattaqiin et al., 2020). Palm oil can be used as a raw material in the manufacture of graphite because it has a carbon content (Thebora et al., 2020). Because of the valence numbers possessed by carbon atoms, graphite can form many allotropes (Ningrum et al., 2020). Carbon allotropes that have been known to date are graphite, diamond, fullerite, carbon nanotubes, fullerenes, and graphene (Honorisal et al., 2020). Graphite is difficult to dissolve in water, is not easy to burn, and has good thermal, mechanical and electrical properties (Mahmudah & Kusumawati, 2020).

Previous studies have reported that synthetic graphite requires high-temperature processing parameters almost in graphite synthesis. This suggests an extremely high temperature is necessary to increase the mobility required by the carbon atom into a graphite crystal lattice. In short, synthetic graphite is produced from the high-temperature processing of
amorphous carbon materials. There are many types of materials used as precursors to produce synthetic graphite including coal, petroleum, and natural and synthetic organic matter (Taufantri et al., 2016).

Wulandari et al. (2017) edict is synthesized by heating graphite powder at a temperature of 1000°C. Wachid et al. (2014) reported that the sample was placed on a crucible and dried at a temperature of 110 °C then continued with an activation phase with temperatures of 400°C, 800°C, and 1000°C and a residence time of 3 -5 hours. Perdani et al. (2021) mention graphite obtained using a time variation of 1-3 hours at a temperature of 600°C. Graphite was characterized using FTIR indicating the presence of functional groups C≡C, C=C, O–H, C–H, and C–O. Therefore, this study aims to synthesize graphite from palm trunks by catalyst through the pyrolysis method.

METHOD
Research Method
This research was experimental and ultimately produced qualitative data that could be examined.

Tools and Materials
The main material used in this study was palm oil stem waste obtained from one of the palm oil mills. The chemicals used include FeCl₃, HCl, and aqueous. The tools used are furnaces, analytical balance sheets, litmus paper, desiccators, Petri dishes, and Buchner vacuums. The instrument used in this study was the Infrared Spectrophotometer (FT-IR Shimadzu).

Procedure
The trunk of the palm is dried in the sun, after drying it is smoothed with a grinder and sifted to the size of 200 mesh. Graphite synthesis uses the carbonization activation stage at a temperature of 500°C. Carbon is neutralized with NaOH 1M and rinsed with aqueous to pH 7. Activated carbon is dried in a 110°C oven for 24 hours and then sifted using a sieve. Impregnation using ferrous chloride (FeCl₃) 3M, with concentration variations at 10% and 30% (v/v). Furthermore, graphitization at a temperature of 900 °C for 3 hours in the furnace. The synthesis results in the form of graphite powder washed with hydrochloric acid (HCl) and aqueous repeatedly to neutralize the pH in obtaining relatively pure graphite. Litmus paper is used to determine the pH of graphite. Characterization of graphite using an FTIR spectrophotometer at a wave number of 4000-400 cm⁻¹.

RESULTS AND DISCUSSION
The FTIR spectrophotometer is used to analyze the functional group of graphite. The results of the characterization of FTIR on graphite samples are shown in figures 1 and 2. From the two samples, it was detected that all graphite samples had a C=C bond. Absorption peaks in figure 1 were found in wave number 1514.19 cm⁻¹ while figure 2 was in the wave number 1512.26 cm⁻¹ which showed the C=C bond as a characteristic of the graphite vibration band. From the graph, it can be seen that the smaller the size fraction, the higher the wavelength absorbed will be. This is following the research carried out by Nandiyanto et al. (2019) and
Allaberdiev (2002) mentioned that there is an absorption of the C=C bond at the wave number 1510 -1620 cm$^{-1}$.

Some carbon functional group absorption bands were detected at wave number 3730.40 cm$^{-1}$ indicating the absorption of the O–H group; at wave number 2875.02 cm$^{-1}$ indicating the presence of a methylene vibration group C–H, and at wave number 2310.82 cm$^{-1}$ indicating the presence of an acetylene group C≡C; at wave number 1291.40 cm$^{-1}$ indicating the presence of a C–H group, and at wave number 1144.80 cm$^{-1}$ there is a C–O group.

CONCLUSION

The synthesis of graphite from palm stem waste is carried out through the carbonization stage and the pyrolysis stage. Graphite characterization includes Fourier Transform Infrared Spectroscopy (FTIR). The results of the FTIR analysis showed that graphite contains functional groups O–H, C–H, C–O, C≡C, and C=C. However, it is expected that more researchers take interest in analyzing this topic since the application can stretch to many other objects as well.

REFERENCES


