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FORMATION OF CARBON MATERIAL ON NICKEL CATALYST DURING REACTION WITH THE VAPOUR PRODUCED FROM THE PYROLYSIS OF SEWAGE SLUDGE

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ABSTRACT

It is a research on the formation of carbon material on nickel catalyst during reaction with the vapour produced from the pyrolysis of sewage sludge. The method used for carbon nanotube (CNT) production is the catalytic chemical vapour deposition (CCVD) method. In this research, the nickel catalyst act as the catalyst for carbon nanotube (CNT) production. The catalyst preparation also plays an important role in carbon nanotube growth rate. The nickel catalyst undergoes the incipient wetness impregnation (IWI) since the method is more faster, inexpensive, and the final property and configuration can be control in advance. The nickel catalyst were characterized by using Thermogravimetric analysis (TGA) and Fourier Transform Infrared (FTIR) Spectroscopy. The heating rate is one of the parameter for the pyrolysis of sewage sludge. Nevertheless, the heating rate have little impact on sludge pyrolysis reaction activation energy and correlative to reaction rate.(Wang Xiaohua & Jiancheng., 2012) Based on the recorded temperature of every 10 minutes during experiment, the heating rate of reactor can be determine by calculating the average heating rate (°C/min). From the nickel with distilled water, the heating rate obtained is 15.2°C/min which is higher than heating rate for nickel with ethanol which is 14.9°C/min. The TGA analysis allows for a more accurate result of the deposited carbon.(Awadallah et al., 2012) Based on research by Pinjari et al., all catalysts shows three mass changing steps which were vaporization of physically adsorbed moisture, surface oxidation of metallic nickel and degradation of graphitized carbon. Based on the both nickel catalyst after CCVD, they showed an initial weight loss tendency which may be attributed to the loss of physically adsorbed water by the catalyst. The analysis on the nickel catalyst by using FTIR was also done to determine the functional group. But it cannot be determine since the carbon was not deposited on the catalyst. All sample for before and after CCVD process shows slightly different peak value. Overall, there were three peaks in the catalyst which are 1738cm^{-1}, 1366cm^{-1} and 1217cm^{-1}.

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CHAPTER ONE

INTRODUCTION

1.1 Research Background

Pyrolysis is a thermal process where organic materials such as biomass and oil are decomposed and lighter materials such as gas, vapor, liquid products, and char are produced.(Shahraki et al., 2018)The sludge was composed of difference solid particles suspended in an impure water sequence. In sewage sludge, the solid particle consist of the complex mixture of organic such as proteins, carbohydrates and others. Other than that, it also consist of inorganic matters, living and dead microorganisms. The sewage sludge consist of different components. Each of them came from origin that have their own definitive and rare production conditions indicate that the sewage sludge's properties are highly flexible. There are many factors that effect the characteristics of sewage sludge such as the wastewater characteristic, treatment system uses in wastewater treatment plant (WWTP) and others.(Syed Hassan et al., 2017)

There were restraint in the pyrolysis and combustion process which were materials that was used in the waste treatment due to production of organic compounds. The product's description and quantity was acknowledge as a part of advancement of the pyrolysis devices. The product formed from the pyrolysis. In the incinerator, there will be the possibility of danger toxic of the pyrolytic compounds formed. It was due to the low value of oxygen ratio. Based on other authors, temperature used in the pyrolysis of sewage sludge was between 400-700°C to obtained the fuel produced from the waste. (Fullana et al., 2003)