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

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ABSTRACT

The study describes on catalytic chemical vapour deposition (CCVD) method for production carbon nanotube onto Fe-alumina supported catalyst. Sewage sludge was used as a carbon source throughout the pyrolysis process. The objective of this study are to investigate the formation of carbon nanotube using iron metal catalyst in CCVD method. Besides that, to identified the characterization of carbon material on catalyst sample between reduction and without reduction steps. The catalyst and their support is prepared by using impregnation method technique between the Ferum (III) Nitrate and Alumina Oxide. The pyrolysis was conducted at the temperature of 600°C, CCVD at 800°C for experiment 1 and 800°C for experiment 2. The experiment was carry out for 30 minute and sample was observed and analyser. Characterization of iron-alumina catalyst was done by series of analysis before and after the process. Mass of catalyst sample, Thermo-gravimetric analyser (TGA), and The Fourier transform infrared spectroscopy (FTIR) was used as analyser the formation of carbon nanotubes (CNTs). The TGA showed that the formation of amorphous carbon occurs at the initially stage and before 300°C. The higher yield of CNTs was produce in experiment 2 with spongy physical appearance carbon material, while fine black powder in experiment 1 indicate low yield of carbon material. The FTIR analysis shows the hydroxyl group are present at early stage followed by C-C stretch bend and stretching mode. Overall the uses of reduction step by allowing the hydrogen gas during reaction occurs increasing the probability of carbon material production. However, some recommendation need to be considered for the future research.

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CHAPTER 1

INTRODUCTION

1.1 Background Study

Sewage sludge is referring to the residual by-product of municipal waste water treatment plant (WWTP). This scenario leads the increasing volume and the impacts associated with its disposal. Wastewater treatment plant objectives are accomplished by concentrating impurities into solid form and then separating these solids from the bulk solid. This concentration of solid referred as a sludge. Sludge contains many unwanted materials and must be disposed properly. The quantity and nature of sludge depend on the characteristics of the waste water and on the nature and efficiency of the process. WWTP facilities usually have three section which is preliminary treatment, primary treatment and secondary treatment. (Peavy, Howard S et al, 1985). The sludge start being removed on the primary treatment and follow by the secondary treatment. The primary sludge is more granular than the secondary sludge and is more concentrated in general. Primary sludge contains both inorganic solids and a coarser organic colloid fraction. However, in the secondary sludge it depends on treatment processes and is more variable. It is sometime advantages to mix primary and secondary sludge to facilitate further processing. The organic content from the total sludge is about 70 percent. The main goals of the sludge treatment process are to reduce the overall weight and volume to facilitate transport. Furthermore, the material must be stabilized by destroying pathogenic microorganisms, eliminating unpleasant odours and reducing the volatile solid content for safer disposal. (Syed-Hassan, Wang, Hu, Su, & Xiang, 2017).

Sludge, biomass, waste tyre and plastic feedstock are the substances that can be converted into something valuable which is energy and fuel by thermochemical conversion. Thermochemical conversion process namely pyrolysis, gasification and combustion. Pyrolysis can be described as the direct thermal decomposition of the organic matrix without oxygen in order to obtain a range of solid, liquid and gas products. (Yaman, 2017). The organic material inside the sewage sludge start to transform to the volatile products and non-volatile solid residue called as bio char. When its porous structure and surface area is appropriate, the car