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

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ABSTRACT

Rapid urbanization in developing countries brings pros and cons to the society, industries and the environment itself. Along with this development, rapid growth on production of sewage sludge from wastewater treatment cannot be tamed without proper practice. Sewage sludge properties which having toxic organic compounds, high moisture content and heavy metals resulted in sludge. Improper techniques in managing sewage sludge has become environmental concerned. Most common techniques for disposal of sewage sludge is by landfilling which is the least favour in disposal method. Lack of uses of sewage sludge in developing a new application to convert to something useful also become one of the problem rapid production of sewage sludge. Therefore, to overcome these problems, several techniques have been developed in replacing landfilling techniques in managing the sewage sludge, and one of the techniques available is pyrolysis process. Since, the pyrolysis of sewage sludge is hypothetically stated can bring benefits aspects in several factors, hence, it is possible to conduct an experiment to develop a new application based on sewage sludge. Based on this study, the uses of gases produce from the pyrolysis can be react with cobalt catalyst in producing a carbon material by catalytic chemical vapour deposition (CCVD) technique. The types of carbon material formed on the surface of catalyst is investigated as this become the main objectives in conducting the research. Each of carbon material formation is observed and the formation carbon nanotubes (CNTs) was investigated. Based on the experiment conducted, 4 samples are made based on the Co catalyst label as Sample A, B, C and D which derived from ethanol and distilled water based is showing the carbon material on the sample after CCVD process. The characterization of these results is made by using FTIR analysis and TGA analysis. As from the FTIR analysis, the constant and dominant peak showing at 640, 1250, 1372 and 1737 cm-1 which corresponds to C-H, C-N, N-CH3, and CNT, respectively. Meanwhile, in TGA analysis, the dominant weight loss steps recorded in the analysis are at a temperature range 400-600°C for sample C and D in the TGA curve due to the removal of impurities in carbon material also due to the decomposition of nanotubes. Hence, it can be concluded that the pyrolysis of sewage sludge contributed to the formation of carbon material on the cobalt catalyst based on the experiment conducted with supported by analysis.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Rapid urbanization in developing a new country brings pros and cons in terms of socio-economy, civilization, industries and etcetera. Along with this development, rapid growth on the production of sewage sludge from wastewater treatment cannot be tamed without proper practice. Improper techniques in managing sewage sludge have become environmental concerned (Feng, Luo and Chen, 2015). Several techniques have been established in handling the problem and one of the techniques used is the pyrolysis method. Pyrolysis has a potential option in reducing the volume of waste, eliminating pathogen compound, also producing the end products such as bio-oil, biochar and syngas (Ko, Wang and Xu, 2018). It was hypothetically stated from the pyrolysis of sewage sludge might have benefits aspects in certain factors. Based on the type or composition produced from the pyrolysis process will produce different types of gases which in term of this research, it is hypothetically assumed can produce Carbon Nanotubes (CNTs). Back to the study, the formation of vapour from the pyrolysis of sewage sludge can be used to investigate the formation of carbon material in different types of catalyst. CNTs is one of the carbon might formed during the process of catalytic chemical vapour deposition (CCVD) in examining under different types of catalyst such cobalt, iron and nickel during the process (Ye, 2007) These catalysts typically in a group of transition metal is required to choose in production of CNTs (Suriani et. al., 2013). Different uses of catalyst give different production of CNTs in the process, therefore the studies regarding carbon formation under different types of catalyst is conducted. In this study, the main catalyst selected for the process is cobalt catalyst in synthesizing the CNTs. Regarding about CNTs, CNTs production have extensively research from the time it was first discovered by Sumio Iijima in early 1990s (Shah and Tali, 2016). Having different morphology, electronic, chemical, mechanical and electromechanical properties pointed out more studies had been conducted for the potential applications of CNTs (Ye, 2007). Several studies in production of CNTs also conducted under different types of decomposition such as decomposition of palm oil precursors and synthesis of