STUDY ON THE EFFECT PERFORMANCE OF CARBON ADSORBENT WITH DIFFERENT TERM OF SIZE AND METHOD IN LPG TANK

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‘I/We approve that we have read this thesis thoroughly
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Supervisor I :……..

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This report is written as a partial fulfillment of terms in achieving the award for Bachelor of Mechanical Engineering (Thermal-Fluid)

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"I admit that this report is all written by myself except for the summary and the article which I have stated the source for each of them."

Signature :……

Writter :……

Date :.....

TO MY BELOVED MOM AND DAD...

TO ALL MY BEST FRIENDS...

ACKNOWLEDGEMENT

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ABSTRACT

LPG, or liquefied petroleum gas, is an excellent choice of fuel for engine. Because it decreases exhaust emissions, LPG is widely considered a "green" fuel. Owning an LPG engine is also an economical choice, as LPG is often less than half the price of petrol or gasoline, and 40% less than diesel. So, in order to overcome such problems, the carbon adsorbent is being used in LPG tank for increasing the storage capacity. In this project, the report is more focuses on development and preparation of carbon adsorbent and also develop experimental rig to study the carbon adsorbent performance different term of size. With everything method was carried out, we be able to know and study that the nature of carbon adsorbent is having performance to absorb greater, more efficient or more saving when applied in LPG tank. The method is not using any gas in the process as it is costly. Therefore, the result of the performance carbon adsorbent can be obtained after doing the all experiment that had in suggestion. The last results had shown that the carbon adsorbent from crushed oil palm shell in LPG tank is successfully worked as the good carbon adsorbent and has a potential to adsorb more gas and more saving. For the recommendation, it is suggested that a better, simple and more saving method have to be applied.

ABSTRAK

LPG, ataupun cecair petroleum gas adalah bahan api alternatif pilihan yang terbaik untuk enjin. Ini kerana LPG dapat mengurangkan kepulan asap dari ekzos, LPG dikenali secara meluas sebagai minyak “hijau”. LPG enjin juga adalah plihan yang ekonomi, dimana harganya kurang dari separuh harga petrol atau minyak tanah, dan kurang 40% dari diesel. Namun begitu terdapat juga beberapa masalah yang timbul apabila di aplikasikan kepada kenderaan. Untuk mengatasi masalah seperti ini, penyerap karbon digunakan di dalam tangki LPG untuk meningkatkan kapasiti simpanan tangki tersebut. Dalam projek ini, banyak memfokuskan tentang penghasilan dan penyediaan penyerap karbon serta juga penghasilan eksperimen yang lengkap untuk mengkaji prestasi penyerap karbon dari segi saiz yang berbeza. Dengan segala kaedah yang telah dijalankan kita dapat mengetahui dan mengkaji bahawa sifat-sifat penyerap karbon ini mempunyai prestasi untuk menyerap lebih banyak, lebih cekap ataupun lebih jimat apabila di aplikasikan di dalam tangki LPG. Kaedah projek ini juga tidak menggunakan sebarang gas di dalam segala proses yang boleh meningkatkan kos. Oleh yang demikian, keputusan perlaksanaan penyerap karbon boleh di perolehi selepas melakukan kesemua eksperimen yang telah di cadangkan. Keputusan akhir menunjukkan bahawa penyerap karbon yang dihasilkan dari serbuk hancur tempurung kelapa sawit di dalam tangki LPG telah berjaya bekerja sebagai penyerap karbon yang baik serta mempunyai tenaga untuk menyerap gas dengan lebih banyak dan menjimatkan. Untuk cadangan, penghasilan yang lebih baik, bagus, ringkas dan jimat hendaklah di aplikasikan di dalam projek ini.

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CHAPTER 1

INTRODUCTION

Activated carbon is made from any substance with high carbon content, and activation refers to the development of the property of adsorption. Activated carbon is important in purification processes, in which molecules of various contaminants are concentrated on and adhere to the solid surface of the carbon.

Activated carbon is widely used as an effective adsorbent in many applications such as air separation and purification, vehicle exhaust emission control, solvent recovery and catalyst support because of its high specific pore surface area, adequate pore size distribution and relatively high mechanical strength. The active carbon is a material with an exceptionally high surface area. One gram of activated carbon has a surface area of approximately $500\,m^2$, typically determined by nitrogen gas adsorption, and includes a large amount of microporosity.

Generally, the starting materials used in commercial production of activated carbons are those with high carbon contents such as wood, lignite, peat, and coal of different ranks. As the price of commercial activated carbon has dropped continually over the last decade or so, interest is growing in the use of other low-cost and abundantly available agricultural by-products. The use of these wastes has not only eliminated the problem of their disposal but has derived tremendous environmental and economical benefits. The active carbon can be produced in different process

from a variety of carbonaceous source materials such as coconut shells, coal, walnut shell, palm date pits, nutshell and oil palm shell. The two different processes include physical reactivation and chemical activation.

1.1 Background research

In order to reduce air pollution, many countries had used LPG as an alternative way replacing natural gas and petrol as a fuel in their vehicles. The use of LPG is more economic because it is simply to prepare and easy to use as the LPG is not using the high pressure tank compared to natural gas.

Many researches are being done to improve the use of LPG in the automotive industry. One of the current researches is to develop LPG and methane gas storage as the alternative fuels for vehicles based upon the carbon adsorbent. Carbon adsorbent or active carbon is used as a gas storage media for LPG. It is an alternative way to overcome the disadvantages of pressurized vessel such as high pressure flammable gas content, dimension of gas tank and other dangerous aspects.

The current research of using the carbon adsorbent in LPG is successfully worked as the carbon adsorbent has a potential to adsorb the gas based on its characteristics.

1.2 PSM flow chart

The flow chart is shown that how the step by step to finished the project. It is start from selecting the title until make to the conclusion.

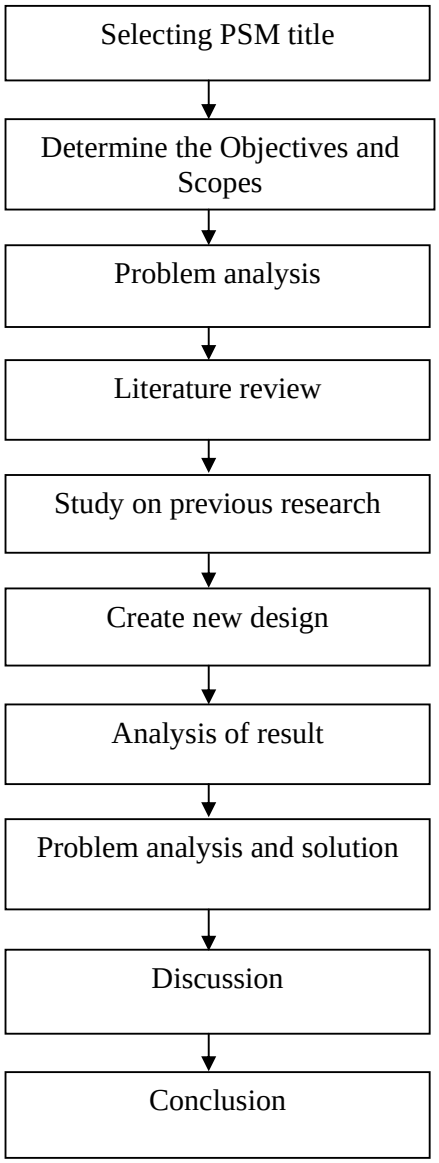

Figure 1.1: PSM flow chart

1.3 Problem Analysis

Nowaday, alternative fuel is become trend since the price of petrol or gasoline contansly increased. Using LPG as a fuel for vehicles give more advantages than the others fuel. This is because the LPG is more economic and is not using high pressure tank.

In application for the vehicles, a small tank for LPG storage with high capacity is needed. LPG is one of the alternative fuel which can be used in vehicle, however the storage capacity of LPG is limited, therefore by using carbon adsorbent, the storage capacity of LPG inside the tank can be increased. Carbon adsorbent has a potential to adsorb LPG due to its characteristics. In real condition, this concept is needed to be tested. Carbon adsorbent was prepared by the process of carbonization and activation on previous research.

Even the process is capable to produce carbon adsorbent in high adsorption capacity; the process is occurs in high temperature and using N_2 and CO_2 gas. Heating at high temperature take a long time to get the product and the use of N_2 and CO_2 gas have to be control to obtain the specific flow rate and CO_2 is costly.

1.4 Objectives and Scope

Objective

- To study the performance of carbon adsorbent in different method and term of size that uses in LPG tank.
- To analyze carbon adsorbent using FTIR and SEM.
- To investigated the LPG adsorption and LPG desorption of carbon adsorbent in LPG tank.

Scopes

- Literature study on carbon adsorbent and the performance of carbon adsorbent.
- Develop a carbon adsorbent to increase the storage capacity of LPG.
- Develop experimental rig to investigate the carbon adsorbent performance.
- Conduct an experiment to determine the performance of carbon adsorbent in LPG tank.

CHAPTER 2

LITERATURE REVIEW

2.1 What Is Activated Carbon

Carbon adsorbent is also known as activated carbon. Activated carbon is a crude form of graphite, the substance used for pencil leads. It differs from graphite by having a random imperfect structure which is highly porous over a broad range of pore sizes from visible cracks and crevices to molecular dimensions. The graphite structure gives the carbon it's very large surface area which allows the carbon to adsorb a wide range of compounds. Activated carbon has the strongest physical adsorption forces or the highest volume of adsorbing porosity of any material known to mankind.

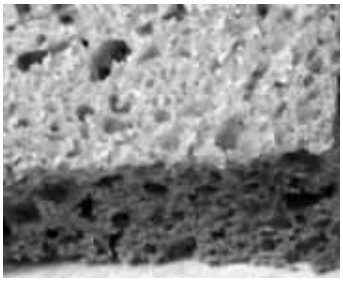

Figure 2.1: Activated carbon
(Source: www.wikipedia.com)

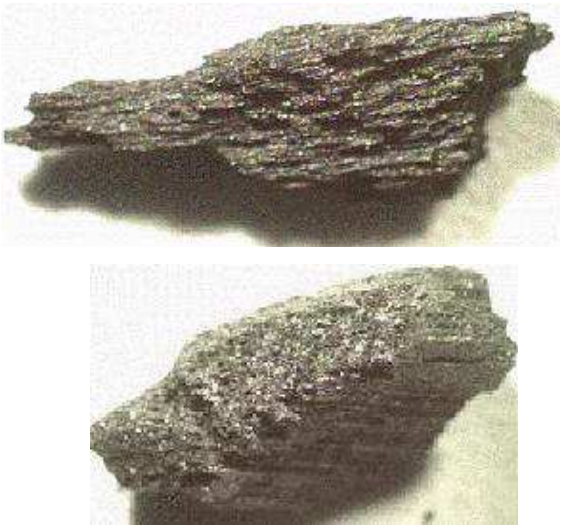

Figure 2.2: Close up of sample activated carbon
(Source: www.wikipedia.com)

2.2 What Is Activated Carbon Made Form

Activated carbon can made from many substances containing high carbon content such as coal, wood and coconut shells. The raw material has a very large influence on the characteristics and performance activated carbon.

2.3 Production of Carbon Adsorbent

There are two different processes in producing the activated carbon. It can be produced using one of the two following processes:

1. **Physical reactivation**: The precursor is developed into activated carbons furnace using gases. This is generally done by using one or combining the following processes:

- Carbonization: material with carbon content is pyrolysed at temperatures in the range 600-900°C, in absence of air (usually in inert atmosphere with gases like nitrogen).
- Activation/oxidation: raw material or carbonized material is exposed to oxidizing atmospheres (carbon dioxide, oxygen, or steam) at temperature above 250°C, usually in the temperature range 600-1200°C.

2. **Chemical activation**: Impregnation with chemicals such as acids like phosphoric acid or bases like potassium hydroxide, sodium hydroxide or salts like zinc chloride, followed by carbonization at temperatures in the range 450-900°C. It is believed that the carbonization / activation step proceeds simultaneously with the chemical activation. This technique can be problematic in some cases because, for example, zinc trace residues may remain in the end product. However, chemical activation is preferred over physical activation owing to the lower temperatures and shorter time needed for activating material.

Figure 2.3: Carbonized coconut
(Source: www.wikipedia.com)

Figure 2.4: Activated coconut
(Source: www.wikipedia.com)