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COAL PYROLYSIS IN INERT CONDITION

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Abstract

Coal pyrolysis is the thermal cracking process in inert gas condition, to produced gas, liquid and solid product. Quantity and quality product will effected by condition of operation.

Pyrulysis process to make use of Kalimantan (KPC) in the atmospheric reactor in inert of nitrogen gas as inert with flow rate gas is 350 ml/minute, with measurement of particle is 6/10, 4/6 and 2/4 mesh, to be done at temperature condition 400 – 700 ^oC and weight of feed 2 kilogram, respectively.

It can be concluded that condition of nitrogen inert and fed with step by step can the probabilities limited of internal secondary reaction and effective enough to resist external secondary reaction, it is showed in the increasing of tar production and decreas of gas product, specialy of particle 4/6 and 2/4 mesh with operation temperature higher 600 ^oC and effectiveness to resist of thermal secondary reaction for 6/10 mesh. The effect temperature to grow into gas product in the measure of particle 6/10 mesh.

The yield of char, tar and gases depends on temperature and particle size. The maximum yield tar was obtained at temperature 500^o C with particle size 4/6 mesh and the maximum yield gas was obtained at temperature 700^o C with particle size 6/10 mesh are 12,4 % and 20.74 % respectively. The concentartion of gases will increase with increasing temperature, but will decrease with increasing particle size. The Atmosphere of nitrogen inert of influence for the higher the particle size at temperature above 500^o C, the less gas product, but more tar, were obtained.

Keyword : pyrolysis, coal, reactor performance

1. INTRODUCTION

coal is an abudant fossil fuel resource distributed widely throughout the world. It has been known that there are around 36 billion tons of coal resource potential in Indonesia. Over 21,4 billion tons is classified as low rank (lignitic) coal. The coal deposits are located especially in Sumatra and Kalimantan.

As an energy source, low ranks coals are not widely used, because of their high moisture content, low calorific value and variable ash content. That's why these low-rank coal have not yet been exploited.

One of the key questions for utilizing low rank coal, is whether lignite can be upgraded into another from which is more economically viable. Various possibilities are being actively investigated in many countries, and research and development efforts are being directed to these studies. Possible products of low-rank coal include: a fuel with higher calorific value; lignite-water slurries; synthetic gas; high-grade briquettes; liquid fuels and/or chemicals. Low rank coal and char briquettes also can be used for tar and chemical production by pyrolysis processes.

2. EXPERIMENTAL

2.1 Apparatus

The tests carried out in this work were all done in a pilot plant fixed bed pyrolysis reactor

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unit (0.743 m height and 0.12 m diameter) provided with hopper, electric heater, coolers and products receivers.

The temperature of the coal bed in the reactor was measured by a chromel-alumel thermocouple and controlled by electrical heating coils. Nitrogen gas was used in this work as a inert gas. The product tar was collected in a tar pot and product gas was measured by calibrated flowmeter. A schematic diagrams are shown in figure 1.

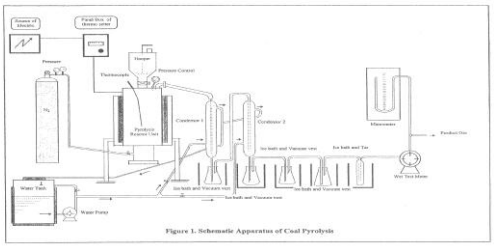


Figure 1. Schematic Apparatus of Coal Pyrolysis

2.2 Material Used

Indonesian coal were the raw material used in this study. The proximate and ultimate analysis are given in table 1.

Analysis	Weight % (m.a.f)
Proximate	
Moisture	4.46
Ash	0.92
Volatile matter	44.84
Fixed Carbon	49.78
Sulfur	3.15
Ultimate	
Carbon	71.82
Hydrogen	5.46
Oxygen	18.05
Nitrogen	1.34
Sulfur	3.33

2.3 Procedurs

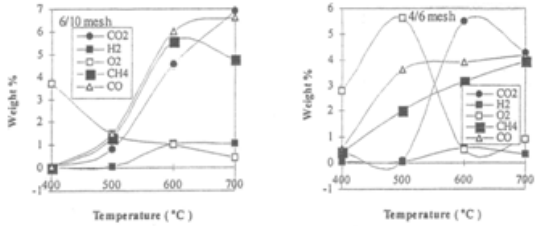
The moisture, the ash, the volatile matter and the sulfur contents of the raw materials and char were determined by routined methods. Liquid products were collected from the two condensor in a tar pot. The rate of gas products were measured by calibrated flowmeter. The amount of the tar, and the gas were determined by weight difference.

In the various pyrolysis test carried out, the follow range of condition were used; temperature from 400^{o}C to 700^{o}C, particle size from 2/4 mesh to 6/10 mesh. The rate of inert gas (nitrogen) was constant at 350 ml/minute.

The gas products were analyzed every 15 minute by gas chromatograph Shimadzu type 9A with Porapag Q column and molecular sieve 5 A (for non hidrocarbon gas), and by GC-MSD HP 5890 with silicon DC 200 column. The tar product were analyzed by GC Shimadzu type 5590 A with Apiezon L Column.

3. RESULT AND DISCUSSION

The yield of char, tar and gases depends on temperature. The yield of tar and gas will increase as increase in temperature, but the char will decrease. At the temperature above 600^{o} C, the yield of tar will decrease, because at high temperature, the secondary reaction will occur. The maximum yield of tar was obtained at temperature 500^{o} C. The effect of temperature on the distribution of pyrolysis product are shown in figure 2.



The composition of gas product was affected by temperature. The concentration of carbon monoxide, carbon dioxide and hydrogen will increase with increasing temperature. The production of gas hydrocarbon, carbon monoxide, and hydrogen occur at high temperature. The effect of temperature on the composition of gas product are shown in figure 3.

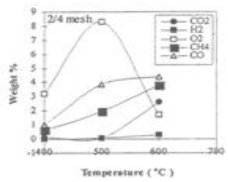


Figure 3. The Effect of Temperature on the Composition of Gas Product

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At the temperature range of 400^o C to 600^o C the decrease of particle size will decrease of volatile product. At temperature above 600^o C the yield of volatile produced during pyrolysis process increased with decrease of particle size from 2/4 mesh to 6/10 mesh. The effect of particle size on the volatile product are shown in figure 4.

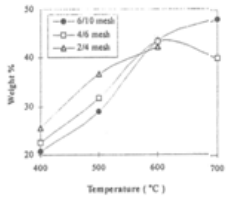

Figure 4. The Effect of Particle Size on the Volatile Product (Weight Loss)

The composition of gas produced during pyrolysis process depends on the particle size. The concentration of gases will decrease with increasing particle size.

4. CONCLUSION

1. The yield of char, tar and gases depends on temperature and particle size.

2. The maximum yield tar was obtained at temperature 500^o C with particle size 4/6 mesh and the maximum yield gas was obtained at temperature 700^o C with particle size 6/10 mesh are 12,4 % and 20.74 % respectively

3. The concentartion of gases will increase with increasing temperature, but will decrease with increasing particle size

4. The Atmosphere of nitrogen inert of influence for the higher the particle size at temperature above 500^o C, theless gas product, but more tar, were obtained.

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