Biogasification of Soma Lignite by Microorganisms

Mustafa Baysal*, Yuda Yürüm

Faculty of Engineering and Natural Sciences, Sabanci University Orhanli, Tuzla, Istanbul 34956, Turkey

**Corresponding author: mustafabaysal@sabanciuniv.edu*

Abstract— The main scopes of this study are to analyze the bacterial activity on the coal samples which come from Soma basin in Turkey and investigation of the bacterial gas production of these samples. For that purpose, characterization of the coal samples was performed by using FTIR, STA, BET, SAM and ICP.

Keywords: Biogasification, Coal, Microorganism

Introduction

Due to the development of technology, energy demand of the world is increasing constantly. In our day, coal still keeps its place as one of the primary sources of energy to supply this demand. However, utilization of coal as an energy source has lots of negative impacts on the environment. For this reason, scientists have investigated alternative processes to produce clean energy from coal.

In 1982, Cohen & Gabrielle published the first report on the biological conversion of the coal by microorganisms [1]. Since that time, biological conversion of the coal has been a major area of interest for scientists. Biological treatment of the coal can be divided into two categories; first one is the removal of the sulfur, nitrogen, metals and other unwanted components of the coal and the second one is the conversion of the coal like liquefaction, methane production, microbial gasification and microbial pretreatment [2].

Usually, biological treatment of the coal takes place under mild conditions at low temperature and pressure unlike the classic thermo-chemical processes. In instance, during the thermo-chemical processes, formation of the gas products and liquid hydrocarbons from the coal have been carried out by the thermocatalytic breakdown of deeply buried organic matter at relatively high temperatures (> 80^{o}C). On the other hand, in the anoxic biogasification processes, microorganisms cause degradation of the organic content (aromatic hydrocarbons) of the coal to produce gas and other hydrocarbons [3].
In this study, some characterization methods were used to understand the bacterial activity on the Soma lignite.

Results and Discussion

Coal samples which come from Soma basin were broken and grinded into small particles, and then passed through the sieve to reduce particle size to 175µm. Resulting samples were preserved at N_2 atmosphere.

For the determination of the nitrogen, sulfur and trace metal content in the coal, elemental analysis of the samples were performed by ICP. Meanwhile, morphology of the samples was investigated by scanning electron microscopy (SEM).
In addition to establish volatile matter content of the coal, samples were characterized by flame experiments with Netzsch STA 449 C equipment at dry air with the heating rate of 5K/min and in the temperature interval 25-1000 C.

Furthermore, aromatic groups of the coal samples are degraded into aliphatic chains by microorganisms during the biogasification process. Therefore, the functional groups of the sifted coal samples were determined by the Bruker Equinox 55 FTIR spectrometer. Result of the FTIR analysis showed that degree of aliphaticity in the coal samples is relatively high due to the bacterial activity on the samples.
Also, studies on the bacterial gas generation and microorganism activity on the coal samples have still continued.

References

[1] Cohen, M.S., Gabriele, *P.D. Degradation of coal by the fungi Polyporus versicolor and Poria monticola, Applied and Environmental Microbiology 44, 23-27 (1982)*
[2] Narayan, R., Ho, N.W.Y. *Prepr. Pap., Am. Chem. Soc., Div. Fuel Chem.; (United States); Journal Volume: 33:4; Conference: Bioprocessing of coal, Los Angeles, CA, USA, 25-30 (1988)*
[3] Steve H. Harris, Richard L. Smith, Charles E. Barker, *International Journal of Coal Geology 76 46–51 (2008*)