THE STUDY OF MACERALS IN LOW RANK COAL (LIGNITE) AT WARUKIN FORMATION, SOUTH KALIMANTAN AND THEIR POSSIBILITY FOR COAL LIQUEFACTION

by Basuki Rahmad

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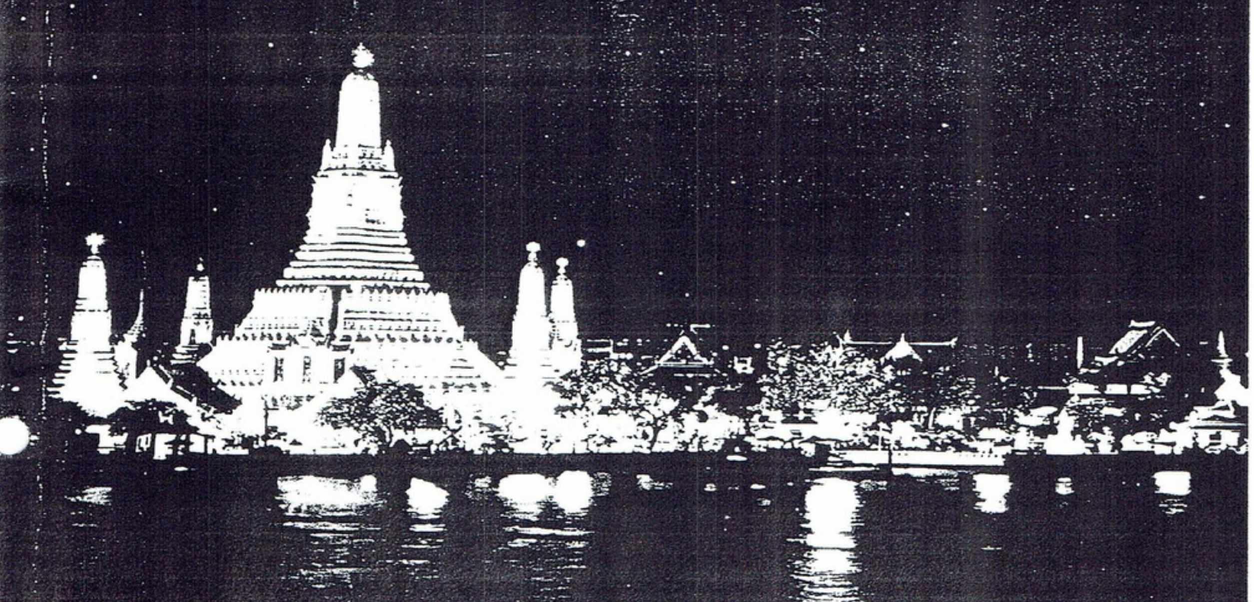

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EDITORIAL

It is my proud privilege to welcome you all to the TheIRES International Conference at Bangkok, Thailand. I am happy to see the papers from all part of the world and some of the best paper published in this proceedings. This proceeding brings out the various Research papers from diverse areas of Science, Engineering, Technology and Management. This platform is intended to provide a platform for researchers, educators and professionals to present their discoveries and innovative practice and to explore future trends and applications in the field Science and Engineering. However, this conference will also provide a forum for dissemination of knowledge on both theoretical and applied research on the above said area with an ultimate aim to bridge the gap between these coherent disciplines of knowledge. Thus the forum accelerates the trend of development of technology for next generation. Our goal is to make the Conference proceedings useful and interesting to audiences involved in research in these areas, as well as to those involved in design, implementation and operation, to achieve the goal.

I once again give thanks to the Institute of Research and Journals, TheIIER, TheIRES for organizing this event in Bangkok, Thailand. I am sure the contributions by the authors shall add value to the research community. I also thank all the International Advisory members and Reviewers for making this event a Successful one.

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THE STUDY OF MACERALS IN LOW RANK COAL (LIGNITE) AT WARUKIN FORMATION, SOUTH KALIMANTAN AND THEIR POSSIBILITY FOR COAL LIQUEFACTION

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Abstract- The study of macerals in low rank coal of Warukin Formation, South Kalimantan, is reported. Coal samples were taken from three layers namely Wara Coal Seam-110, Seam-120, and Seam-200. The macerals were observed usingcoal with diameter of 3 cm then pulverized with +10-20 mesh size. The results of observation show that the content of macerals in Wara layer consists of vitrinite group reach of 81%w, the liptinite groupof 51%w and the inertinite group of 27%w. Coal with high percentage of liptinite group could be utilized for liquefaction due to the groups were derived from trace of plants such as spores, resin, wax and fat. The contents of coal have corelation with the amout of conversion during liquefaction. The more macerals of vitrinite the more conversion got.

Keywords- Low Rank Coal, Warukin Formation, Maceral, Coal Liquefaction

I. INTRODUCTION

The South Kalimantan has abudance of coal. In coal there is organic mater enabling coal can be used as an energy source. The organic contents make coal tradionally have been used to generate heat.Coal is classified based on its composition and transformation level that occurred or formed from plants within long years ago. Much of coal contains organic material. The coal were formed throug hconverting of plants under swamp conditions (aerobic) of peat, then transformed to produce a type of coal known as lignite, sub bituminus, bituminous and anthracite. The organic materialswhich are humic called by maceral normally exist in coal. The macerals are existing with some minerals that can be observed under a special microscope.

The reflected ray microscopy can be used to distinguish macerals based on reflectance of coal morphology. The macerals with same optical properties and chemical composition are categorized into one type of maceral, called by maceral group (Stach et al., 1982). Generally, macerals are divided into three groups such as vitrinite, liptinite and inertitinite. When liptinite and inertinite are exist in brown and hard coal they called in the same name. The liptinite in the low rank coal (brown coal), relatively rich with hydrogen and they have the lowest reflectance where as inertinite relatively rich in the carbon element, they have the highest reflectance (Stach et al., 1982).

In this paper, it will be discussed how the low rank coal can be utilized to get an alternative fuel. The coal in this study was taken from PT. Adaro Indonesia at Warukin Formation within Wara block.The coal sample are containing deposits with punctuated by mudstone and sandstone.

II. GEOLOGY SETTING

The Wara block is located around Barito Basin in Kalimantan island. Darman and Sidi (2000) explain Barito Basin is located along the south eastern border of Kalimantan and Schwaner Mountains in the south (Figure 1). This basin is restricted by Meratus in the east and Adang Fault in the north.

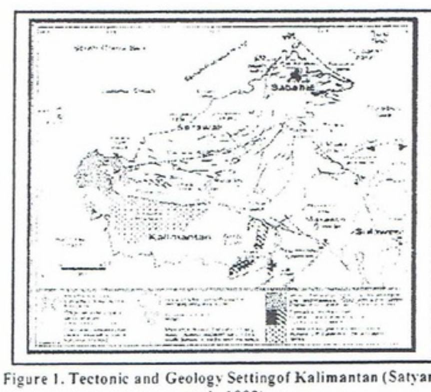

Figure 1. Tectonic and Geology Settingof Kalimantan (Satyana et al., 1999)

Barito basin is asymmetrical, formed in foredeep area on the eastern side and a platform adjacent to Schwaner or Shield of West Kalimantan. Barito Basin have an elongated shape according to the basin direction of northeast-southwest. This form has the same direction as the shape of Meratus bordering in the south eastern. Barito basin began to form basin at the end of the Cretaceous, along with the collision between Paternosfer and South-West Kalimantan Micro continent.

Warukin formation for first time was discovered in the Warukin Village, Tanjung Raya, South Kalimantan Province. The age of Warukin Formation is Miocene to Late Miocene. It is estimated that within Miocene, regression process occurs resulting Barito Basin. The formation was started from the flood plain, overflow, and swamped precipitation then formed Warukin Formation. The observation showed that the formation composed of mudstone, sandstone and inserted coal (Heryanto, 2008). Basically, Warukin Formation consists of three types, from older to old layer, those are:

1. Lower Warukin, consists of marl, limestone, shale, and calcareous shale.
2. Middle Warukin consists of marl, silt, clay and thin sand layer with coal inserted.
3. Upper Warukin consists of coal by the insertion of carbonate clay and sandstone.

III. COAL MACERAL OF LIGNITE

Based on quality parameters, Wara coal at Warukin formation is lignite type. Sampling of the seam was conducted using ply by ply method. Results of analysis on the coal show that the content of maceral in Wara layer consists of maceral groups i.e. vitrinite could reach of 81%, liptinite could reach of 51% and inertinite of 27% (see Table 1).

IV. DISCUSSION

1. Effect of Coal Characteristics

Coal characteristics reflect coal quality therefore the information of the caharacteristics are very helpful in the planning for coal utilization.The study of the maceral composition and mineral are crucial point related to the design of its process system. Coal can be liquefied based on its characteristics which can be seen from the rank, petrographic, and mineral composition. The coal rank is an important information when coal will be liquefied. The rank informs the maximum conversion that could be reached in the liquefaction. Low rank coal are generally composed of small compound of aromatic and they also contain many functional groups which are very reactive and easily to be ruptured during liquefied. The rank of coal is indicated by the content of maceral of vitrinite. When coal observed under x-ray, the vitrinite will show the reflectance.

Coal which is containing vitrinite maceralsof low rank coal can be easily hydrogenated then liquefied, whereas the high rank coal must be procceed through a special process. There is also a type of maceral taking role for liquefaction. The maceralis liptinite which containing more hydrogen. The coal which containing the maceral is easier to be liquefied. Contrary, inertinite in all ranks of coal are not good enough for liquefaction because of the macerals havelow hydrogen content. Low rank coals which have high maceral content such as vitrinite and liptinite contributes to 91% of the organic material content (Marco, et. al, 1990).

All of coal contents mentioned influence the total conversion of coal during liquefaction to get oil product. This has been demonstrated by Tsai (1982) who conducted experiments with many different of coal rank that liquefied at a temperature of 450°C. The results showed that quantitavely, the product of liquefaction on low rank of coals yields more than that produced by high rank of coals.

2. The influence of Maceral and Geochemical on Coal Liquefaction

Actually, the hydrogenation on coal for liquefaction has been known since long time ago. Coal was first converted to liquid by a reaction with hydrogen iodide in an enclosed glass tube (Speight, 1994).

In fact, coal is natural organic compound that containing a little bit of hydrogen. The ratio of hydrogen/carbon (H/C) in coal generally less than 0.8. It is lower compared with a ratio of H/C in crude oil, heavy oil or bitumen which is approximately 1.4 to 1.8. Therefore by addition of hydrogen, coal might be a good raw material to be converted to produce an alternative fuel (Speight, 1994). Because of low ratio of H/C in coal, when liquefaction, the process requires the addition of some hydrogen to produce an alternative fuel. The converting process from coal to alternative oil could be carried out without the addition of hydrogen from outside coal. The hydrogen needed as hydrogen donor could be supplied from organic material in the coal.

It is also known that a catalyst influences the yield of coal liquefaction. Besides, the coal rank indicates how easy a type of coal can be liquefied. However, the information of macerals content is essential as well as the coal rank. The maceral contents have direct corelation with availability of conversion in liquefaction. As an example, vitrinite has an important role in the process of coal liquefaction. On the other hand, fusinite in the inertinite group is a resistance in the hydrogenation regardless the maceral condition. Based on microscopic observation, the residue from the coal liquefaction process has characteristics of fusinite. Theresults of the observation providean evidence that thecoal which is containing fusinite maceral will not good enough for liquefaction.The other macerals group which are containing macerals such as sporinite, resinite and cutinite are also key compounds in the liquefaction. It can be proved that the coal with maceral of micrinite content makes liquefaction easier than the previous macerals.

CONCLUSION

1) The Wara coal consists of maceral group such as vitrinite which could reach of 81%w, liptinite compound of 51%w and 27%w for inertinite compound. The Coal of Warukin also contains types of lignite which is in low rank coals.
2) Coal containing macerals of vitrinite could be liquefied. There is a correlation between the percentage of vitrinite in coal and yield of liquefaction.

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Wara Seam 120 (3)			Wara Seam 120 (4)		
Maceral Group		Total (%)	Maceral Group	Maceral	Total (%)
Vitrinite (%) (61.24)	Telinite		Vitrinite (%) (66.11)	Telinite	
	Vitrodetrinite	47.87		Vitrodetrinite	A
	Corpohuminite	7.56		Corpohuminite	1.33
	Gelinite	5.81		Gelinite	3.32
Liptinite (%) (15.12)	Sporinite	2.33	Liptinite (%) (10.96)	Sporinite	3.16
	Cutinite			Cutinite	
	Resinite	9.69		Resinite	6.48
	Suberinite	3.10		Suberinite	1.33
Inertinite (%) (3.88)	Fusinite	1.71	Inertinite (%) (4.82)	Fusinite	3.32
	Semifusinite	1.55		Semifusinite	1.33
	Funginite	0.58		Funginite	0.17
	Macrinite			Macrinite	
	Micrinite			Micrinite	
Mineral (%) (19.77)	Pyrite	12.79	Mineral (%) (18.11)	Pyrite	14.95
	Others Mineral	6.98		Others Mineral	3.16
Total		100	Total		100
Wara Seam 120 (5)			Wara Seam 120 (6)		
Maceral Group	Maceral	Total (%)	Maceral Group	Maceral	Total (%)
Vitrinite (%) (65.99)	Telinite		Vitrinite (%) (50.09)	Telinite	
	Vitrodetrinite	61.15		Vitrodetrinite	10.37
	Corpohuminite	4.09		Corpohuminite	8.79
	Gelinite	0.74		Gelinite	0.93
Liptinite (%) (19.89)	Sporinite	11.52	Liptinite (%) (22.43)	Sporinite	12.71
	Cutinite	1.49		Cutinite	1.31
	Resinite	4.65		Resinite	8.41
	Suberinite	2.23		Suberinite	

Inertinite (%) (6.32)	Fusinite	6.13	Inertinite (%) (19.44)	Fusinite	8.41
	Semifusinite			Semifusinite	4.11
	Funginite	0.19		Funginite	0.19
	Macrinite			Macrinite	0.37
	Micrinite			Micrinite	6.36
Mineral (%) (7.81)	Pyrite	3.35	Mineral (%) (8.04)	Pyrite	7.10
	Others Mineral	4.46		Others Mineral	0.93
Total		100	Total		100

Wara Seam 120 (7)			Wara Seam 120 (8)		
Maceral Group	Maceral	Total (%)	Maceral Group	Maceral	Total (%)
Vitrinite (%) (50.89)	Telinite		Vitrinite (%) (54.71)	Telinite	
	Vitrodetrinite	46.25		Vitrodetrinite	48.73
	Corpohuminite	3.21		Corpohuminite	3.59
	Gelinite	1.43		Gelinite	2.39
Liptinite (%) (15.00)	Sporinite	6.07	Liptinite (%) (27.35)	Sporinite	1.79
	Cutinite			Kutinite	3.14
	Resinite	7.68		Resinite	13.30
	Suberinite	1.25		Suberinite	9.12
Inertinite (%) (3.75)	Fusinite	2.14	Inertinite (%) (13.30)	Fusinite	0.60
	Semifusinite	0.71		Semifusinite	0.75
	Funginite	0.36		Funginite	7.47
	Macrinite	0.36		Makrinite	0.30
	Micrinite	0.18		Micrinite	4.19
Mineral (%) (30.36)	Pyrite	19.82	Mineral (%) (4.63)	Pyrite	2.84
	Others Mineral	10.54		Others Mineral	1.79
Total		100	Total		100

Wara Seam 120 (9)			Wara Seam 120 (10)		
Maceral Group	Maceral	Total	Maceral Group	Maceral	Total (%)
Vitrinite (%) (65.19)	Telinite		Vitrinite (%) (66.02)	Telinite	
	Vitrodetrinite	55.93		Vitrodetrinite	58.01
	Corpohuminite	4.26		Corpohuminite	1.17
	Gelinite	5.00		Gelinite	6.84
Liptinite (%) (17.41)	Sporinite	8.70	Liptinit (%) (12.70)	Sporinite	2.93
	Cutinite	0.37		Cutinite	1.56
	Resinite	3.15		Resinite	8.20
	Suberinite	5.19		Suberinite	
Inertinite (%) (3.15)	Fusinite		Inertinit (%) (0.79)	Fusinite	
	Semifusinite	1.85		Semifusinite	0.20
	Funginite	0.74		Funginite	0.59
	Macrinite			Macrinite	
	Micrinite	0.56		Micrinite	
Mineral (%) (14.26)	Pyrite	11.30	Mineral (%) (20.51)	Pyrite	10.94
	Others Mineral	2.96		Others Mineral	9.57
Total		100	Total		100

Tables1. Result of Maceral Analysison Wara Coal

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