COAL UPGRADING TECHNOLOGY FOR INDONESIAN LIGNITE

Lambok H. Silalahi 1), Tetsuya Deguchi 2), Eiichiro Makino 3)
1) Agency for the Assessment and Application of Technology, Indonesia
2) Takasago Coal Liquefaction Center, Kobe Steel, Ltd. 3) Sojitz Corporation

Abstract
Langkah strategis untuk promosi aplikasi teknologi upgrading lignit di Indonesia telah menjadi bahasan. Tulisan ini memberikan pemikiran dan pertimbangan cara-acara proosi teknologi yang sedang dalam proses komersialisasi. Perubahan secara drastis suplai dan demand energi diseluruh dunia telah mendorong Indonesia untuk mengkaji kebijakan berjalan untuk mengantisipasi perubahan di tahun-tahun mendatang. Salah satu perubahan yang mendasar adalah meningkatnya demand batubara, selama batubara masih dinilai sebagai bahan bakar yang paling ekonomis dibandingkan sumber energi lainnya, meskipun harga batubara masih cukup tinggi mengikuti harga bahan bakar minyak. Oleh karena batubara merupakan potensi terbesar di dalam negeri, perubahan yang sangat mendasar kebijakan energi, khususnya menyangkut pendayagunaan batubara peringkat rendah menjadi sangat penting mengingat hampir 70% dari total cadangan batubara sebesar 57,8 miliar ton merupakan batubara peringkat rendah. Indonesia telah menaikkan volume ekspor batubara per tahun meskipun terjadi krisis ekonomi baru-baru ini. Kebutuhan domestik batubara masih bersifat flat disebabkan krisis ekonomi. Diprediksi demand akan meningkat karena subsidi bahan bakar minyak secara bertahap akan dihapuskan dan batubara merupakan energy alternative. Mengingat situasi tersebut usaha promosi teknologi upgrading batubara sudah seharusnya dipercepat. Untuk itu diperlukan seleksi teknologi yang berpegang efektivitas biaya, ramah lingkungan dan menghasilkan produk batubara dengan nilai kalor tinggi dan tidak mudah terbakar. Hasil pengoperasian pilot plant 5 ton per hari yang terdapat di Palimanan, Cirebon, Jawa Barat yang merupakan proyek kerjasama Indonesia dengan Jepang, untuk konfirmasi kinerja enjiniring pada proses yang kontinyu juga menjadi topik bahasan dalam tulisan ini.

Keywords: coal upgrading technology, upgrading brown coal, pilot plant, low rank coal, Cirebon

1. BACKGROUND
Recently it has been found that energy resources, particularly fossil energy, is rather scarce. This is due to the high demand of oil, gas and coal in China and several Asian countries. Moreover, the natural disaster that occurred in several countries such USA, made the production of oil and gas reduced significantly. To make the things worst, the closing of several underground coal mining in China due to mining accidents has remarkably reduced the production of coal in China making them to import from overseas. These situations have created a significant increase of energy production, especially coal, to meet the high demand all over the world.

Under this situation, Indonesia has to find ways to maximize the energy utilization in the country, because the domestic energy demand continues to grow every year. So far, oil and gas has benefited the country by largely exploiting it for export in order to gain the foreign exchange revenues. Besides that, coal has also contributed greater role for national revenue in recent years reaching 140 million tons production in 2005.

Nowadays, this coal resource has played an important role for domestic energy supply. Undoubtedly, coal will take a greater role in meeting the increasing energy demand in Indonesia to obtain an optimal energy mix in the country. Electric power is the largest consumer of coal and expected to grow substantially in the near future due to current shortage of electricity.

Indonesia’s coal resources are estimated at around 57.8 billion tons [1], mostly located in South Sumatra and East Kalimantan. Unfortunately almost 65% of the resources are categorized as Low Rank Coal (LRC) such as lignite or brown coal. Actually, the government
policy on energy encourages the use of lignite for domestic use.

However, due to its high moisture content and low heat value, this type of coal cannot be economically transported over long distances. Therefore, much efforts have been made to utilize the low rank coal so it can contribute a great share of the national energy mix of Indonesia. To this end a series of studies have been carried out during the few years, the results of which indicate that LRC could be utilized in the following manner:

1) Direct Use
Coal for Generating Electricity (mine mouth power plant) is an effective utilization to reduce the coal transportation hence coal cost itself. For this purpose power transmission system should be more improved and new lines to the coal mining area is encouraged. Beside this, coal as a direct fuel for Small Industries (lime burning, tile, brick burning, etc) is good to reduce the use of kerosene and diesel fuel which consequently reduce the production cost.

2) Indirect Use
a) Coal Liquefaction
By using proper liquefaction process technology, LRC is converted to a liquid fuel that can be used for vehicles, industries and other purposes. A study to construct a plant on coastal coal mining has been made that shows remarkably feasible compared with inland plant site. Since liquefaction plant requires a massive amount of coal resources, it is a must to select a location with huge deposit of coal.

b) Coal Gasification
Through gasification technology, low rank coal can be converted to synthetic gas (Mixture of Carbon Monoxide and Hydrogen) that can be used as a raw material to produce ammonia methanol, liquid hydrocarbons (FT fuels).

c) Upgraded Low Rank Coal
With the assistance of Japanese Government through Kobe Steel Ltd, a study to improve LRC using Upgraded Brown Coal (UBC) technology has been carried out since 1999. The result shows that Indonesian Low Rank Coal has the great potential to be upgraded so as to become commercial commodity. Further studies will be done in 2003 through technological optimization towards commercial possibilities.

2 SELECTION OF COAL UPGRADING TECHNOLOGIES
There are several criteria of selecting a suitable process to indigenous coal and cost effective while environmentally friendly.

1) Effective Dewatering, water removal with very lowest energy consumption.
2) Stabilizing the treated product, little possibility of reabsorbing the moisture from outside.
3) Low poluted waste water, no involvement of organic compound from the treated coal to the water.
4) Binderless, Since the treated coal is produced in powder and should be briquetted, desirably no binder is added to make it more economical.

Figure 1 shows state of the art of upgrading technology developed world-wide. As can be seen in Figure 1, the UBC process has advantageous in that, the reaction condition is mild, low pressure and temperature. This means that the cost for the equipment of the process is relatively easy to manufacture and inexpensive. The heat transfer between liquid and solid in slurry dewatering is better than gas to solid in other process, will surely make the UBC process is attractive in terms of energy efficiency. Moreover, the use of asphalt with high molecular heavy oil could prevent the treated coal to reabsorb moisture and remains stable from the tendency of spontaneous combustion. In order to optimize the use of energy, it is possible to reuse the latent heat of the steam from the pre-heater.
3 CURRENT STATUS OF UP GRADING BROWN COAL (UBC) DEVELOPMENT

3.1. UBC Demonstration Process

3.1.1. Process Concept
UBC process is designed to upgrade low rank coal (lignite and brown coal) by removing moisture trapped in the coal porous structure, and suppress the self-ignition nature. In general, low rank coals contain much water and they are easy to ignite by itself, so it is difficult to handle it for long distance transportation and stockpiling. By way of UBC technology it can upgrade the coal through the following steps.

a. De-watering by media of heating oil,
b. Stabilizing through the high molecular oil adsorption, and
c. Briquetting, if required for transportation.

UBC demonstration plant with the capacity of 3ton/day-D.B.is under construction and planned was commissioned in October 2003. The plant was constructed in Palimanan, Cirebon in Indonesia under the collaboration between Ministry of Energy and Mineral Resources of Indonesia and Japan Coal and Energy Center (JCOAL) of Japan.

3.1.2. UBC Process Description
The process flow is shown in Fig 2. The upgrading brown coal UBC process consists of the following unit operations:
- Mix raw coal with heating oil to make slurry
- Heat the slurry to remove the moisture and stabilize coal by asphalt addition
- Separate dewatered UBC and recycle oil
- Make briquette coal for transportation, if the market is distant.

As shown in Figure 3, the process condition of each unit are mild with temperature less than 200 C. The recycle oil used is of kerosine fraction with phisycal capability to transfer heat to molecul and to dilute the asphalt for homogenous diffusion to coal particles. This upgrading system is unique in terms of mild process condition and solvent media heating.

4. FUTURE PROSPECT
As mentioned above, Indonesian government is very keen to introduce and apply any technology which can utilize the vast brown coal resources in the country to a maximum level. The UBC technology offers all the requirement and criteria for the implementation of it in near future. As the technological development has come to a demonstration stage, it is expected that the first commercial plant can be constructed very soon.

The pioneer plant is planned to be constructed in Kalimantan. It is desirable that the first commercial plant is also close to the demonstration plant, using the same coal as feedstock. This commercial plant would be followed by the next unit if the demand for this UBC product increase. However, once the first plant is successfully operated, it is predicted that the similar plants might be constructed almost simultaneously in other coal concession not only in Kalimantan but also in Sumatra island. Especially in Sumatra, since the demand for electricity continued to grow every year, the integration of UBC and coal-fired power plant seems to be the right option to be implemented. Since based on the preliminary study, the cost of
power generation has a competitive price compared with other fuels.

5. THE ROAD MAP OF UBC TECHNOLOGY IMPLEMENTATION

A draft of Road map of UBC technology has been proposed. UBC research and development with larger plant has been started since 2001, under joint collaboration between JCOAL, Japan and MEMR, Indonesia. This development will be continued until the construction of commercial scale, in 2010. The development schedule of UBC is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
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<tbody>
<tr>
<td>2006</td>
<td>UBC Demonstration Plant Development in Kalimantan</td>
</tr>
<tr>
<td>2010</td>
<td>Commercial Plant Construction in Kalimantan and UBC integrated with Power Plant in Sumatra.</td>
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The UBC integrated power plant is planned to be constructed in Sumatra in view of high power demand increase in Sumatra and Java. Moreover, if the submarine power cable connecting Java and Sumatras system is introduced, more and more mine mouth power plant might be constructed in Sumatra, including integrated UBC power plant. A study of integrated UBC and mine mouth power plant has already been conducted, which shows a promising results with less power tariff 4.2 cents per kWh, reduce the CO2 up to 13% and save the coal resources significantly. [2]

6. STRATEGIC STEPS AND CONSIDERATION TOWARD COMMERCIALIZATION

The implementation of UBC technology in Indonesia should have a great contribution not only for the larger utilization of vast brown coal resources but also for the revitalization of the power and other industries. Since the energy supply industry has a strategical function which would directly provide a great contribution for the economy recovery. Under this circumstances, any possible support and attention should be paid by the government to the successful implementation of UBC technology. Actually domestic companies, especially coal companies have shown their great interest to the UBC technology and expecting the acceleration of commercialization. As the world demand for coal has risen to a highest point, many coal players have shown enthusiastic interest for the technology to start. The consideration which expected to be given by the government are as follow.

4.1. Incentives and Tax exemption

Some incentives for a newly applied technology are commonly provided until the project shows a good profit. Some incentives which possibly be given are: taxes of imported equipment used for the construction, corporate tax and so forth. Moreover, special cares should be provided for all procedures required before and during the plant construction. Currently the importer tax of equipment is 10% of the total value and corporate tax is 30 of the total sales.

4.2. Reducing the royalty for low rank coal

Currently the royalty for any grade of coal is treated the same, imposing 13.5% of the total produced coal. Some considers that it is not fair to impose such the same royalty to all coal company whose coal concession not favourably good, such as bad infrastructure, high stripping ratio, low quality of coal and far from coast. The fair treatment based on careful evaluation should be made in order to encourage more coal production, especially for maximum utilization of brown coal resources. The cut down of the royalty had already been discussed previously, down to 5-6%, however there has no concrete planning of implementing this measure.

4.3. Improvement of Infrastructure

The improvement of transportation infrastructure for coal should be more encouraged in order to invite the minig investors, hence to increase the coal production. Transportation in Kalimantan for example, are now mainly using waterway, by barge before loading to a large ship. However, due to the sedimentation in the river, sometimes it is difficult to access with barge farther inland unless dredging work is conducted periodically. This kind of operation would require a great deal of budget allocation. In order to increase the coal production, such work together with necessary budget should be burn by the local government. In land transportation which mainly using trucks, made. Moreover, other utilities such as electricity, industrial water and necessary public service such as housing, medical center and telecomunication availability should be provided.

VII. CONCLUSION

UBC process has been so attractive compared with other processes with several features such as effective dewatering with high efficiency,
relatively clean waste water, stabilized product and binderless briquette.

After finishing the operation of pilot plant in Palimanan, Cirebon the next target is to construct and operate a (pioneer) semi commercial plant in Kalimantan, with capacity 500 – 700 ton/day. The successful of operating the demo plant or pioneer plant would be followed with construction of commercial plant with larger size. The similar plants might also be constructed in other coal mines almost simultaneously, if the demand for coal and UBC continues to rise in the future.

The government could play a great role to the success implementation of this technology by providing necessary incentives and tax exemption as well as improving the surrounding infrastructure.

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