INDONESIAN LOW RANK COAL RESOURCES TO WHICH UBC TECHNOLOGY IS COMMERCIALLY APPLICABLE

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ABSTRACT

Low rank coal (LRC) that constitutes more than 65% of the national coal resources has to be utilized optimally in order to achieve the security of domestic energy supply and an optimum mix of primary energy consumption by the year 2025. The LRC can be upgraded to higher rank coal, both for export and domestic use, particularly for existing industries. Upgraded Brown Coal (UBC) process is one of the best upgrading technologies that can be implemented. Moreover, the low cost production of LRC and the availability of infrastructures would be the more attractive for UBC commercialization. Based on the coal quality specification recommended in this paper, the total moisture of the LRC varies from 25.33 to 57.89% (typical 35 - 40%, as received/ar) and its calorific value ranges from 2,504 to 4,900 kcal/kg (typical 3,000 - 4,000 kcal/kg, ar). The ash content of the recommended LRC is less than 10% (typical <5%, dry basis/db) and the sulphur content is typical <0.5% (db). The LRC located in East and South Kalimantan is more attractive for UBC commercialization compared to LRC located in South Sumatera. Most of the LRC in South Sumatera is located far inland that makes the transportation cost for UBC equipment and product become expensive.

Keywords: low rank coal, upgraded brown coal, coal quality, utilization

1. INTRODUCTION

Coal has a potential to be a major future primary energy source in Indonesia, for both domestic use and export market due to its large resource base, easy and low cost of exploitation, good quality and supported by appropriate infrastructure, particularly in Kalimantan. The coal resources are estimated at 61.3 billion tons, mostly located in Sumatera and Kalimantan as shown in Figure 1 (Centre of Geology Resources, 2006). The measured quantity amounts to 10.4 billion tons of which mineable reserves are about 7.0 billion tons. The indicated resources are 12.7 billion tons and the inferred resources amount to 41.6 billion tons.

The coal resources are classified mostly as lignite (58.7%) and the rest are subbituminous (26.7%), bituminous (14.3%) and anthracite (0.3%) as shown in Figure 1. In this paper, coal of lignite and subbituminous “C” rank (categorized by ASTM), is classified as LRC.

There are three groups of coal producers in Indonesia based on types of permit as follows:

1) state-owned coal company;
2) coal contract of work (CCoW) contracting companies (first, second and third generations);
3) mining authorization (KP) holders (including KP for Cooperative).

The majority of Indonesia’s coal resources (about 70%) are LRC with high moisture contents. This LRC basically is still under-utilized. Most of the coal that currently exploited is high rank coal. However, the reserves of these high rank coals are depleted and become more expensive to exploit. Accordingly, the future production will inevitably move towards LRC.

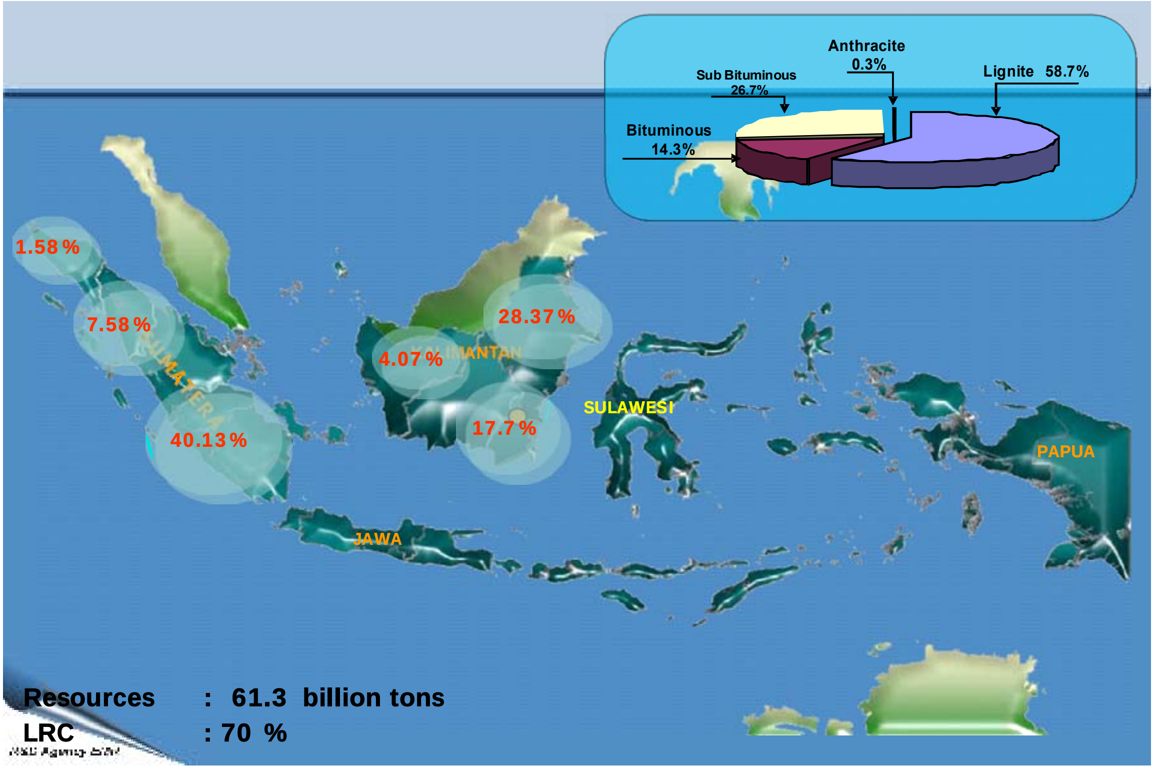

Figure 1. **Distribution of coal resources in Indonesia (Centre of Geology resources, 2006)**

In the near future, the Indonesian Government will encourage using the LRC as the main source of energy in the national energy mixed policy that is about 33% in 2025 as stated in Presidential Decree number 5/2006. In that sense, the government encourages to use more coal domestically, while maintaining the export level. By applying the advanced technologies, for instance UBC, the utilization of LRC can be optimalized. This paper intends to review the Indonesian LRC resources to which UBC technology is commercially applicable.

2. CONDITION OF LRC

LRC of Indonesia is characterized by high total moisture (20 - 50%, as received/ar), low calorific value (<5,000 kcal/kg, ar), high volatile matter (30 - 60%, ar), low thermal efficiency, low ash melting temperature and high tendency for spontaneous combustion. In addition, the LRC contains high level of inorganic, which has a potential to produce large number of sticky particle during combustion in the furnace. The LRC is also high reactive under low-temperature oxidizing condition (Fierro *et al*., 1999). However, in terms of ash and sulphur contents, most of the Indonesian LRC has good quality in which ash and sulphur contents are <10% (average of 5%, dry basis/db) and <1% (average of 0.4%, db), respectively. Due to those properties, the LRC should be utilized close to mining site or upgraded to reduce the moisture content.

The LRC seam is normally homogenous with the thickness from few cm up to 30 m and the dip of normally less than 10°. Most of the LRC occurs closed to the surface that makes this coal cheap to exploit. The production cost of LRC is relatively low since the location of LRC's deposits is generally accessible. In addition, the LRC is not only attractive from cost perspective, but also particularly attractive from a total value-in-use when it is upgraded and converted to clean fuel that can be used for all practical purposes of industries, transportation and household.

Coal upgrading, a process to convert LRC to dry upgraded coal that is comparable with a bituminous coal offers one of the best solution of LRC utilization. The benefit of LRC upgrading includes increasing its value, both for export and domestic markets and stabilizing coal quality feed for the existing power generation and other industries. Upgrading of LRC depends on many factors including technology, coal characteristics, market, economics, environment, policy and strategic issues being prime.

Several upgrading technologies have been introduced in many countries (Suwono and Hamdani, 1999; Mahidin *et al*., 2002), however UBC process which was originally developed by Kobe Steel Ltd. of Japan as a pre-treatment for brown coal liquefaction process is one of the most advanced solutions of upgrading, due to its relatively simple and mild processes, indicated by its lower pressure and temperature (Shigehisa *et al.,* 2000; Daulay *et al.,* 2005).

Indonesia under cooperation with JCOAL of Japan has successfully developed the UBC process to upgrade LRC into high rank coal of 6,800 kcal/kg (adb), mostly through moisture content reduction technique. By the development of UBC process, LRC can be utilized in the future in a manner similar to current uses of high rank coal. The UBC product can be used directly or converted into gas or liquid that cleaner to the environment and much easier to be handled in transportation and utilization. The cost of the process is estimated about US$ 7 per ton of product.

3. PREFERABLE CONDITION

In order to make the programme of UBC is attractive for commercialization, Table 1 shows the preferable condition of LRC. Moisture, ash and sulphur contents are the most important parameter for quality consideration. Mineable reserve of the LRC is preferable more than 50 million tons in each location and the location is near the water front, with hauling road is assumed less than 100 km.

4. RESULTS AND EVALUATION

Based on the criteria of preferable LRC condition for UBC commercialization as shown in Table 1, there are at least nineteen locations of LRC that can be identified (Figure 2). They are one location in Central Sumatera (Riau Province), nine locations in South Sumatera, five locations in South Kalimantan and four locations in East Kalimantan. However, in some locations (for instance: Banjarsari, North Suban Jeriji, West Banko, Benuang and Sigoyang, Musibanyuasin, Punan and Kelai) there is one parameter/item does not fit with the criteria.

The locations of LRC that match with the parameters shown in Table 1 are estimated to about 50% of the total Indonesian LRC and mostly located in South Sumatera, East Kalimantan and South Kalimantan Provinces.

Table 2 shows the summary of LRC quality that recommended for UBC commercialization. Mineable reserve varies between 50 million and 846 million tons, and the stripping ratio ranges from 1.85 to 4. In this condition, it is expected to have low price of LRC and automatically the cost of UBC process will also be lower compared to the other LRC.

Table 1. Preferable condition for UBC commercialization

Number	Items	Specification
1	Quality	
1.1	Moisture content	25 - 50%: wet base as received (ar)
1.2	Calorie value	3,000 - 5,000 kcal/kg gross as received
1.3	Total Sulphur	Less than 1% as dry basis (db)
1.4	Ash	Less than 5% as dry basis (db)
2	Quantity	
2.1	Mineable resources	More than 50 million tons as mineable
3	Mining condition	
3.1	Stripping ratio	Less than 4
3.2	Location	Near the water front (assumed hauling road is less than 100 km)

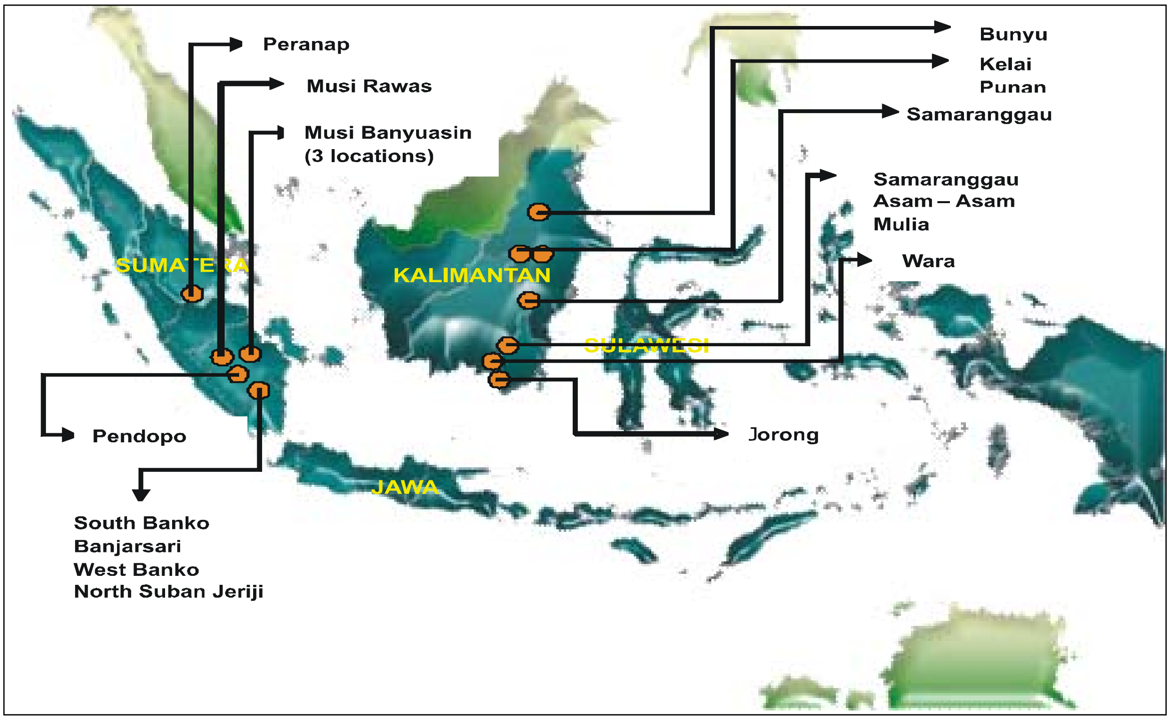

Figure 2. Location map of LRC deposit

Table 2. Summary of LRC quality

No	Location	Mineable Reserve, M tons	Stripping Ratio	Quality				
				Total Moisture % ar	Ash % db	Total Sulphur % db	Calorific Value Kcal/kg ar	HGI
	Central Sumatera							
1	Peranap	569.07	4	44.60 - 49.30	1.98 - 5.12	0.15 - 0.27	3123 - 3232	38 - 66
	South Sumatera							
2	South Banko	273.41	3	25.32	3.64	0.34	4900	55 - 65
3	Banjarsari	312*	3	38.05	1.94	0.19	3933	47
4	West Banko	171.32	3.5	27.31	6.43*	0.49	4876	46
5	North Suban Jeriji	502.23*	3	42.77	4.06	0.12	3574	47
6	Benuang and Sigoyang	327.7	2	55.00	8.10*	0.40	2675 - 3144	60 - 95
7	Musi Rawas	566.00	5	40.42	3.12	0.17	3867	53
8	Musi Banyuasin	265.00	1.85	45.90 - 48.70	3.09 - 5.00	0.42	3662	60
9	Musi Banyuasin	65.80	2	51.65	5.40*	0.33	2635	60
10	Musi Banyuasin	125.00	4	57.89	6.27*	0.28	2504	68 - 91
	South Kalimantan							
11	Wara	846.00	3.25	40.00 - 45.00	2.50 - 3.30	0.23	3940 - 3578	41 - 55
12	Sarongga	126.00	3	43.00	3.00	0.08	3447 - 3774	65 - 70
13	Asam-Asam	50.14	2.37	34.00 - 38.50	1.40 - 4.60	0.17	3506 - 3977	65
14	Mulia	53.09	2	34.10 - 38.80	2.10 - 4.20	0.20	3924 - 4333	65
15	Jorong	66.108	2.35	32.28	3.80	0.25	4418	47
	East Kalimantan							
16	Samarangau	326.00	-	35.00	4.00	0.20	3682	53
17	Bunyu	90.50	3	37.87	3.98	0.32	3533	43
18	Punan	41.06*	-	38.20 - 42.30	0.60 - 4.10	0.13 - 1.21	3680 - 4153	-
19	Kelai	709.07*	-	46.50	0.40 - 8.20	0.12 - 2.58	3426	-

**does not fit with the preferable condition for UBC commercialization*

Content

The calorific value of LRC ranges between 2,504 and 4,900 kcal/kg (ar) (typical 3,000 - 4,000 kcal/ kg, ar) with the total moisture varies from 25.33 to 57.89% (typical 35 - 40%, ar). Figure 3 shows the relationship between total moisture and calorific value of the LRC.

The ash content of the LRC varies from 1.94 to 5.00% (db) and the sulphur content is typically <0.5% (db), except for few locations in East Kalimantan, the sulphur content is up to 2.5%. Hardgrove grindability index (HGI) of the LRC ranges between 38 and 95 with the typical of 45 - 60.

The locations of LRC in East Kalimantan and South Kalimantan are mostly closed to the access of shipping, ranging from 10 to 100 km. On the contrary, the locations of LRC in South Sumatera are mostly far inland; the access of shipping is normally more than 100 km as shown in Figure 4. Therefore, the LRC of East Kalimantan and South Kalimantan is more attractive for UBC commercialization compared to LRC of South Sumatera.

Feasibility study of most of the LRC has been completed since the year of 2000, however, due to limitation of markets, the exploitation of the LRC is not well developed. Only few LRC, for instance Asam–Asam, Mulia and Jorong have been exploited and mostly used for domestic market (mainly for power plant) or used as blending material with higher rank coal.

5. CONCLUSIONS

LRC occurs in many places in the islands of Sumatera and Kalimantan with varying quantity and quality in each location. However, based on the preferable condition for UBC commercialization, only nineteen locations of LRC can be identified, although in few locations, one parameter does not fit with the criteria. The status of the LRC ranges from detailed exploration up to exploitation stages. It is expected that LRC can be upgraded using UBC process into coal of high calorific value and low moisture content that will be best suited for domestic and export markets. The condition of LRC in East Kalimantan and South Kalimantan (normally near the water front) is more attractive for UBC commercialization compared ton LRC in South Sumatera, although the quality of both coals are normally equal.

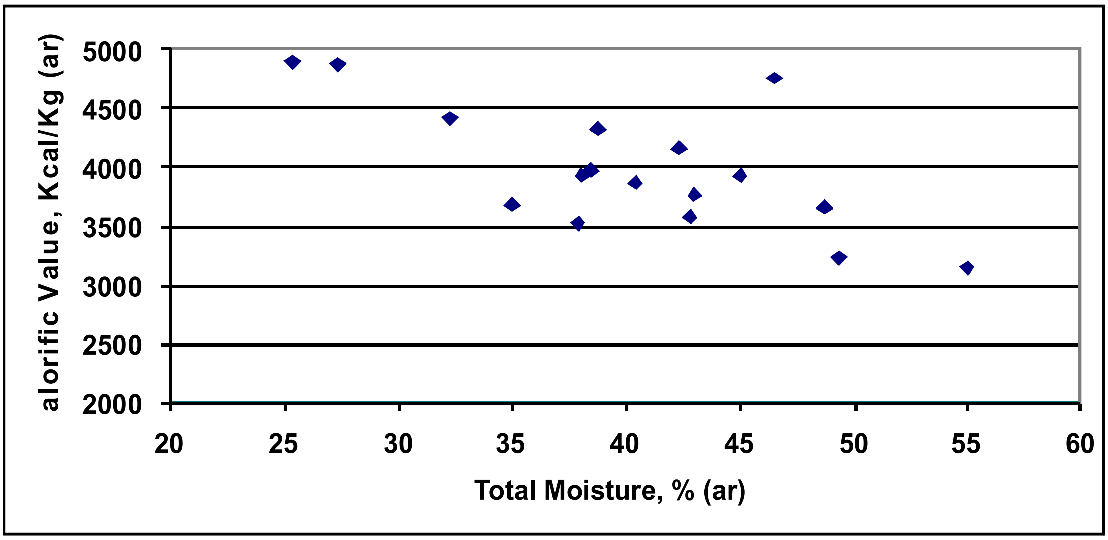

Figure 3. Relationship between total moisture and calorific value

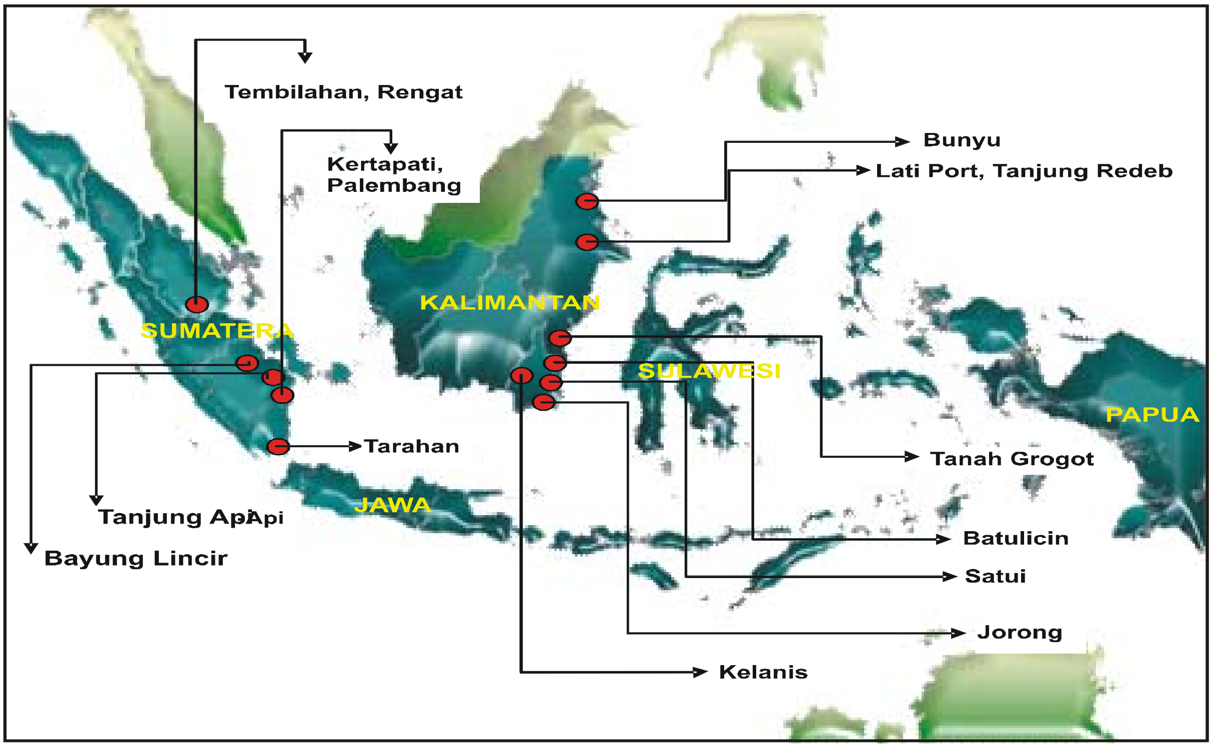

Figure 4. Location map of coal shipment

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