Prospects for UBC (upgraded brown coal) technology

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Abstract:
Utilization of low rank coal has been limited so far, due to its high moisture content, low calorific value and spontaneous combustibility. Some lignite has the feature of low sulfur and low ash content. Therefore, it can be turned into an attractive fuel coal, if it is upgraded, using an economical dewatering method. Kobe Steel has been developing upgraded brown coal (UBC) technology since 1980s. By applying the UBC technology for high-moisture coal (total moisture 50wt% or more), it is possible to obtain product moisture 0wt%. It may also be applied to the dehydration of biomass waste Kobe Steel was promoting a UBC demonstration plant (600tons-UBC/day) project, it was completed successfully, and this technology is now ready for commercialization. UBC process and the method for utilization of UBC products are introduced in this paper.

Keywords: *UBC; Lignite; Dewatering; Power Generation Efficiency*

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1. Introduction

According to the United States Department of Energy's projection in 2011, the world's coal demand is expected to exceed 8 billion ton per year in 2035, which is more than 2 billion ton per year higher than today. Most of the increase comes from Asia. In addition, World Energy Council Data in 2010 indicates, high quality coal accounts for only a half of the world minable coal reserve.

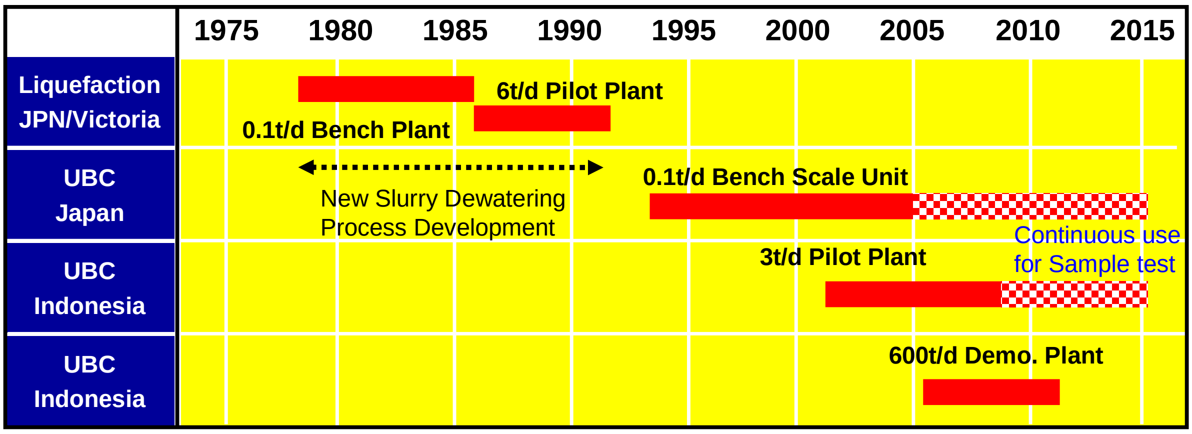
Under these circumstances, if lignite can be used, we also can take advantage of the characteristics of lignite, such as low sulfur and low ash content, lower mining cost, which we often see in lignite reserves. Therefore, upgrading of lignite can be an economical option to seek after, if there is a suitable technology.

Kobe Steel invented UBC process to turn lignite to high calorie fuel like high quality coal.

2. History of Development of UBC Process

Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described. If equations are used, they should be referred to in the text.

Table 1 the history of R&D efforts



3. Feature of UBC Process
It is a technology which efficiently upgrades lignite of high moisture content to high calorific value coal by removing moisture COMPLETELY with unique Coal - Oil Slurry Dewatering technology. Fig. 1 shows the process flow of UBC Process.

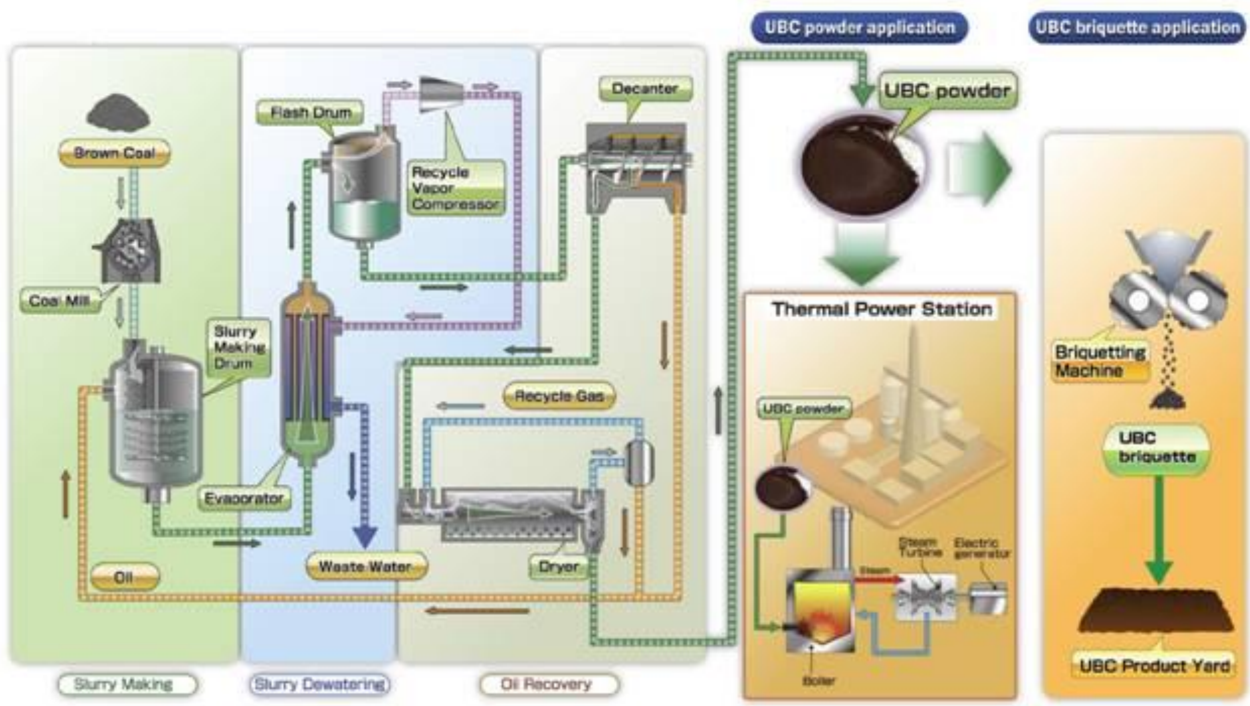


Fig. 1 Process flow of UBC Process

The UBC Process is described as follows;

First, the lignite is pulverized in the Coal Mill. Then, it is mixed with light oil in the Slurry Making Drum. The slurry is sent to the Evaporation unit, where it is steam-heated to about 150°C, and the water contained in the lignite is removed. In the Flash Drum, the water vapor is separated from the lignite. The vapor is sent to a compressor so that the latent heat can be recovered and used as a heat source for the Evaporation unit, thereby reducing energy consumption.

The coal and oil slurry goes to the Decanter centrifuge for separation, and the oil recovered is sent back to the Slurry Making Drum.

In the Dryer, the coal - oil cake is steam-heated for further separation of the oil. The oil contained in the cake is reduced to 0.5%. The oil recovered from the Dryer is also returned to the Slurry Making Drum.

The UBC product, which is in the form of powder, is then zero (0) % moisture content and therefore the calorific value is upgraded to its maximum level.

3. The method for utilization of UBC product
UBC product can be in two forms (Briquette or Powder) depending on user requirements.

<Briquette type>
If UBC product needs to be transported for long distance, it is made into briquette by roller press. Because it will be exposed to atmosphere during transportation and open storage, the product reabsorbs the water from atmosphere, then; moisture content will become approximately 8% which

is the equilibrium point of hydrophobic UBC product.

<Powder type>
If UBC product is to be used at the power station next to UBC plant, it does not have to be briquetted, so, it remains powder and is a good fuel for pulverized coal fired boiler without need of further pulverization. Other big advantage is that UBC powder can keep zero moisture. Because it does not have to be transported long distances or stored long time, it will not be exposed to atmosphere. So, there will be no water re-absorption.

4. Transportation test and Burning test

UBC product has been transported by ship from Indonesia to Japan in the same manner as ordinary coal, and burned at three different power stations, once at our own steel works and twice at third parties' power stations. Through these test burning, good combustibility was confirmed.

Further, boiler test was conducted recently at a testing facility of boiler manufacturer to collect data for designing UBC-fired ultra-super critical (USC) boiler.

5. Advantages of the UBC + USC integrated plant

Most of the lignite based power generating facilities in the world such as Australia, Germany, Poland, etc. has the same range of lower efficiency due to its higher moisture content of the lignite.

The advantages of the UBC based mine mouth power generation are as below.
(1) Zero moisture UBC can be used.
(2) Integration of UBC plant and Power plant eliminate costly facilities.
(3) High energy efficiency power plant (such as USC) without special design can be utilized.

Table 2 shows the comparison of power generation efficiency between Lignite-fired power generation and UBC based power generation. In order to evaluate contribution by each of UBC process and USC, a case where UBC product is fed to conventional Sub-Critical boiler is also provided.

Table 2 Efficiency Improvement from Conventional Lignite-fired Power Plant

		Power Generation Efficiency <Sending End, HHV basis>	Improvement from Conventional	Remarks
Conventional Power Generation				
	Lignite-fired Sub-Critical Plant	29.2%	NA	Data from operating plant
UBC based Power Generation				
①	Integrated UBC-fired Sub-Critical Plant	32.6%	11.8%	Energy used for UBC plant is deducted
②	Integrated UBC-fired Ultra Super Critical Plant	34.5% (40.9%: LHV basis)	18.2%	Energy used for UBC plant is deducted
③	Non Integrated UBC-fired Ultra Super Critical Plant	40.6% (42.7%: LHV basis)	39.4%	Energy used for UBC plant is not deducted

* Lignite: TM52%, 2,830kcal/kg, UBC Powder: TM0%, 5,900kcal/kg.

The third column shows that the introduction of UBC facility to Sub-Critical boiler will bring about 12% of improvement compared to Lignite-fired Sub-Critical Plant.

The fourth column shows that the introduction of UBC facility to USC boiler will bring about 18% of improvement compared to Lignite-fired Sub-Critical Plant. This shows that out of the total 18% improvement, approx. 12% is contributed from the UBC technology and the rest of approx. 6% is contributed from the USC boiler. As such, UBC based power generation realizes high energy efficiency and therefore low CO_2 emission.

6. Conclusion

UBC technology is ready for commercial use. UBC product can be two kinds of applications, one is UBC briquette for transportation, and the other is UBC powder for UBC based power generation. UBC technology improves energy efficiency of power generation compared with Lignite-fired Boiler.

7. Acknowledgement

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