Commercialization of UBC® Process

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Agenda

- Company Profile
- Kobe Steel’s approach to low-quality natural resources utilization
- UBC Process
- Commercialization of UBC
Company Profile

- Kobe Steel is known as KOBELCO
  - A steel, aluminum, copper and machinery producer as well as engineering company and coal-based power supplier (1400MW)

- Now focusing on low-grade natural resource utilization
  - UBC Process
  - New ironmaking technology (pellet feed + steaming coal)
Kobe Steel’s approach to utilize low-quality natural resources

<Iron-making>
- Pellet utilization in BF instead of lump ore 1966~
- Pulverized coal injection to BF 1980~
- FASTMET direct reduced ironmaking 1992~
- ITmk3 iron nugget making 1994~

<Energy industry>
- Coal liquefaction in China 1939-1944
- Coal liquefaction in Australia 1981-1993
- UBC process development 1990~
- Hyper Coal process development 1999~
Coal Liquefaction

H/C ratio: 0.8

Catalyst Hydrogen

H/C ratio: 1.5~2

Kerosene

Gas-oil

Gasoline

Coal is hydrocracked & hydrogenated at high temperature and pressure to obtain liquid fuel.

’81 ~: After the 2nd oil crisis, Brown Coal Liquefaction (BCL) project was started in Australia & Japan.
(AC, 0.1t/d PDU, 50t/d Pilot Plant Operation)

’93 ~: Follow-up Studies in Japan
(AC, 0.1t/d BSU Operation)

’99 ~: Indonesian BCL Feasibility Study

’04 ~: Follow-up Studies on Indonesian BCL

’08 ~: US PRB Coal Liquefaction Project

50t/d PP (Morwell, Australia)
Hyper-Coal (HPC) Process

1. Solvent recycled
2. No hydrogen used
3. Low temperature, low pressure

HPC process:
- Slurry Making
- Solvent extraction
- Solid-Liquid separation
- Solvent recovery

HPC:
- Excellent thermal plasticity
- Additive of coke for blast furnace

COAL + HPC

High Strength Coke

Iron ore Coke

Coke Oven

tuyere
hot blast
molten iron
slag

Residue RC

Extracted Coal HPC

Over flow

Under flow

Settler
UBC Process

• Basic Concept
• R&D Project in Indonesia
• Process Description
• Commercialization
Basic Concept of UBC

Turn Un-utilized Low Quality Lignite into High-Value Energy Resource
Lignite & UBC spec.

<table>
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<th></th>
<th>Type A</th>
<th>Type B</th>
<th>Type C</th>
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<tbody>
<tr>
<td>Moisture wt% ar</td>
<td>33.6</td>
<td>&lt;10</td>
<td>34.0</td>
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<tr>
<td>Heating Value kcal/kg</td>
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<td>6,380</td>
<td>4,200</td>
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<td>Ash wt% db</td>
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<td>2.7</td>
<td>4.6</td>
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<tr>
<td>Volatile Matter wt% db</td>
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<td>52.5</td>
<td>48.5</td>
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<td>Fixed Carbon wt% db</td>
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<td>44.8</td>
<td>46.9</td>
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<tr>
<td>Sulfur wt% db</td>
<td>0.48</td>
<td>0.49</td>
<td>0.17</td>
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</table>
-Upgrading the Future-

Typical Size of Briquette

30mm

35mm

47mm
Demonstration Project

- Capacity: 600 t/day on product basis (1,000 t/day on feed coal basis)
- Location: Satui, South Kalimantan
- Coal run: from December 2008 to May 2011
- Raw coal: Arutmin Ecocoal (TM=35%)
R&D Project Structure

<Japan – Indonesia GG–based R&D Project>

Japan

- METI
  Ministry of Economic Trade and Industry

- JCOAL
  Japan Coal Energy Center

Indonesia

- MEMR
  Ministry of Energy and Mineral Resources

- PT Bumi Resources

- PT Arutmin

Strong Support

Participate as assigned entity
Demonstration Plant
Results of R&D Project

- Development of the UBC Process was successfully completed.
- Combustion and transportation tests were successfully conducted.
- Scaled up information was collected.
- Capital and operation cost data were collected.
- Several research subjects were found and studies are underway.
Towards Commercialization
Commercialization Concept

Lignite

<Disadvantages>
- Low CV
- Spontaneous combustion

<Advantages>
- Widely spread in the world
- Huge reserve
- Cheap mining cost

Technology (UBC)

- Increase CV
- Stabilize

Stable Energy Source

- Stable Supply
- Stable Cost

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Location and Client

- Target Areas
  Where will we built UBC plants?

- Target clients
  With whom are we having discussions?
Target Areas

<First priority area>
- Indonesia

<Second priority area>
- India
- China

<Third priority area>
- Australia
- Russia
Candidate Clients / Partners

• **Mine owners**
  who want to sell high-moisture lignite, which has no commercial value now.

• **Power utility companies**
  who want to have a stable price & source of energy.

• **Traders**
  who want to use UBC as a calorie booster.
UBC Application

<Briquette form: moisture 8-10%, 6000kcal/kg>

• Ocean or rail transport for long distance
• Mix with LRC as calorie booster

<Powder form: moisture 0%, 6670kcal/kg>

• Direct feed to mine-mouth power plant
• Feed to UBC power (including IGCC) plant in distant location
-Upgrading the Future-

Project coming up

• F/S for 1st Commercial Plant is now in progress with PT DH Energy (Bumi Gr.) and an Asian power utility.
• The project is in Pendopo, South Sumatra.
• We are also having discussions with several lignite mine owners in Indonesia and in other countries.
KOBEELCO’s business scheme

• EPC Business

• License Business
  – Construction License to engineering company
  – Production License to producer of UBC

• UBC Production Business
  – For Captive Use
  – For Merchant Sale
Conclusion

- Kobe Steel has completed R&D of the UBC Process. The Process has now reached the commercialization stage.
- The UBC process gives calorific and commercial value to un-utilized lignite, which is available all over the world.
- The UBC process has various applications beside briquette export.
- A feasibility study for a 5-million-ton project in Sumatra is now under way.
- Kobe Steel is ready to discuss commercial projects with mine owners, power utility companies, traders and engineering companies.
Thank you

UBC® Process

-Upgrading the Future-