3A3. Brown Coal Liquefaction Technology (BCL)

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Project type: Development of Brown Coal Liquefaction Technology; Development of Liquefaction Basic Technology; Coal Liquefaction International Cooperation Project; and other projects
Period: 1981-2002 (21 years)

Outline of technology

1.Background and process outline

Economically viable global coal reserves are expected to total about one trillion tons, about half of which is comprised of low-grade coal such as sub-bituminous coal and brown coal. Coal has a larger ratio of reserves to production (R/P) than that of oil and natural gas. For full-scale effective utilization of coal, however, the effective use of low-grade coal is critical. Low-grade coal contains a large amount of water but has an autoignition property in a dry state compared with bituminous coal and other higher grade coals. Consequently, brown coal liquefaction technology development progressed aiming to contribute to a stable supply of energy in Japan by converting the difficult-to-use low-grade coal into an easy-handling and useful product, or by producing clean transportation fuels such as gasoline and kerosene from the low-grade coal.

As shown in the figure, the BCL process has four stages: the slurry dewatering stage where the water is efficiently removed from low-grade coal; the liquefaction stage where liquefied oil production yield is increased by using a highly active limonite catalyst and the bottoms recycling technology; the simultaneous hydrogenation stage where the heteroatoms (sulfur-laden compounds, nitrogen-laden compounds, etc.) in the coal-liquefied oil are removed to obtain high quality gasoline, kerosene, and other light fractions; and the solvent deashing stage where the ash in coal and the added catalysts are efficiently discharged from the process system.

In Asian countries, economic growth steadily increases energy demand, and countries possessing low-grade coal resources, such as Indonesia, anticipate commercialization of the technology.

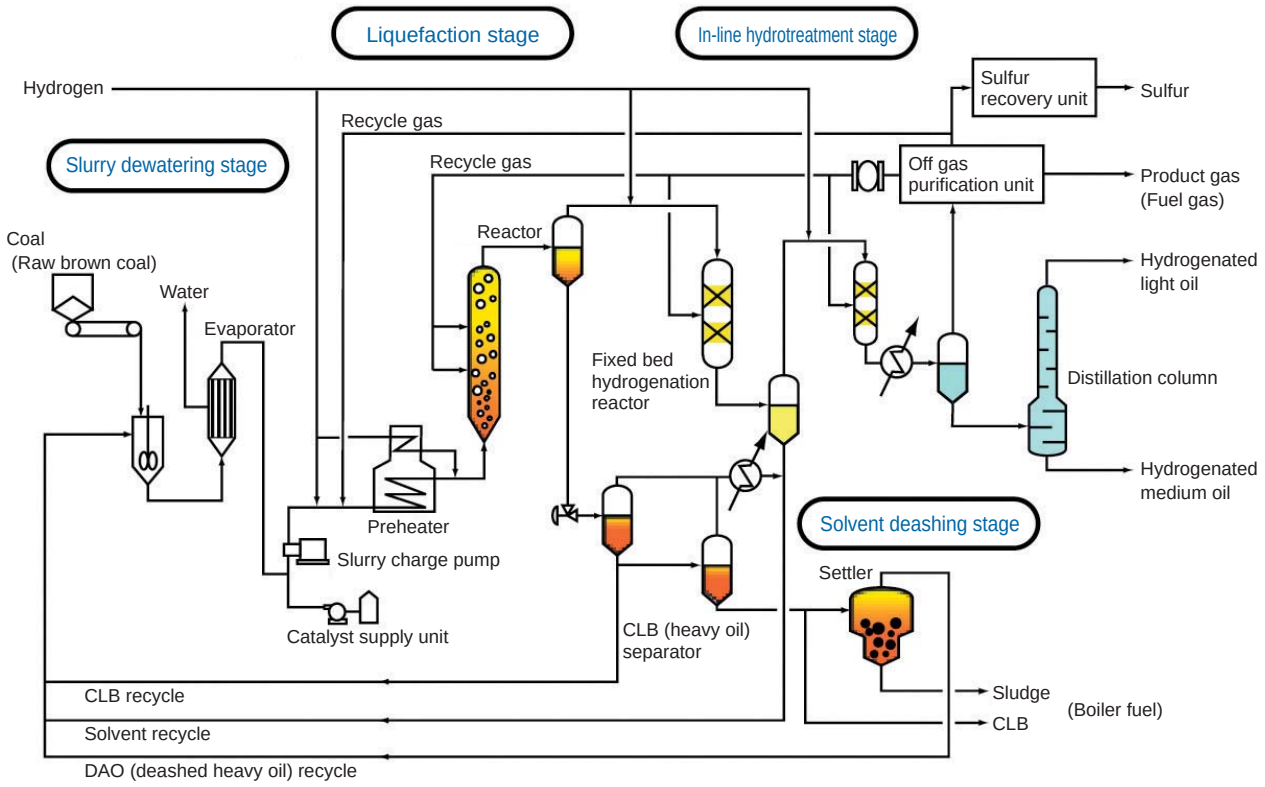

Fig.1 Flowchart of BCL

2.Development objectives and technology to be developed

A pilot plant (refer to the photograph) study conducted under the governmental cooperation of Japan and Australia investigated the subjects listed below.

(1) Achieving high liquefied oil production yield: 50% or more

(2) Achieving long-term continuous operation: 1,000 hours or more

(3) Achieving high deashing performance: 1,000 ppm or less

(4) Establishing a new slurry dewatering process

Through four years of operation and study (1987-1990), all of the above targets were achieved. Furthermore, scale-up data necessary to construct commercial liquefaction plants and expertise on plant operation was obtained through pilot plant operation.

Fig.2 50t/d Pilot plant (Australia)

During the study period, (the 1990s), however, a state of low oil prices and stable oil supplies existed worldwide owing to a stable international oil supply and demand situation. Thus, further improvements in the economics of the coal liquefaction process were requested, while cleaner liquefied oil was demanded owing to increased environmental concerns. Accordingly, the study team constructed a bench-scale plant (0.1 t/d) in the Takasago Works of Kobe Steel, Ltd. to conduct a study for improving the process. The study developed: a limonite catalyst which has extremely high activity compared with existing liquefaction catalysts, and which has superior handling properties such as crushing property; a method to maintain catalytic activity through the bottoms recycling technology; a simultaneous hydrogenation technology which significantly improves the quality of coal-liquefied oil; and various improvements for increasing operational reliability. Through the development work, the study established the improved BCL process (Improved Brown Coal Liquefaction Process, refer to the flowchart on the preceding page) that significantly improves the economics, reliability, and environmental compatibility of the brown coal liquefaction process.

3.Progress and result of the development

On the basis of a memorandum on cooperative coal liquefaction research between the Agency for the Assessment and Application of Technology of Indonesia and New Energy and Industrial Technology Development Organization, the study team carried out surveys and liquefaction tests of the low-grade coal in Indonesia beginning in 1994, in addition to screening of candidate coals for liquefaction. Furthermore, the team endeavored to increase the technical abilities of the Indonesian engineers through instruction and supply of liquefaction testing equipment.

In 1999, the study team selected three candidate sites for the liquefaction plant in Indonesia, and carried out a feasibility study on coal liquefaction, including an economic evaluation. The feasibility study revealed that coal liquefaction would be economically feasible only if the price of oil did not decrease.

4.Issue and feasibility of practical application

Supported by steady economy growth, Asian countries exhibit rapidly increasing energy demand. Although currently a net oil-exporting country, Indonesia is expected to become a net oil-importing country by around 2010. Since the stable supply of energy from Asian countries to Japan significantly contributes to the energy security of Japan, expectations are high for the practical application of brown coal liquefaction technology utilizing unexploited low-grade coal. From a medium-term viewpoint, the possibility of practical application of the technology is large.

References

1) Shunichi Yanai and Takuo Shigehisa: CCT Journal, vol.7, p 29 (2003)

2) Report of the Result of the International Coal Liquefaction Cooperation Project (Cooperative Study of Development of Low Grade Coal Liquefaction Technology) (2003)