

2A4. Pressurized Internal Circulating Fluidized-bed Combustion Technology (PICFBC)

Research and development: Japan Coal Energy Center; Ebara Corporation
 Project type: Coal Production and Utilization Technology Promotion Grant
 Period: 1992-1998

Technology Overview

1. Overview

PICFBC's basic technology is the technology of the internal circulating fluidized-bed combustion boiler (ICFBC) described in

2. Features

The pressurized internal circulating fluidized-bed boiler (PICFBC) applies the circulation flow technology of the previously-described ICFBC. Accordingly, the load is controllable without varying the height of the fluidized-bed. In addition, cooling of the combustion gas is avoided because the intra-bed heat transfer tubes are not exposed on the bed during the load controlling action, which minimizes the generation of CO₂ and eases the maintaining temperature at the inlet of the gas turbine. Since the wear problems of the heat transfer tube in the bed are decreased,

3. Technology overview



Fig. 1
Schematic drawing of PICFBC

Figure 1 shows a schematic drawing of a PICFBC. The cylindrical pressure vessel contains a cylindrical ICFBC. Similar to ICFBC, silica sand is used as the fluidizing material. The fluidized-bed is divided into the main combustion chamber and the heat recovery chamber by the tilted partition. The swirling flow is created in the main combustion chamber,

4. Study sites and application fields

The PICFBC pilot plant test was carried out at a site next to the Idemitsu Kosan Co., Ltd.'s Coal Research Laboratory (Nakasode, Sodegaura City, Chiba). Potential applications include the steam turbine generator, using the generated steam, and the gas turbine generator, using the combustion flue gas. IGCC at coal-fired thermal power plants, therefore, are potential candidates for the technology. Photo 1 shows a PICFBC hot model installation of 4 MWth. Photo 2 shows an overview of a pressurized two-stage gasification plant (30 t/d of waste plastics throughput). The pressurized two-stage gasification technology can be utilized to synthesize ammonia from coal, as well as to produce hydrogen for fuel cell power generation. The pressurized two-stage

5. Period of development

The ICFBC pilot plant test was carried out from 1992 to 1997, jointly conducted with the Center for Coal Utilization, Japan (now known as JCOAL), as a Coal Utilization Technology Promotion Grant Project of the Ministry of Economy, Trade and Industry (formerly the Ministry of International Trade and Industry). The

6. Progress and study subjects

As a coal-fired PICFBC, the study progressed to the pilot plant test at Sodegaura. The technology, however, was developed to a pressurized two-stage gasification technology in which a thermal load and a lock hopper system in the pressurized fluidized-bed

the preceding section. The PICFBC mounts ICFBC in a pressurized vessel.

silica sand can be used as the fluidizing material, and the amount of limestone can be minimized to a level necessary for the intra-furnace desulfurization, thus suppressing the generation of ash. Furthermore, the main combustion chamber has no intra-bed heat transfer tube so that the problem of interference of the intra-bed heat transfer tube against the movement of the particles does not occur, which prevents the generation of agglomeration, the solidification of a melted medium.

and the circulation flow is created between the main combustion chamber and the heat recovery chamber.

Figure 2, (p. 27), shows a basic system flowchart of a pilot plant test in Sodegaura plant. The coal feed unit has two lines: the lock hopper system, which feeds lump coal, and the CWP (Coal Water Paste) system, which feeds coal as slurry mixed with water. The flue gas dust is removed by a ceramic high-temperature bag filter. The lock hopper system technology is applied to develop the pressurized two-stage gasification technology.

gasification technology has been in operation as a commercial plant (195 t/d of waste plastics throughput) at Showa Denko K.K.'s Kawasaki plant since 2003.



Photo 1
PICFBC facility



Photo 2
Pressurized, two-stage gasification plant

test operation began in December 1996. The pressurized, two-stage gasification technology was developed jointly with Ube Industries, Ltd. Demonstrative operation of the plant (30 t/d of waste plastics throughput) began in January 2000, and commercial operation commenced in January 2001.

have been applied. The issues of the pressurized system include the improvement of the reliability of the lock hopper system in the fuel charge line as well as measures to prevent low temperature corrosion.