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Gas Turbine Combustor Development for Gasified Fuels and Environmental High-efficiency Utilization of Unused Resources

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Japan depends on imports for most primary energy resources. To obtain stable supplies of energy and protect the global environment in the future, reexamination of unused resources, reclamation of waste matter, and highly effective use of such resources will be important issues. Discoverable reserves of bituminous raw material and oil shale are believed to contain about 5.8 trillion barrels of oil and are several times larger than the reserves of crude oil. Such oil fields are distributed over Latin America and North America where the political situation is comparatively stable. However, future distribution of energy resources and stable electricity supply in Japan require high efficiency use of those resources as fuel for power generation.

Development of integrated gasification combined cycle (IGCC) power generation systems continue worldwide, and such technologies enable high-efficiency generation from various fuel sources. Gasified fuels are chiefly characterized by the gasifying agents and the synthetic gas cleanup methods and can be divided into four types. The calorific value of the gasified fuel varies according to the gasifying agents and ammonia originated from nitrogenous compounds in the raw materials of bitumen, etc., and depends on the synthetic gas cleanup methods. In particular, air-blown gasified fuels provide low calorific fuel of 4 MJ/m^3 and it is necessary to stabilize com-bustion. In contrast, the flame temperature of oxygen-blown gasified fuel is much higher, so control of thermal-NO_x emissions is necessary. Moreover, to improve the thermal efficiency of IGCC, hot/dry type synthetic gas cleanup is needed. However, ammonia in the fuel is not removed and is supplied into

the gas turbine where fuel-NO_x is formed in the combustor. For these reasons, suitable combustion technology for each gasified fuel is important. This paper reviews the trends of technological developments of IGCCs worldwide and outlines the background of combustion technology development of the high temperature gas turbine for IGCC in Japan. Particular combustion technologies developed in Japan are explained in detail.

Keywords: Unused resources, Gasification, Gas turbine combustor, High efficiency power generation, Low nitrogen oxides emission

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