Reduction of Global Warming by High Efficiency Waste Power Generation

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Abstract

A number of electric power generation facilities recovering heat energy produced by waste disposal are operated in Japan; however, its power generation efficiency of 10 - 15% (in an average) is relatively low taking into account corrosion of heat exchanger tubes. In Southeast Asian countries, most waste are still disposed of directly in landfills, causing several problems such as contributing to global warming through the emission of methane, and the need for these countries to secure additional land for future disposal. From the perspective of global environmental protection and energy security, it is important to effectively use the waste as an energy source.

To address these circumstances, Kyushu Electric's Research Laboratory has developed a yttria stabilized zirconia（YSZ）coating method that applies supersonic plasma spray to prevent high temperature corrosion of heat exchanger tubes in waste power generation plants. The durability of sprayed coatings increases due to high-speed jet velocity and by means of controlling the melting condition of the spray material using high-temperature plasma. Further, the coatings have a double-layered structure. The structure comprises a Ni-based self-fluxing alloy used for the undercoat and YSZ for the topcoat. This brings about high durability against thermal shock and corrosion. In a 2-year durability test, conducted jointly by Mitsubishi Heavy Industries, coatings applied in a high temperature, molten salt corrosive environment with the YSZ coating method showed excellent corrosion-resistance on an actual plant's heat exchanger tubes. In the case of an Inconel 625 superheat tube of a waste incinerator, thickness loss of 0.4 -1.8 mm every two years is usually seen cause of corrosion. However, the sprayed coatings can contribute to the protection of base materials against corrosion wastage for a few years.

Application of this coating method to a waste power generation plant brings an increase in power generation efficiency of 30% (steam condition of 9.8 MPa at 500ºC at inlet of turbine). If Southeast Asian nations were to shift from landfill disposal to adopting high-efficiency waste power generation, several benefits would accrue, such as a decrease in fossil fuel consumption, an increase in electricity generation, and a reduction in methane gas emission. With waste accumulating at 300 t/day, the estimated effect of energy conservation and alternative energy sources will amount to a savings of 1,400,000 TJ/year, as well as the potential amelioration of global warming through a reduction of 9 billion t-CO_2/year.