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# Experimental Study on Different Load Operation and Rapid Load-change Characteristics of Pulverized Coal Combustion with Self-preheating Technology

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**Abstract :** Under the basic national conditions that the energy structure is dominated by coal, it is of great significance to realize deep and flexible peak shaving of boilers in pulverized coal power plants, and maximize the consumption of renewable energy in the power grid, to ensure China's energy security and scientifically achieve the goals of carbon peak and carbon neutrality. With the promising self-preheating combustion technology, which had the potential of broad-load regulation and rapid response to load changes, this study mainly investigated the different load operation and rapid load-change characteristics of pulverized coal combustion. Four effective load-stabilization bases were proposed according to preheating temperature, coal gas composition (calorific value), combustion temperature (spatial mean temperature and mean square temperature fluctuation coefficient), and flue gas emissions (CO and NOx concentrations), on the basis of which the load-change rates were calculated to assess the load response characteristics. Due to the improvement of the physicochemical properties of pulverized coal after preheating, stable ignition and combustion conditions could be obtained even at a low load of 25%, with a combustion efficiency of over 97.5%, and NOx emission reached the lowest at 50% load, with the concentration of 50.97 mg/Nm3 (@6%O2). Additionally, the load ramp-up stage displayed higher load-change rates than the load ramp-down stage, with maximum rates of 3.30 %/min and 3.01 %/min, respectively. Furthermore, the driving force formed by high step load was conducive to the increase of load-change rate. The rates based on the preheating indicator attained the highest value of 3.30 %/min, while the rates based on the combustion indicator peaked at 2.71 %/min. In comparison, the combustion indicator accurately described the system’s combustion state and load changes, whereas the preheating indicator was easier to acquire, with a higher load-change rate, hence the appropriate evaluation strategy should depend on the actual situation. This study verified a feasible method for deep and flexible peak shaving of coal-fired power units, further providing basic data and technical supports for future engineering applications.

**Keywords :** clean coal combustion, load-change rate, peak shaving, self-preheating
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