Recirculating of burned fuel

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Heat recuperation of emitting smoke fumes is an indicator of high efficiency of heat-power technology. The suggested method of fuel combustion (Fig. 1) allows reducing emissions of NO_x and CO_2 by reducing combustion temperature and the temperature of flue gas down to 50^0C.

Similarly to the method developed by D. L. Astanovskij [1], in suggested method of burning fuel, flue gas partially recycled by burning. However, condensate from the heat exchanger 3 is injected into the flue gas flow and forms steam-and-smoke mixture (SSM). Significant temperature decrease of flow from evaporating allows reducing the thickness of insulation. Plus significant heat of condensation can be reached in smaller heat exchanger.

Condensate is injected after the heater, because SSM more aggressive to the contact surface than dry products of combustion while heat transfer rates of flue gas and SSM without condensation are comparable.

Deep recuperation of combustion products would increase amount of condensate in a closed circuit after each cycle of evaporation / condensation on the mass of water vapor formed during combustion. Thus, the surpluses of condensate formed in the circuit can be used for preheating fuel. Air-and-gas mixture is preheated in heat exchanger 2 by flue gas.

Partial recirculation of cooled flue gas in the blast air flow reduces the adiabatic combustion temperature of fuel, which is inversely proportional to the percentage of flue gas in the air-and-gas mixture. Reduction of adiabatic combustion temperature leads to suppression of hazardous compounds (NO_x, CO) and decreasing of detrimental effect on contact surfaces of pipelines and heat exchangers.

In contrast to the method of burning of fuel, developed by D.L. Astanovskij [1], the proposed method solves the problem of disposal of the unfiltered condensate ($90 \div 95^0$C) and lowers the minimum temperature of the heated medium in the external circuit (from 180^0C down to 80^0C). Also massive heat exchanger capable of cooling the flow of dry flue gas from 1100^0C down to 200^0C is no longer required [2]. Thus, one can conclude reasonable prospects of using the proposed method in fired equipment of any capacity for various purposes.

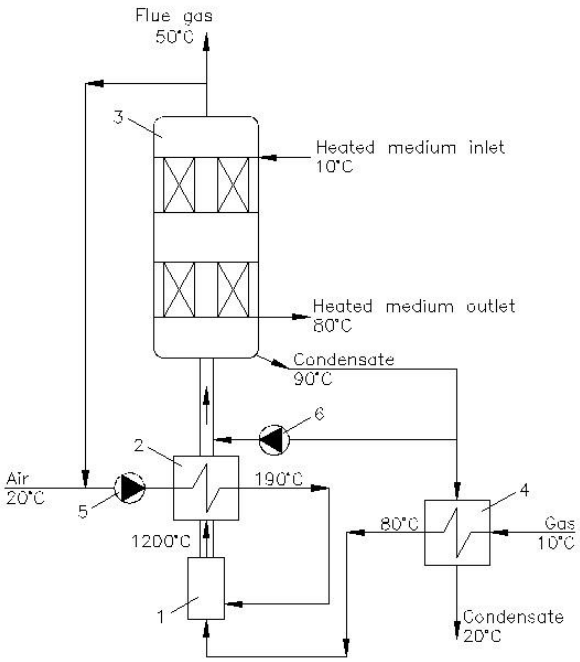

Fig. 1. Schematic diagram of the proposed method of fuel combustion: 1 – burner unit; 2, 4 – plate heat exchanger; 3 – technological exchanger; 5, 6 – Fans.

References

[1] Astanovskij, D. L. Method of burning fuel. Patent RU 2347977 C1. 27 February 2009.
[2] Heat exchanger designed by «Fast Engineering»: catalogue. Moscow, 2009.

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