Part 1

AIR PROTECTION FROM POWER INDUSTRY EMISSIONS

1.1. Nitrogen oxide emission reduction

1.1.2. Technological methods for reduction of nitrogen oxide formation in boilers at combustion of different types of organic fuel

1.1.2.2. Modernization of the furnace process

1.1.2.2.4. Concentric combustion

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This method also intends creation in the furnace of a zone with a lack of oxidizer, in which nitrogen-containing components don't convert into NO, but into the molecular nitrogen. In this zone partial conversion of the formed NO into N_2 is possible. Reducing zone in this diagram is provided by a change of construction of direct-flow burners, already mentioned in it. 1.1.2.2.1. Fig. 1.15 shows one of the options of such a burner, designed by VTI CKB "Energoremont" and mounted at TP-85 boiler at Irkutskaya CHPP-9. Upper secondary air nozzle in the burner can deviate from the axis of the burner at an angle β. As a result, in the furnace center the enriched fuel zone is formed, and near the screens – the enriched air medium is created. Horizontal step structure gives almost the same effect as a vertical one. At TP-85-9 boiler of Irkutskaya CHPP burning brown coal, concentration of nitrogen oxides decreased from 1100 to 700 mg/m^3 (at a load close to the nominal) [12].

In the U.S. concentric combustion is widely introduced, both at reconstruction of the operating boilers and at construction of the new ones, designed for burning hard and brown coal. In [15] information on 17 major coal-fired boilers, retrofitted by ABB C-E using concentric combustion, is presented. As a result of new arrangement of the combustion process at all the boilers it was possible to reduce nitrogen oxide concentration in flue gases by 1,5 ... 2,0 times, and efficiency of boilers remained practically the same.

Concentric combustion effectiveness is determined by a degree of fuel enrichment at the furnace central zone and thus, by a degree of air enrichment at the peripheral zone adjacent to the furnace screens. It is clear that by increasing the secondary air quantity, which stream deflects from the direction of fuel-air mixture jets, and increasing the angle (in design) between two streams, we can achieve a stronger reduction of NO_x emissions. However, a presence of fuel in the oxidizer deficiency zone reduces the rate of coke residue burning, residence time in the top of the furnace after supplying tertiary air is limited by the existing sizes of the furnace. Incomplete fuel combustion, as it is known, leads to an increase in heat losses q_4 and reduces the fly ash quality, and therefore, for introducing concentric combustion it's needed to know a relationship between the degree of NO_x emission reduction and design parameters of the concentric circuits, as well as an influence of the concentricity degree on the content of combustibles in fly ash.