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The Influence Of The Burning Process At The Thermoelectric Power Station On Ecology And The Ways Of Reducing The Harmful Wastes Into The Atmosphere

E.M.Mammadov, R.M.Kasimov
The Institute of Chemical Problems of the National Academy of Sciences Azerbaijan Republic
Baku, AZ0143, 29, Huseyn Javid prospect, phone (+99412) 439 41 59
e-mail: baku@bk.ru

By the increase of prices of fuels in world market the use of these products in production processes is one of the important problems. As the basic technological processes of Heating Electrical Station (HES) are burning processes, the exact determination of fuel and air consumption prevents extreme use of fuel and influences positively on ecological balance. Correct regulation of fuel and air flaw causes the decrease of toxic gases in burning products by carrying out burning processes.

Using the latest achievements of new technologies, the application of modern data-measuring systems causes obtaining of high results.

One of the main technological processes at the thermoelectric power station is the process of burning in the crater. There, at the result of burning of sulfur containing fuel oil and gases, toxic oxides of nitrogen and compounds have been formed.

In order to reduce the number of nitrogen oxides in the content of out coming smoke gases, there have been used some methods, the main purpose of which is reducing the quantity of oversaturated air in the camera of burning and recirculation of smoke gases. Dependence between the quantity of oversaturated oxygen and the formatted nitrogen oxides in the zone of burning has been studied by of researchers. It has been established that nitrogen oxide (NO) in the camera of burning makes 90-95%, and at exit of the pipe it exists till 30-40% in the type of nitrogen dioxide (NO_2). Dependence of concentration the nitrogen oxides on the coefficients of oversaturated air in the various zones of burning has been studied in details by I.I. Seagal. One of the main methods for reducing the number of nitrogen oxides in smoke gases is their recirculation in the burning camera. It provides reduction of temperature in the centre of fire and influences the slowing down of nitrogen oxidation reaction. While providing the recirculation of smoke gases with various methods, it has been established, that the influence of these gases on the oxidation of molecular nitrogen is fulfilled by the full mixing of the fuel with the air before the camera of burning.

In spite of the same methods applied by the researchers while passing the smoke gases to the zone of burning, the obtained results were different. The reason is first of all, the difference in constructions of the burning cameras aggregates, as well as mixing of fuel and air in the various conditions.

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It's well know, that among fuels the natural gas takes the main in the balance of HES. While its burning the outlet of nitrogen oxides is much more than at the fuel oil usage. In this connection the demand for making effective technology in recirculation of smoke gases in aggregates rises.

Inspite of numerous literature sources on applying recirculation of smoke gases in energetic, lots of interesting problems still remain unsettled. Thus, the influence of fuel, air and smoke gases mixture on recirculation effectiveness with the aim of reduction the outlet of nitrogen oxides hasn't been fully studied.

In order to analyze exactly the influence of smoke gases recirculation on formation the nitrogen oxides at the process of burning, we have created a laboratory (fig.1) and a pilot plant.

As you see in fig.1, the laboratorial plant consists from the direct-running camera of burning 1, in order to use the gas fuel, the knot of draught from outlet smoke gases 2, and the analyzer for defining the concentration of these gases 3. The expenses of the volume of fuel and air streams, which have been giving to the camera of burning, are defined by the transmitters 4 and 5. The volume of smoke gases is defined by the flow frequency consumptionmeter 6.

The degree of recirculation is defined by the correlation of smoke gases quantity on the air stream consumption.

For optimal management and calculating operations there is an electrocalculating block 7, on the plant, which is connected with all transmitters and consumptionmeters.

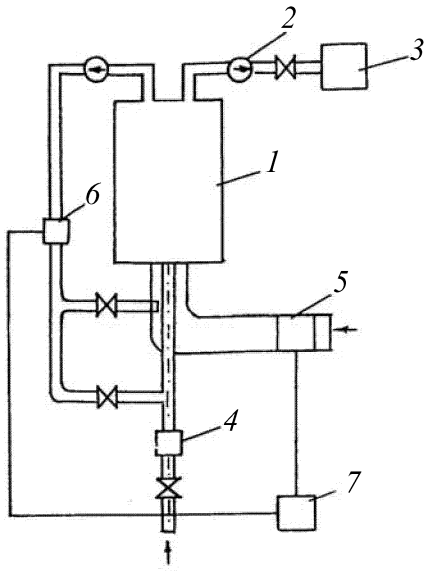

Fig 1.

For exact definition of dependence of nitrogen oxides number on the degree of recirculation in the smoke gases, first of all there was defined the volume of the air stream, which was given to the camera of burning for the full fuel burning. The quan-

tity of the air stream for full burning of natural gas 1 sm^3 has been defined according to the formula:

$$V_0 = 0{,}0476\ [\ 0{,}5\ CO + 0{,}5\ H_2 + 1{,}2\ H_2S + \sum (\ m + \frac{n}{4})\ C_m H_n + O_2\ ] \qquad (1)$$

On the base of the composition of the investigated gas (look at Table), the volume of the air stream necessary for full burning of the gas is equal V_0 =9,79 m^3 /m^3, according to formula 1.

If α_T is equal 1,05, then the quantity of the air stream in the camera of burning will be defined on the formula:

$$V_h = \alpha_T \cdot V_0 \qquad (2)$$

Having calculated the exact quantity of the air according to this formula, we have got V = 10,2 m^3 /m^3.

Table 1. ***Composition*** **of investigated fuel**

Type of fuel	Volume composition in %						
	CH_4	C_2H_6	C_2H_8	C_4H_{10}	C_5H_{12} and much heavier	N_2	CO_2
Natural gas (Deposit Karadag Azerbaijan)	93,9	3,1	1,1	0,3	0,1	1,3	0,2

In fig.2 there is a curve dependence of recirculation level of concentration the nitrogen oxides in smoke gases at the process of burning on the fixed consumptions of fuel and blowing air. Here, the curve 1 indicates to giving smoke gases into the air stream, and curve 2 – into the fuel.

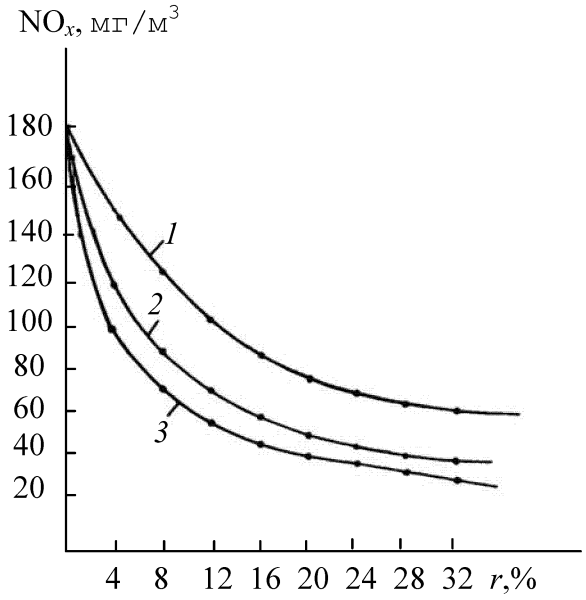

Fig2.

Curve 3 indicates to dependence of nitrogen oxides (NO_x) on the level of recirculation of the burning products at the moment of simultaneous giving of these gases into fuel and blowing air.

As you see in fig.2 the simultaneous giving of smoke gases into the fuel and the blowing air have a great influence on formation the nitrogen oxides in them (curve 3). In this case in the field of recirculation lever R < 15% the reduce of nitrogen oxides is non – linear.

During the carried out investigations it has been established, that at recirculation of smoke gases to 10% and in the different correlation of the blowing air to the fuel the concentration of nitrogen oxides in the products of burning reduces to 36%. Much better indexes of reduction the content of nitrogen oxides up to 46% at the same per cent of recirculation have been achieved while simultaneous giving of recirculation into the fuel and air.

As you see in fig.2 when recirculation is r < 20% the reduction of the content of nitrogen oxides in the products of burning runs much faster. As for concentration of nitrogen oxides, it takes place when recirculation is over 20%.

Thus, according to the results of the carried out investigations, that at the points of when recirculation r < 20% the simultaneous giving of smoke gases into the fuel and air leads to more effective reduction of the nitrogen oxides in the products of burning.

On base of carried out investigations and created technical facilities the data-measuring system was worked out for disperse control by burning process on heating-electro station. The system measures by air-jet transmitters of consumption and alary

radome of air stream with rate of velocity to boiler unit of thermoelectric power station (fuel oil or natural gas) and air.

References

Chastukhin V.A., Chastukhin V.V. Fuel and theory of burning. Kiev: Vita school, 1989, 169 p.
Seagal I.Y. Protection of air pool while fuel burning. L.: Bowels, 2008, 235 p.