UDC 666.76

Quality Control of Fuel Combustion and Saving It in the High Thermal Generating Units

A.P. Kryachko

SPE "Dneprchermetavtomatika"

The article considers the ways of gas saving and products quality improvement in the fuel combustion control in thermal metallurgical units.

Keywords: FUEL COMBUSTION CONTROL, REFRACTORY AND THERMAL METALLURGICAL UNITS

Introduction

Modern metallurgical, mining and refractory production is characterized by a large number of energy-intensive processes in high-temperature reheating furnaces and burning kilns. Age and deterioration of equipment do not ensure the maintenance of the required temperature modes, determined by procedure sheets of the furnaces. Increasing of fuel consumption for producing a higher temperature is the most frequently used method of heating [1, 2].

As a result of fuel combustion depending on the process conditions there is produced a certain amount of combustion products, the composition of which is close to the theoretical composition of the combustion products, containing CO_2, H_2O, N_2, or characterized by a large amount of unburned CO, H_2 and CH_4. The so-called complete combustion is characterized by the release of the maximum amount of heat directly into the combustion zone and requires a supply of air in quantities that provide oxidation of combustible components of fuel. Practically such combustion can not be achieved without introducing excessive amounts of oxygen, the absolute value of which depends on the fuel and the combustion methods.

Results and Discussion

Numerous observations showed that the effective way to provide optimal combustion and heating of the unit is to make his parameter charts. In the process of compiling the chart heating process management is carried out in the "manual" mode, as a result of which presence of the "traces" of CO in the combustion products is achieved and the values of the oxygen content in the flue gases are traced. Using the obtained percentage of O_2 in the flue gases excess air factor α, which provides complete combustion of fuel, is calculated.

Excess air factor α can be calculated using the following formula [3]

$$\alpha = 1 + \frac{O_2}{(21 - O_2) \cdot Z},$$

where Z – coefficient accounting for the type of fuel used.

This excess air factor α can be used as a system installation by the operator. After that the system should automatically maintain this excess air factor during the process.

With increasing excess air factor increases the volume of combustion products and, consequently, the heat loss with the waste combustion products and gas flow rate for maintaining the desired temperature are increased. While reducing the coefficient α deficiency of oxygen in the combustion process appears and chemical underburning is formed, i.e. the excess (unburned) gas with a considerable amount of carbon monoxide CO is injected into the atmosphere. In such a case gas flow rate consumption is also increasing. For optimization and control of fuel combustion it is necessary to monitor continuously the percentage of oxygen in the flue gas, which will help to respond efficiently to deviations from the desired modes of combustion.

Developed in the Scientific Production Enterprise "Dneprchermetavtomatika" fuel

combustion control system for high-temperature units with controlled environment temperature up to 1400 C underwent enhanced tests and long-term practical operation on the heating furnaces of metallurgical production and refractory production kilns.

The system consists of a sampling facility (**Figure 1**) that is installed directly on the furnace and ensures sampling through a special process by ejection openings, and information block (**Figure 2),** installed in the workplace of the boilmaker. The system can operate in two modes:

- Informational, which displays the information on the oxygen content or excess air factor in exhaust gases for manual control of the object;
- Automatic, which ensures the transfer of information to the automatic object control system.

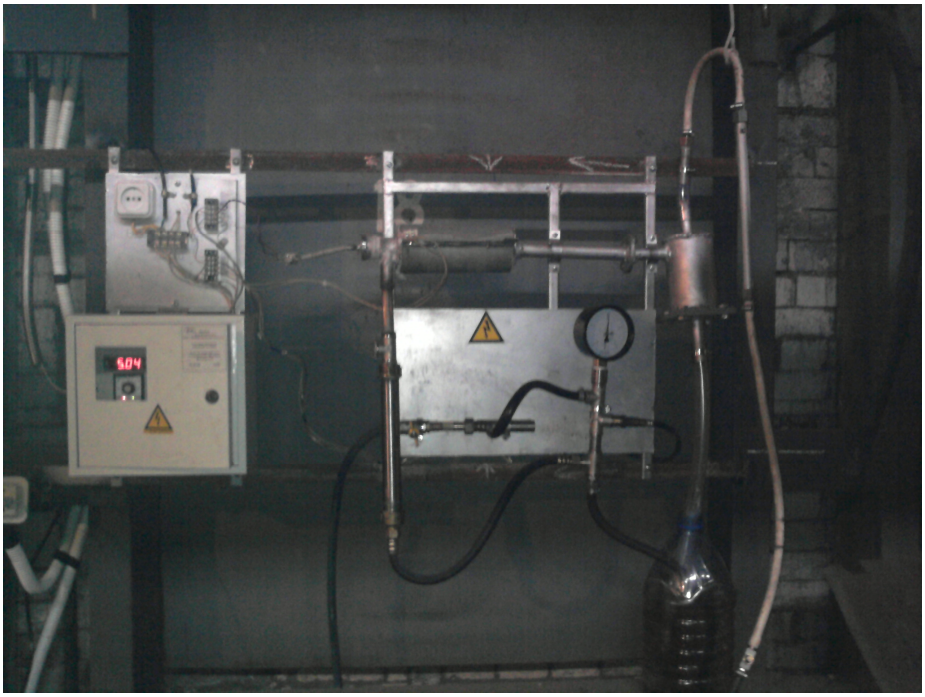

Figure 1. Sampling device of fuel combustion control system

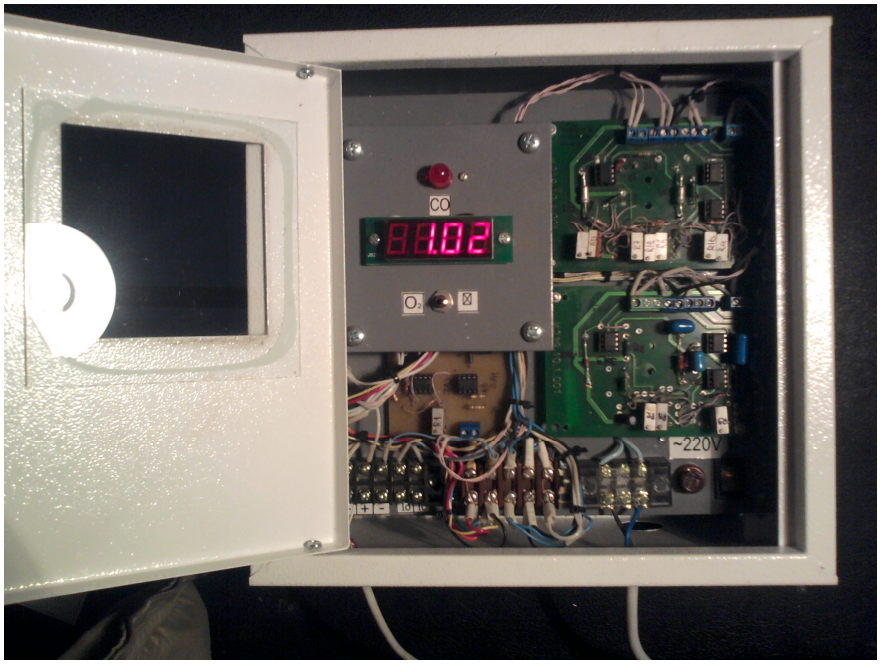

Figure 2. Information block of fuel combustion control system

Operating the system at different combustion objects of metallurgical and refractory production showed the effectiveness not only in terms of gas saving (up to 10%), but also the production technology and product quality. Because the amount of oxygen in the heating furnace influences the intensity of oxidative processes, the redundancy of oxygen affects both the quality of refractory products, and the amount of the formed scale in the metal products. Therefore, control of oxygen content in the flue gases significantly affects the product quality.

As the experience of the practical use of oxygen combustion control showed, it can be used as the primary diagnostic means of the thermal unit. A significant change in the coefficient from the value of defined by a parameter chart of heating mode of the thermal unit shows defects in the upfilling, the presence of significant air leaks, as well as inefficiency of the fan or fume exhaust. Timely detection of problems also has a significant impact on saving gas and improving product quality.

Conclusions

1. Control and optimization of combustion in real time reduces gas consumption up to 10%.
2. Reducing the amount of oxygen and carbon monoxide in the combustion process in thermal units allows to increase the quality of products.
3. The control system of oxygen content in the flue gases provides indirect control of the thermal unit defects.

References

1. Kryachko A.P., Nochvinov P.V. i dr. Osobennosti primeneniya gazoanalizatora na kislorod v usloviyakh agressivnoi vysokotemperaturnoi sredy rekuperativnykh nagrevatelnykh kolodtsev, Metallurg. i gornorud. prom-st, 2005, № 4, P. 106-108. *
2. Kryachko A.P., Vonskii A.Yu., Shapovalov V.I. i dr. Sistemy kontrolya szhiganiya topliva v pechakh ognyeupornogo proizvodstva, Metallurg. i gornorud. prom-st, 2008, № 3, P. 104-105. *
3. Troib S.G. Kontrol koeffitsienta izbytka vozdukha, M.: Metallurgizdat, 1955, 130 p. *

* Published in Russian

Received October 4, 2011

Контроль качества сжигания топлива и его экономия на высокотемпературных тепловых агрегатах

Крячко А.П.

В статье рассмотрены пути экономии газа и повышения качества продукции при контроле сжигания топлива на тепловых металлургических агрегатах.