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METHODS TO REDUCE THE FUEL CONSUMPTIONS AND POLLUTION IN INDUSTRIAL HEAT TREATMENT PROCESSES

P. RĂDUCANU [1] C. PAPADOPOL[1]

Abstract: *Today, when the diminishing of classical energetic resources leads to an increase of their price, anticipating a new world energetic crisis, it is strongly recommended a very carefully approach of the energetic aspects in case of the industrial installations in use. The present paper investigates the way in which a thermal installation can be improved, in order to decrease the heat and fuel specific consumptions, and in the same time to reduce the pollution which accompanies these processes.*

Keywords: *heat transfer/ thermal network model/ piston head/ field of temperature/ ethanol - gasoline blend.*

1. Introduction

The development of the industry, both in Romania and in the entire world, takes place into the permanent modernization of the technological processes and continuously intensification of the concerns for rational use of the energy, in all its forms. The problem of the rational use of the energy is very complex and involves a lot of factors, from different fields, because it follows some main directions, such as:

- Saving of primary energetic resources, which are limited.
- Reduction of the costs for the obtaining of the primary energy.
- Reduction of the investments and costs of the thermal installations.
- Reduction of the pollution to the environment.
- Efficient recovery of the secondary energy resources.

In case of a thermal installation in use, there are always some possibilities to improve its working. Nowadays, when the energetic fossil fuels are less and less, and in the same time, more and more expensive, the intelligent use of energetic resources is an important measure for both the decrease of the fuel consumption, and the diminishing of the environment pollution, leading to a global improvement of thermal efficiency and to better conditions on earth.

An important direction to reach these goals is the recovery of energetic secondary resources, which is, in some way, limited from thermodynamics, energetic, technical and economic point of view.

- Using a technologic recovery (for instance the preheating of the air for combustion, the preheating of fuel etc).

[1] Chair of Engineering Thermodynamics, University Politechnica Bucharest

- Using an energetic recovery (for example the preparation of hot water for social needs, for heating etc.).

One establishes the directions of recovery of the industrial secondary energetic resources according to the efficiency of their use. To this purpose, one must make a detailed analysis, by taking into account a series of factors.

Generally speaking, one highlights the energy, saved as result of recovery, by comparing the performances of the installation before and after the use of the recovery processes. Recuperation of the energy from combustion gases just in technologic direction, named primary recovery, leads to an incomplete recovery, which does not develop all the supplied energy [2]. That is why, it is strongly recommended, when it is possible, to complete it with an energetic recovery, named secondary, which raises the degree of recovery, contributing to a significant increase of the efficiency of the thermal installation.

Concurrently to these measurements of recuperation of the energy, available in combustion gases, one can use a series of other simple modifications [3], which can contribute to the most economic possible operation of the thermal installation in question.

2. Constructive solutions

The thermal equipment analyzed is a heat treatment furnace. The fuel used was the natural gases.

The pieces introduced into the furnace were putted into some boxes, around which the burnt gases flow free. The regime temperature was at about 940^0C…980^0C. The time for the heating of the pieces was about three hours, while the time for the treatment was also of three hours.

An initial energy analysis leads to the conclusion that the installation, due to the technology used, presents a high degree of generation of secondary thermal energy, having a good recovery potential. It means that one can recover a part of this energy both by technological methods (preheating of the combustion air), and by energetic methods (preparation of hot water for the working personnel or/and heating using a heat pump), a combination of both leading to a high thermal efficiency.

The use of certain heat-exchangers for heat recovery will have as effect the fall of the enthalpy of the flaring evacuated gases, such increasing the load factor of fuel and weight of significant energy of fuel in the sum of entered heats.

On a detailed analysis of the initial constructive solution imposed by the technological process, one chose a mixed solution [3], [4], which includes two heat recuperators.

Into the first stage it was introduced a radiant type heater for preheating of combustion air [5]. This device was fitted direct to the burn gases evacuation.

Into a second stage, it was introduced, over the air pre-heater, along of the gas flow, a convective heater for heating of water for social needs [5].

3. The Comparative Presentation Of The Specific Parameters Of The Equipment

The comparative study of the three constructive alternatives (initial not-modernized furnace, furnace modernized by hot blast stove equipment and furnace equipped with hot blast stove and heater for the preparation of hot water) was carried out starting from the real energy balances of the thermal installation in those three situations. The measurements led to the calculation of the characteristic sizes, which treated, allow the determination the technical-economic indices of the installation and the comparison of the various constructive solutions.

The fuel consumption decreases from 73,84 m^3_N/charge in case of the nonmodernized furnace, to 70,52 m^3_N/charge after the first modernization, and to 64,8% after the second modernization.

The above modifications led to an improvement of the economic indicators of the installation.

The output of the process increased from 22,89%, in case of the nonmodernized furnace, to 23,63% after the first modernization (furnace equipped with hot blast stove equipment) and to 30,2% after the second modernization (furnace equipped with hot blast stove and heater for the preparation of hot water).

The output of the fuel use in the process increased from 18,34% in case of the nonmodernized furnace to 19,89% after the first modernization, and to 26,73% after the second modernization.

The specific conventional fuel consumption decreased from 120,47 kg of conventional fuel per tone of produces in case of the nonmodernized furnace, to 110,6 kg of conventional fuel per tone of produces after the first modernization, and to 94,3 kg of conventional fuel per tone of produces after the final modernization.

The fuel consumption per charge, the process out put, the fuel use output and the specific conventional fuel consumption, for the three variants, are presented, comparatively in table 1.

Table 1.

Variant	Fuel consumption [m^3_N/charge]	Process output [%]	Fuel use output [%]	Specific conventional fuel consumption [kg cc/t]
1	73,84	22,89	18,34	120,47
2	70,52	23,63	19,89	110,6
3	64,8	30,2	26,73	94,3

4. Conclusions

The analyzed energetic installation presents broad possibilities for improvement of the efficiency of the technologic process and implicitly a reduction of the fuel consumption by the adoption of certain constructive solutions, both of technological and energetic recovery, adopted for the existing construction.

To insure a high degree of technological energy recovery it is necessary that the recovery equipment to be placed as near to the furnace as possible, because the transport of burned gases to long distances produces great loses of heat, which means a poor quality and a less quantity of the gases.

In case of the energetic recovery the consumption of heat to the user must be in accord with the quantity of energy recovered. The use of the saved energy for heating of water for social needs has a limited character during the year. In the same time, the hot water amount used is less than the recovered energy potential. That is why the both modernizations must be adopted together, or one can use the accumulation of the heat from the recovered energy. But this solution requires an extra investment, which increases the total costs of the equipment.

The comparative analysis of the suggested solutions highlights a considerable improvement of all the characteristic indices of the modernized installation compared to the initial constructive solution. This means also a significant reduction of the air pollution.

One also notices that the suggested modernization is done in two stages, each one with his advantages, so that the capital costs can have set out in time. But these costs are fully compensated by the saving in fuel, therefore are found in the more reduced prices of exploitation.

Moreover, the investments made carry out to a reduction in the pollutants so that one achieves a reduction of noxious gases in the atmosphere.

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