The accelerated controlled cooling of products in the vacuum resistance furnace with mobile thermal insulation

Pogrebisskiy Mikhail, Shageev Emil

Department of Automated Electrotechnological Installations and Systems, National Research University "Moscow Power Engineering Institute", Krasnokazarmennaya street 14, Moscow, Russia, e-mail: PogrebisskiyMY@mpei.ru

Abstract **The way of the accelerated controlled cooling of products in vacuum resistance furnaces, based on use of mobile thermal insulation is offered. Temperature field of a product are investigated when cooling with this way.**

Keywords **resistance furnace, controlled cooling, temperature field, mobile thermal insulation.**

I. INTRODUCTION

Electric resistance furnaces, including vacuum furnaces, are widely applied to implementation of technological processes of heat treatment, agglomeration, refinement of various materials, etc. The major indicators, defining quality of production and productivity of the furnace, are uniformity of a temperature field in a product during all production cycle in furnaces, and also compliance of speeds of heating and cooling set.

One of features of technological process of vacuum resistance furnaces is that product cooling after the termination of stages of heating and storage is, as a rule, carried out in the heating chamber which thus won't become depressurized. It is connected with danger of oxidation of a material of a warm product on air, and also with complexity of a locking through of a product in the separate vacuum cooling chamber.

II. ACCELERATED CONTROLLED COOLING

Application of a massive thermal insulation of the furnace provides high uniformity of a temperature field and reduces an electric power expense at the expense of reduction of thermal losses, but increases time of cooling of products and, thereby, reduces productivity of the furnace.

One of ways of the controllable cooling, allowing to operate with speed of cooling of product and to provide sufficient uniformity of a temperature field, possibility of programmed change of value of thermal losses through a thermal insulation of the vacuum furnace is. Thus increase of speed of cooling of products shouldn't be accompanied by increase in unevenness of a temperature field on a cooled product: the thermal tension connected with considerable unevenness of a temperature field, at their relaxation leads to deformation of products or to formation of cracks.

The way of the controllable accelerated cooling based on use of a "deformable" thermal insulation [1] when on a signal about change of temperature in various points of a product there is a moving of separate blocks of a thermal insulation is offered (see Fig. 1). Speed of cooling, thus, is regulated at the expense of change of the area of slits between blocks of a thermal insulation and, therefore, value of losses of heat radiation. It is most convenient to realize the offered way on furnaces with a thermal insulation from carbon composite materials [2].

Moving of each block of a thermal insulation is carried out by a separate drive, for example, pneumatic or hydraulic, by means of a rod deduced through vacuum sealing out of the case of the heating chamber.

The offered way of the accelerated controlled cooling allows to maintain the set speed of cooling more precisely, than when using some other ways, for example, cooling in protective gas.

At control system design, a choice of the control law of elements of a thermal insulation moving and selection of settings it is necessary to consider a lag effect of the sensor of temperature and, in particular, the executive mechanism.

Development of a computing procedure of a temperature field in a product in furnaces with a mobile thermal insulation and based on results of modeling of a temperature field of equipment and algorithmic decisions allows to minimize unevenness of a temperature field at preservation of high speed of cooling for products, various in a form and a material. It promotes improvement of quality of production which has passed heat treatment.

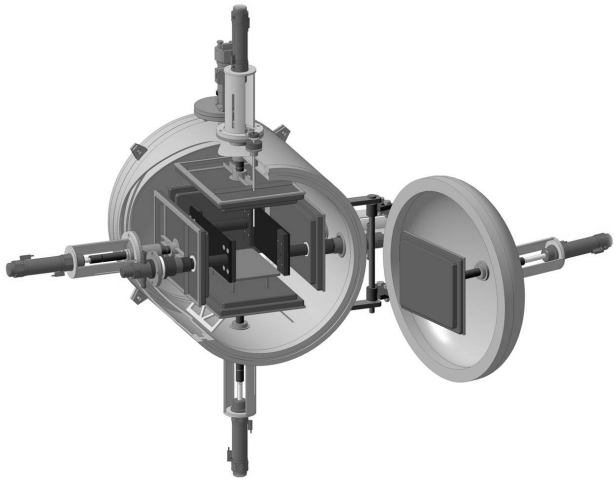

Fig. 1. The furnace with mobile thermal insulation (a cooling stage - blocks of thermal insulation are moved apart)

III. REFERENCES

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