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Research of Dependence of Electro-Thermal Fluidized Bed Heat Electrical Resistivity on the Technological Parameters

The peculiarities of the process, heat exchange research at electrical heating of carbon material in moving dense layer, are electric resistance, which depends on temperature, speed, diameter of particles and current intensity.

Heating process in electrothermal furnace goes the following way: calcined oil coke of middle size (2mm), with the temperature up to 1200 ° Celsius is submitted into the furnace. Coke gets into furnace working zone (boiling layer). Heating of the material occurs because electric current goes through boiling layer of the material from graphite central electrode to side electrodes. Also, nitrogen is submitted into the furnace in order to get boiling layer and increase resistance.

If the temperature increases – electric resistance decreases.

If the speed increases – electric resistance rises too.

If the diameter of particles increases – electric resistance lowers.

If current intensity increases – electric resistance lowers.

The analysis was conducted with the help of V.A. Borodylia's work in which the results of experimental measurements of electrical resistivity are given. Dataset was obtained and statistically processed in the Excel program. The regression dependence of fluidized bed electrical resistivity was obtained in the form of the following equation:

$$\rho = -114{,}961375600348 - 81{,}9940179123134 * I + 428{,}522957631683 * w$$
$$+199{,}062997289718 * w^2 + 0{,}473007186669974 * wt$$
$$+0{,}000640596495299648 * w^2 * t^2 + 4{,}79940723106542E\text{-}09 * It^3$$

where:

I – current density, a/sm^2;

w – the filtration rate of the fluidizing gas (nitrogen), nm/c;

wt – ratio of speed and temperature;

w^2t^2 – speed ratio squared to the temperature squared;

It^3 – the ratio of cubed current density and cubed temperature.

The coefficient of determination equals to 0.77.

In conclusion it is necessary to mention that the experimental heating material research, the development of recommendations as for the choice of constructions of furnace operation with continuous material movement will be developed in the nearest future.