Drying of Copper Powder in a Vibratory Moving Bed

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The drying of electrolytic copper powder is a process which must meet several stringent requirements. The dry powder must contain not more than 0.05% of moisture and not more than 0.1% of oxygen, and in addition to this it must retain its dendritic particle structure and have certain apparent density and particle size values. To ensure that these requirements are fulfilled, in one factory in the Soviet Union copper powder is dried for 60 h in electrically heated vessels at temperatures of 300-350°C. The process is inefficient and impractical from the viewpoint of the amounts of manual labor and energy required. A continuous process in which powder is dried and sintered on a moving belt in a reducing atmosphere at temperatures of 480-780°C is known to be used abroad [1]. In the subsequent comminution operation, however, the apparent density of the powder increases and its dendritic structure is disturbed.

At present vibratory "fluidization" as a means of intensifying the drying of materials is receiving a great deal of attention. The method consists essentially in fluidizing a material by applying vibrations to the surface on which it rests and at the same time blowing through it a drying agent. As a result, mixing of the two phases (a solid and a gas) is accelerated, and the heat- and mass-exchange processes are intensified. The action of the vibrational field on the material increases the rate of evaporation of the moisture contained in it by producing repeated pressure drops. Such processes find their application in industry for drying various articles and building materials, and are usually combined with the lifting (or, more rarely, lowering) of materials [2].

The authors have developed a method and a plant for drying copper powder in a vibratory bed moving in a converted natural gas atmosphere. The development of a pilot plant was preceded by experiments with two - cold and hot - laboratory models. The cold model was a spiral trough mounted on the outside surface of a vertical tube rigidly connected to a VPU-400 universal vibratory drive unit. Experiments conducted with this model established in principle the feasibility of transporting upward wet copper powders with moisture contents ranging from 5 to 30% in a vibratory trough at speeds depending on the amplitudes of the horizontal and vertical vibrations transmitted from the vibrator to the trough.

The horizontal model, which was tested at the State Scientific-Research Institute of Nonferrous Metals, consisted of a drying chamber the working organ of which was an ascending spiral trough mounted on a VPU-400 vibratory drive unit. The powder being dried was heated with 80% Ni-20% Cr alloy spirals fitted around the furnace chamber. In this model, a powder bed of 3- to 4-mm-thickness moving in an inert gas (nitrogen) atmosphere at a temperature of up to 300°C was effectively dried in 10 min.

Pilot Plant Tests

A copper powder drying pilot plant with an output of 150 kg/h of dry powder was assembled and tested in the Powder Shop of the Pyshminsk Electrolytic Copper Factory. In Fig. 1 is shown a general view of the vibratory drying plant, and in Fig. 2 a diagrammatic view of the drying unit.

The drying unit is a vertical transporter consisting of a hollow tube carrying a spiral conveying trough. At the bottom, the transporter is rigidly attached to a VPU-630 universal vibratory drive unit. The conveying trough is enclosed within a heat-insulated housing fitted with electric heating elements.

Fig. 1. General view of drying plant with vibratory moving bed: 1) wet powder tank; 2) drying unit; 3) cooler; 4) dry powder receiver; 5) VPU-630 vibratory drive unit.