The tests showed that Tarasovskii Deposit quartz sands may be used for preparation of steel teeming ladle rammed linings and preliminary grinding of the sand provides longer lining life in service.

At present it has been decided to organize at Tarasovskii Mine Administration an area for production of ramming compounds from ground sand with addition of refractory clay and a binder of orthophosphoric acid.

The data obtained and the service results in steel teeming ladle linings of standard production quartz-containing ramming compounds indicates that these materials must be used for ramming of ladles for teeming of commercial types of steels. A decrease in the length of contact of the lining with the slag will cause an increase in life as the result of formation in the working zone of refractory of a smaller quantity of molten material and an increase in its viscosity. From this results the desirability of increasing the teeming speed to the maximum allowable and introduction of interception of the slag, providing a decrease in the quantity of it in the ladle.

As the result of their high heat resistance rammed linings of quartz-containing compounds may be successfully used under conditions when it is not possible to eliminate a reduction in lining temperature in the period between heats.

LITERATURE CITED


REFRACTORY-FIBER FORMATION PROCESSES

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Creation of new technological processes in different fields of industry and intensification of production by increasing the working temperature of the thermal units require the application of effective thermal insulating and compensating refractory material. Such materials include refractory glass fibers and the products based on them which exhibit a number of specific properties that are superior to those of the dense refractories, viz., lower apparent density, low thermal conductivity, vibration resistance, very high thermal shock resistance, chemical resistance, and low heat capacity. Application of fibrous thermal insulation makes it possible to decrease the weight of the linings of the units, the material consumption for the structures, and the fuel consumption significantly, to reduce the labor involved in mounting, and to increase the productivity of the installations.

Rapid development of the Soviet fiber-refractory industry [1, 2] requires scientific understanding of the processes related to melting of the raw components used for obtaining the fibers and the conversion of the melt into fibers and the fibers into products. Fiber formation is the most critical step. A direct study of the mechanism of fiber formation and its dependence on the properties of the melt and the process parameters is extremely difficult since this process occurs at fairly high temperatures and quite rapidly. Up to now, the studies in this field have been of general technological nature. These studies have not attempted to establish the internal regularities of the mechanism of fiber formation and to give a mathematical description of the mechanism.

Special studies on the theory of the fiber formation process that cover the entire set of phenomena occurring during this process are absent in the published literature. The well-known studies concerning the disintegration of jets, droplets, and liquid films have
been taken into account adequately when investigating the mechanism of fiber formation. In view of this, in most cases, the viewpoints of different investigators on the mechanism of fiber formation are hypotheses that can only be confirmed partially on the basis of the experimental data or by the visual observations of the fiber formation process during the production of mineral and glass fibers.

All the scientific concepts regarding the mechanism of fiber formation are classified into two groups, viz., the hypotheses according to which fiber formation occurs due to prior disintegration of the jet of the melt by the current (stream) of the energy carrier into individual portions (drops) that are elongated subsequently into fibers and the hypotheses according to which fiber formation is a result of direct elongation of the fibers (threads/filaments) from the jet of the melt under the action of the frictional forces developing between the jets of the melt and the current of the energy carrier [3].

It is held that the jet of the melt is initially disintegrated into droplets (drops) under the action of the energy carrier. The droplets separate out from the jet and elongate into cylinders, which are narrowed (thinned) down and form pear-shaped bodies that are connected with threads (dumbbell). These pear-shaped droplets elongate further and are transformed into fibers. In this case, it appears as if the fiber thickness is automatically controlled due to a sharp increase in the viscosity of the melt in the thinnest regions of the thread. If, for some reason, the viscosity of the melt increases considerably, fiber elongation stops and nonfibrous inclusions (splashes/beads) are retained between the fibers and deposit at the bottom of the settling chamber [4, 5].

Lagunov [6] explains the process of fiber formation in a different way. He considers that a droplet emerging from the jet of the melt by the action of steam (or some other energy carrier) is not completely detached from the jet, but moves away and draws out (stretches) a thread from it. According to Shkol'nikov et al. [7], there are two hypotheses concerning fiber formation, viz., friction and breaking up (dismembering). According to the first hypothesis, air or some other energy carrier moves (slides) very rapidly along the surface of the jet of the melt, imparts a certain degree of movement to it due to friction, stretches it, and converts it into a long (but relatively thick) fiber.

According to the second hypothesis, at the region of contact with the melt, the stream of the energy carrier causes distortion of the axis and localized deformations of the jet of the melt because of its turbulent nature of flow. In this case, dynamic pressure (head) of the gas current begins to act on some regions of the jet, breaks it up and separates individual small volumes of matter from it. Owing to the viscosity of the melt, an isolated volume is not separated out from the jet; and a fine fiber forms due to the movement between the isolated volume and the jet. Nonfibrous inclusions can form when the fibers are cut short (broken off). During inflation, the melt cools down up to the solid state within a few hundredths or thousandths of a second, but during this interval, it is subjected to mechanical effects and physical changes. During the period of low viscosity of the melt, the jet is decomposed in air into droplets whose formation is caused by the instability of the cylindrical jet due to the surface tension developed in it. During this period, nonfibrous inclusions (beads, teardrops, etc.) form and fragmentation of a part of the droplets occurs which leads to the formation of two spherical or pear-shaped particles that are connected with threads [4]. With subsequent increase of viscosity, the jet of the melt is fragmented into thin streams (not into droplets) which narrow regions are elongated (stretched) and expanded to attain a softer condition.

A study of the mechanism of fiber formation using multiple (fast) photography made it possible to determine certain parameters of fiber formation [8-13]. The ratio of the viscosity of the melt and the surface tension was found to be an extremely important parameter; in this case, it must not be less than 0.1 since lower values lead to drop-disintegration (atomization) of the jet of the melt.

The most important properties of the melt that determines the choice of the method of forming fibers include the viscosocity of the melt, its cooling rate, the surface tension, crystallization, and wetting [15, 16].

The viscosity and the temperature of the melt are the primary factors affecting the process of fiber formation. The viscosity can be controlled on the basis of the modulus of viscosity $M_v$:

\[ M_v = \frac{SiO_2 + 2Al_2O_3}{CaO + MgO + 2Fe_2O_3 + R_2O + ...} \]