Modified assembly for spraying fine powder

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Abstract: *The results of testing a nozzle with a zero angle of attack for obtaining atomized metal powders are presented, which indicate its increased overhaul life, a satisfactory yield of fine fraction powders with a good spherical powder shape.*
KEYWORDS*: INSTALLATION FOR OBTAINING POWDERS, SPRAYING UNIT, SHOWER, SPRAYED BRONZE POWDERS*

1. Introduction

One of the ways to increase the powders yield of fine fractions obtained by dispersing a metal melt with a gas flow is a nozzle developed on the basis of a Laval nozzle, which ensures an increase in the yield of fine powder fractions up to 80% [1, 2]. However, the developed nozzle has a relatively short overhaul period of the spraying unit, associated with the sticking of melt particles on the lower end of the nozzle for the outflow of the melt jet, and therefore, it is necessary to stop work and replace the part in the spraying unit. As a result, the output of fine powder per shift due to time losses is no more than 6 kg (which corresponds to the weight of the melt in one crucible).

Work purpose - study of the possibility of increasing the overhaul life of the nozzle, developed on the basis of the Laval nozzle, by changing the direction of the gas flow.

2. Experiment results and their discussion

To solve this issue, a small-sized installation was developed to study the processes of obtaining and producing copper-based powders (Fig. 1).

For the experiments, a spray assembly was made, in which the nozzle had a zero angle of attack (Figure 1). It was assumed that this would prevent sticking of metal to the end of the pipe for the outflow of the melt jet, and the process of dispersion of the melt jet would occur due to ejection and a sharp expansion of the air flow.

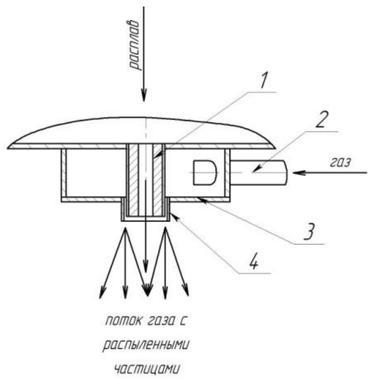

Fig. 1. *The design of the spray unit: 1 - ceramic branch pipe for the outflow of the melt jet; 2 - branch pipe for supplying gas-energy carrier; 3 - nozzle; 4 - nozzle*

Approbation of the nozzle design was carried out as part of a laboratory installation with a metal receiver capacity of up to 10 kg (nominal volume 6 kg).

The appearance of the installation during the spraying process is shown in Figure 2.

Fig. 2. *The process of spraying copper-based powders*

The experiments were carried out in the preparation of powders of tin-phosphorous bronze of the BrO10F1 grade (the charge included copper, tin of the O1 grade, and phosphorous copper of the MF 10 grade). The melt was overheated by 2500 s above the melting point of copper. Within no more than 30 seconds from the moment of readiness, the melt entered the metal receiver and then into the nozzle, which was simultaneously supplied with compressed air. The dispersed powder particles were cooled in water located in the lower part of the apparatus housing. Then the powder was dried in an oven for 2.5 hours at a temperature of 110–120°C, its granulometric composition was determined by sieve analysis, and the shape factor was studied according to the method [3] using the Mini-Magiskan automatic image analyzer by Joyce Loebl . The appearance of the powder is shown in Figure 3, the granulometric composition (averaged data for four experimental batches of powder are given) - in Figure 4. The shape factor was in the range of 0.95-0.97.

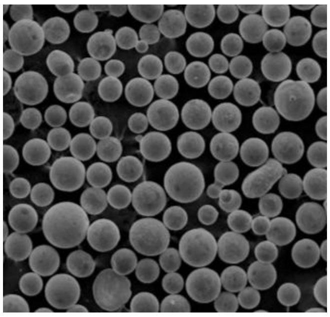

Fig. 3. *Appearance of the manufactured powder*

Fig. 4. *Particle size distribution histogram of manufactured powder*

In the experiments course, 40 kg of powder was produced, after which it became necessary to replace the nozzle for the outflow of the melt jet, that is, in comparison with the previous design, the service life was increased by more than 6 times. However, despite the fact that the yield of fine fractions is quite high (at the level of 75% of particles with sizes less than 160 µm), it decreased by 5–10% [4] (depending on the particle size (up to 160 or 100 µm). On the whole, it can be concluded that it is expedient to use the proposed nozzle design.

Conclusion. The results of testing a nozzle with a zero angle of attack for obtaining atomized metal powders are presented, which indicate its increased overhaul life, a satisfactory yield of fine fraction powders with a good spherical shape of the powder. It has been established that, compared with the previous design, the service life can be increased by more than 6 times. At the same time, the yield of fine fractions is quite high (at the level of 75% of particles with sizes less than 160 µm), although it decreased by 5-10%. In general, it can be concluded that it's expedient to use the proposed nozzle design.

4. References

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