Methods for Controlling Particle Size in Corrosion - Resistant Steel Powders

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The selective melting of dispersed powders using electronic and laser radiation is a new and progressive technological process. The physical, mechanical and metrological properties of products obtained using selective melting are defined not only by controlling the modes, characteristics and parameters of the technological process, such as the protective environment, the size of the work area, the scanning speed, the power and diameter of the focused beam, and the thickness of the layer of powder material, but also the quality of the initial powder material. One important task, which is in many cases the most important one, is to develop technical requirements for the powder materials employed in selective melting using electronic and laser radiation. Both in scientific studies and in practice, the number of powder material properties that influence constant and strict reproducibility of characteristics in the manufacture of consolidated products using the methods of selective melting using electronic and laser radiation is constantly expanding. The quality indicators for metallic power for purposes of selective melting using electronic and laser radiation are its chemical composition, particle size distribution, particle shape, fluidity, apparent density and tap density.

Powders or corrosion resistant steel grades 20X13 and 12X18N9T were used for this experimental work. Metallic powders 20X13 (fraction 0 – 40 micrometers) and 12X18N9T (fraction 20 — 63 micrometers) were manufactured by the Joint Stock Company "POLEMA" (Russia) plant by dispersing molten metal using a jet of

compressed gas.

The dispersion (grain size) for powder materials PR20X13 and PR12X18N9T were determined using a OCCHIO500nano image analyzer manufactured by OCCHIO SA (Belgium) using the static image analysis technique in accordance with ISO 13322-1:2014.

The chemical analysis and particle morphology for the powder material PR12X18N9T was determined in real-time using a VEGA 3 LMN scanning electron microscope manufactured by TESCAN, a.s. (the Czech Republic) using the scanning electron microscopy technique in accordance with State Standard P 54597–2011/ISO/TR 27628:2007. The processing and presentation of measurement results was performed with the aid of the built-in software Aztec ver. 2.0 # 60850, vega 3 control software ver. 4.2.7.0 build 2769.

Conclusions and Recommendations

1. It has been shown that the dispersion of molten metal using a stream of compressed gas permits us to receive finely dispersed metallic powders from PR20X13- and PR12X18N9T-grade steels with a granulometric composition of from 0 to 40 micrometers and from 20 to 63 micrometers, which is suitable for selective laser melting.

2. It has been shown that PR12X18N9T has a narrow distribution range and a larger quantity of spherical particles, as a result of which high fluidity is achieved and the product roughness class obtained through selective laser melting is increased. Spherically shaped particles have a small surface area and, as a result, are more easily applied to the surface of the working area in selective laser melting installations.

3. It is recommended that, based on the example of PR20X13, metallic powders be sifted before each subsequent used in selective laser melting installations in order to avoid reduced quality of products obtained.

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