Unified Device for Hydro-Vacuum Dispersion of Melts to Produce Various Types of Activated Powders

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Abstract:

Against a backdrop of progressively growing demand for producing high-quality metal powders, the problem of developing new, high-throughput methods for melt dispersion and energy-efficient devices has become highly relevant, where the task of minimizing energy-intensive processes for subsequent thermo-mechanical, anti-oxidation, and activation treatment of the produced powders has also been placed on the agenda. Based on the assigned tasks, the main goal of the research was to improve and unify the hydro-vacuum dispersion method that we developed and related equipment, through modernization of process units and parametric optimization. This was achieved by practical implementation of new technical solutions discovered on the basis of the system analysis of the results of simulation modeling of the dispersion process and experimental studies. As a result, the new device has acquired the function of mono-stage realization of hydrovacuum dispersion of the metal melts and asymmetric deformation-mechanoactivation technological processes, as well as the ability to control the fractionation of the produced powder materials. In addition, it has already become possible to use this device for almost any type of the previously problematic metallurgical (metal and non-metal) melt with below average fluidity (according to the core spiral ≈ 100 mm), making the device completely multifunctional, technologically flexible, and universal. In addition, large-scale experimental studies of the optimized dispersion technological process revealed unforeseen positive results for the project, such as the removal of unwanted oxidized (slag) inclusions from the produced powders and particle sonochemical hydrogenation. The first result is important in the context of the emergence of prospect for using partially contaminated, relatively cheap secondary metal melts in the production of high-quality powders, which were previously unused. The second result is noteworthy in terms of the possibility of directly using the produced powders without the need for prolonged activity maintenance and anti-oxidation-hydrogenation treatment. The implementation of the new knowledge and experience gained within the project is important for the further development of the powder materials industry due to its interdisciplinarity, ease of scaling, and techno-economic efficiency. The working technological line of the new device has been implemented and is being successfully functioning in the project co-financing partner organization, LLC “Geo Interpise”.

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Website of materials presenting completed works: https://imm.ge/en/sax.html

Video footage of the work carried out:

https://www.youtube.com/watch?v=FcGjfPD6DSo
https://www.youtube.com/watch?v=-8nlJRr13Qw
https://www.youtube.com/watch?v=Nij33oZLNi0
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