ANNOTATION

On dissetation for the degree of Doctor of Philosophy PhD.
on a specialty 6D070900 - "Metallurgy"

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Research and development of technology for smelting an aluminum-chromium-silicon alloy using Borly high-ash coals as a reducing agent

Objective – research and development of technology for smelting an aluminum-chromium-silicon alloy using Borly high-ash coals as a reducing agent.

Research tasks:

- agglomeration of substandard chrome ores using suction dust from the production of ferrosilicon aluminum;
- preparation of a computer program for the calculation of the mixture for smelting aluminum-chromium-silicon complex alloy;
- laboratory experiments in the Tamman furnace to obtain a complex aluminum-chromium-silicon alloy;
- large-scale laboratory tests in an ore-thermal furnace with a transformer capacity of 200 kVA for smelting the complex alloy ACS;
- production of nickel-chromium cast iron from substandard nickel ore using a complex aluminum-chromium-silicon alloy.
- conducting pilot tests to obtain corrosion-resistant and heat-resistant steel 30X13L using a complex aluminum-chromium-silicon alloy.

The relevance of research.

The need to expand the raw material base by involving in the processing of substandard raw materials, industrial waste, unclaimed coal. Increasing consumer requirements for the quality of products.

The introduction of aluminum-chromium-silicon alloy smelting technology using Borlino high-ash coals as a reducing agent will lead to the expansion of the country's chromium ore base. This technology has the following advantages:

- poor chrome ores unsuitable for the production of chromium ferroalloys according to existing technologies can be used unenriched, i.e. one redistribution is excluded;
- industrial waste - suction dust from the production of ferrosilicon aluminum, which is captured by dry gas purification filters used to produce pellets;
- the integrated use of poor chrome ores - waste rock and coal ash serve as raw materials for obtaining silicon and aluminum in the alloy;
- the use of low-grade charge materials - poor ores and high-ash coals will ensure low cost of the obtained alloy ACS;
- complex aluminum-chromium-silicon alloy can be used for deoxidation and alloying of steel and in the production of nickel-chromium-containing cast iron.

Scientific novelty. For the first time in this paper:

- Theoretical basis for the use of FSA as a dusting flux in fluxing processes of poor substandard chrome ores.

- The simulation of the technological process for producing pellets from substandard chrome ores using the method of mathematical planning of the experiment. The partial and generalized equation for the dependence of the strength of the pellets on the consumption of PSA and binder, the diameter of the pellets and the sintering temperature are obtained.
- The scientific basis for the production of a complex alloy of ACS using high-ash Borly coals as a reducing agent has been developed.
- Based on the study of the microstructure of an experimental corrosion-resistant heat-resistant steel grade 30X13L, it is shown that the use of the complex alloy ACS provides a fine-grained martensitic structure

The practical value of the work.

- A technology has been developed for sintering substandard chrome ores using suction dust from the production of ferrosilicon aluminum;
- The involvement of poor substandard chrome ores in the production contributed to the expansion of the raw material base of the Kazakhstan ferroalloy industry;
- An efficient technology has been developed for the production of nickel-chromium-containing cast iron from substandard nickel ore using a complex aluminum-chromium-silicon alloy.
- A technology has been developed for the production of corrosion-resistant heat-resistant steel 30X13L on arc steel furnaces: DS-6NT and DSP-1.5 of Kurylysmet LLP using a complex aluminum-chromium-silicon alloy.

The main provisions of the work to be defended:

- test results for testing the modes of pelletizing feedstock using FSA dust;
- results of a study of the physicochemical properties of high-ash coal of the Borly deposit;
- technical solutions for obtaining a complex alloy aluminum-chromium-silicon;
- test results for the smelting of nickel-chrome-containing cast iron using a complex alloy AXS;
- microstructural studies of corrosion-resistant heat-resistant steel grade 30X13L using a complex aluminum-chromium-silicon alloy;
- technological schedule for the smelting of a complex chromium alloy in an ore-thermal furnace 200 kVA.

The work was carried out at the Department of Nanotechnology and Metallurgy of the Karaganda Technical University and in the laboratories of “Ferroalloys and Recovery Processes” and “Metallurgy of Cast Iron and Fuel”, the experimental section of the Chemical and Metallurgical Institute named after J. Abishev. Pilot tests were carried out on the electric arc furnace DC-EAF-6NT and 1,5Fassonno-foundry (FLC, Kurylysmet LLP, JSC "AMT").

Work approbation: The main scientific results of the thesis are presented in 8 publications published in the Republic of Kazakhstan and abroad. In the publications recommended by the Committee to ensure quality in education and science of the Republic of Kazakhstan for publication of the main results of scientific activity, 3 articles were published (Proceedings of the University, Karaganda,

Kazakhstan) and 1 article included in the Scopus database (Steel in Translation, PleiadesPublishing, CiteScore 2018 - 052, SJR 2018 - 0.410, SNIP 2018 - 0.750, percentile - 30). The author has published 4 reports at international scientific and practical conferences (with personal participation). The main provisions of the thesis are presented and discussed at the international scientific-practical conference "Innovations in the field of natural sciences as the basis for export-oriented industrialization of Kazakhstan", dedicated to the 10th anniversary of the Kazakhstan National Academy of Natural Sciences and the 25th anniversary of the National Center for the Integrated Processing of Mineral Resources of the Republic of Kazakhstan, Karaganda, Kazakhstan, as well as at the congress with international participation and the conference of young scientists “Fundamental research and applied development of the process in the processing and disposal of technogenic formations ”(Technogen-2019) Yekaterinburg, Russia.

The structure and scope of the dissertation: The distribution consists of an introduction, the main part of 4 chapters, conclusions, 6 appendices. The volume of the distribution is 105 pages of the machine text, the work contains 26 figures, 37 tables, a list of the used sources, including 87 names.