

AP19576811 “Development of technology for obtaining a conditioned product from highly dispersed dust of ferroalloy production” – p.m. Issagulova D.A.

Relevance:

The production of ferroalloys generates a large number of by-products: slag, precipitation of small fractions of ore raw materials and finished products (ferroalloys), sludge, dust and a number of other materials. Their utilization and processing allow to reduce the consumption of initial minerals, thus increasing the efficiency of the main production and reducing environmental pollution. The greatest environmental risks are represented by technogenic wastes of ferroalloy metallurgical industry, which are finely dispersed formations in the form of dusts and sludges of various types of production. One of the main methods of enlargement of powdery substances is briquetting as a process that requires energy inputs only for giving a certain shape to briquettes and their compaction and does not require heat energy inputs for agglomeration. Briquetting is the cheapest and most compact way of pelletizing various dusty materials, so it becomes economically feasible to pelletize industrial waste by briquetting on presses.

The project purpose:

Creation of a new technology for production of ferrosilicon briquettes from highly dispersed dust of ferroalloy production using a new complex binder material.

Expected and achieved results:

According to the results of the project realization there will be:

- a new composition of briquetted ferrosilicon will be obtained;
- a new technology for obtaining durable briquettes from dust has been developed;
- the mechanism of interaction of highly dispersed dust of ferroalloy production with a new complex binding material was determined.

For 2023 - Work was carried out on the feasibility of feasible development of ferroalloys in the RoK while obtaining a conditioned product from ferroalloy dust.

The main trends in the development of ferroalloy production in the world production were identified. The data on binder compositions and their chemical properties are revealed.

Ferrosilicon (FeSi) is used in the steel industry and as a modifier added to the melting process, as a deoxidizer and melting stuff in the production of steel and cast iron.

Information analysis shows that at the stage of ferroalloys production a large amount of waste from highly dispersed ferroalloy dust and a number of other materials is generated. Their utilization and recycling allow to reduce the consumption of the main raw materials, as well as to increase production efficiency and reduce environmental pollution.

However, the scale of utilization of ferroalloy production waste is relatively small. Recycling and reuse of waste as secondary resources is currently relevant.

The conducted information analysis has shown that the ways of waste utilization in the smelting of ferroalloys at the plant remain insufficiently studied. Briquetting is an attractive way of their recycling. Briquettes introduced into furnaces must have certain mechanical and chemical properties. However, there is no standard to determine the suitability of briquettes used in the smelting process. And there is no optimum binder material, for utilizing the waste. Thus, using different binders, it is possible to find a method of briquetting of ferroalloy wastes, including highly dispersed dust, which allows to obtain strong briquettes and increase the degree of assimilation of alloying elements in their subsequent use.

Work was carried out on sample dust briquettes of ferrosilicon with 0-3 mm grain fraction based on liquid glass addition. Ferrosilicon production is an energy intensive process involving high consumption of electricity and raw materials such as ore, quartz (quartzite), fluxes and reducing agents such as coke, coal and biomass. Ferrosilicon production also produces residues which are by-products such as filter powders (silica fume), sludge from scrubber and slag from smelting process. Briquetting and pelletizing are also a convenient and economical way to utilize ferrosilicon dust. And the high pressing force results in briquettes that are strong, no crumbling, published a journal article from the CQAES database.

1 article was published in the journal with CiteScore percentile in Scopus database 35.

1 patent of the Republic of Kazakhstan for a utility model was obtained.

For 2024 - Work has been done to investigate the use of different components as binder.

One of the key issues arising in briquetting is the proper selection of the binder. The binder must provide a certain amount of ductility to form the briquette, mechanical strength after appropriate processing (e.g. drying) and must not change the chemical composition of the briquette too much, so that the briquette composition complies with the All-Union State Standard for the ferroalloy in question.

A considerable amount of work has been devoted to the search for a binder and development of charge composition for briquetting on the basis of VP.

The optimal binder composition was selected on the basis of mechanical and chemical properties of the obtained briquettes. The optimal composition of the conditioned product was determined.

A complex composition of liquid glass and bentonite clay is proposed as a binder. Various ratios of these additives were investigated. The probable mechanism of hardening is enveloping (cladding) of dispersed dust particles with clay and their good adhesive bonding in the medium of liquid glass.

A preliminary process flow chart was obtained - laboratory studies were conducted to evaluate the influence of composition and structure of briquettes from highly dispersed dust of ferroalloy production.

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Figure 1 - Sample 4
a - before testing; b - after testing



Figure 2 -- Microstructure of briquettes

Research team:

Issagulova Diana Aristotelevna - Project Supervisor, PhD, Associate Professor of the Department of “Nanotechnology and Metallurgy”, Abylkas Saginov Karaganda Technical University, Hirsch Index is equal in Clarivate Analytics 2, in Scopus 3, in RSCI 6. Scopus ID 55778253200..

Yerzhan Aidana (Omarova) - responsible executor, doctoral student of gr. METD-22-1 of “Nanotechnology and Metallurgy” department, Abylkas Saginov Karaganda Technical University, Hirsch Index 2, ORCID 0000-0002-6942-2020, Researcher ID ABD-5912-2021, Scopus ID 56901129500.

Arinova Saniya Kaskataevna - executor, PhD, Lecturer, Department of Nanotechnology and Metallurgy, Abylkas Saginov Karaganda Technical University, Hirsch Index 1 Scopus ID 57192206332.

Dostaeva Ardak Mukhamedievna - executor, PhD, Acting Associate Professor, Department of Nanotechnology and Metallurgy, Abylkas Saginov Karaganda Technical University, Hirsch Index 4. ORCID 0000-0002-1982-2368, Researcher ID AAB-9478-2020, Scopus ID 57160297400.

Kovaleva Tatiana Viktorovna - executor, teacher, Department of Nanotechnology and Metallurgy, Abylkas Saginov Karaganda Technical University, Hirsch Index 2, Researcher ID : A-2567-2017, ORCID 0000-0002-1186-1805, Scopus ID 57211297553.

Aitbaev Nurlan Berikuly - executor, Senior Lecturer, Department of Nanotechnology and Metallurgy, Abylkas Saginov Karaganda Technical University, Hirsch Index - 2, Scopus Author ID: 57211295299, ORCID: 0000-0002-7469-4442.

Alina Araylym Altynbekovna - executor, teacher, Department of Nanotechnology and Metallurgy, Abylkas Saginov Karaganda Technical University, Hirsch Index 0, ORCID 0000-0003-3577-4914, Scopus ID 57218196165.

Adamova Gulden Hasenovna - executor, doctoral student of gr. METD-21-1 of “Nanotechnology and Metallurgy” department, Abylkas Saginov Karaganda Technical University, Hirsch Index 0, ORCID 0000-0001-6933-6571.

List of publications:

1) Omarova A.E., Issagulova D.A., Kvon SV.S., Kovaleva T.V. Selection of binder for production of briquettes from highly dispersed dust of ferroalloy production/ DOI 10.52209/1609-1825_2023_3_79. Proceedings of the University No. 3 (92) - 2023. <http://tu.kstu.kz/archive/journal/26>

2) D.A. ISSAGULOVA, SV.S. KVON, A.E. OMAROVA, T.V. KOVALEVA, V.YU. KULIKOV, A.A. ALINA/ Studying the binder effect on the properties of briquettes of ferroalloy production waste. ISSN 0543-5846 METABK 63(1) 143-145 (2024). Журнал METALURGIJA 63 (2024) 1, 143-145. Croatia.

3) Patent for useful model. Authors Omarova A.E., Issagulova D.A., Kovaleva T.V., Alina A.A. No.8617 dated 10.11.2023.

4) Erzhan A., Kvon Sv.S., Issagulova D.A., Kulikov V.Yu., Kovaleva T.V. «The possibility of using iron ore concentrate as a binder when briquetting waste of ferroalloy production» // METALURGIJA 63 (2024) 3-4, 454-456. (Croatia). (Scopus percentile – 35, CiteScore 1,2), P454-456. - <https://hrcak.srce.hr/en/file/456164>

Information for potential users:

The obtained results are the basis for more detailed studies on the development of modes of pressing and drying from the VP of Kazakhstan content for the production of a conditioned product.

Scope:

Metallurgy, ferroalloy production.

Information update date: 05.07.2024.