

# **The technology of processing high moisture ferriferous slime to obtain a complex iron-carbon-containing materials for metallurgical processing and new commercial products**

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**Abstract – Thus, the proposed project and the technology will make it possible to organize production processing high-moisture of iron-containing slime and receiving integrated iron agglomerate material as a secondary metal-containing raw materials for metallurgical plants producing steel and steel products, to fully utilize not only iron-containing slime, but finely pulverized waste calcining limestone and raw dolomite (limestone and dolomite dust from dry gas cleaning) as drying and binding materials, as well as screenings of coke and coal as the reductant, which also solves the problems of air pollution and land data production.**

**SPELL: sludge, recycling, zero-discharge technology, dehydration, dust, air pollution.**

## **Introduction**

Metallurgical production is technologically accompanied by formation of a significant amount of various waste reaching 30% from production of steel. It consists about 80% from them slags, and about 20% - the dust and other waste.

Processing and utilization of techno genic waste are important not only from the point of view of their use as alternative source of raw materials, but also from the point of view of environmental protection. Thus waste often surpasses in technological qualities the ores extracted from subsoil. However, despite the huge resource potential, mining waste in Kazakhstan are used, generally as the raw materials for building industry, but also here are processed no more than 10% of annual volume of their formation.

It belongs to high-damp ferriferous slimes of metallurgical production. Due to the lack of effective technologies of dehydration and ball milling they are, as a rule, stored in the ashes and slime store where mix up with other slimes and dust, and their metallurgical value is lost.

There are annually formed on JSC “ArselorMittal Temirtau” about 95-100 thousand tons of ferriferous slimes of domain and oxygen converter’s gas purifications which contain 35-45% of iron and others, important for metallurgical processes of elements’ oxides (calcium, magnesium), and which by the slime conductor it is stored in the ashes and slime store. There are annually formed on JSC “Aluminum of Kazakhstan” about 100 thousand tons of ferriferous sand with the maintenance of 50-75% of iron which also develop on slurry fields. Considering that the content of iron in natural iron ore concentrates decreases (45-50%), ferriferous slimes can be good substitute of iron ore concentrates and will reduce need for natural ore materials. But it is possible in the presence of technology of preparation of ferriferous slimes to metallurgical processing (dehydration and ball milling). Today in Kazakhstan in the ashes and slime store there is store million tons of ferriferous slimes of various productions, also are formed technogenic fields of ferriferous materials which could serve as metallurgical raw materials and substitute of natural iron ore materials. Besides they, as a rule, are in close proximity to the metallurgical enterprises. The problem consists in fine dispersibility and increase of slimes’ humidity.

On the other hand, at the metallurgical enterprises of a full cycle what JSC “ArselorMittal Temirtau” treats, a large number of finely dispersed calcium - and containing magnesium dust is formed by roasting limestone and crude dolomite in the form of a limy and dolomitic dust, which are fine dehydrating and astringent materials and, as a rule, aren’t demanded and also are stored in the ashes and slime store.

Existing technologies of recycling of waste of various productions, first of all, the metallurgical – are imperfect. For example: use of agglomeration slime by production of agglomerate has a technological limit not higher than 250 kg on agglomerate ton.

Solution of the problem of development of high-damp fine ferriferous slimes dehydration technology, and also development of complex composite self-repairing materials as alternative sources of raw materials, can serve as a basis for creation of resource-saving, low-waste, closed and ecologically safe and drainless metallurgical processes which solve not only problems of raw materials, the maximum involvement of production wastes in economic circulation, but also environmental problems of the region.

### **Background of the subproject, proof of the level of innovation in the technology**

Prerequisites to development of this project was consistent new patterns determined by author when processing high-damp ferriferous slimes of calcium and containing magnesium materials (limy, dolomitic dust) for chemical dehydration of slime, mix curing, as cement mix gauging by water, with dehydrated material formation in form of small slurry, limy sand. When hashing of high-damp slime with dehydrating materials, owing to exothermic reaction of calcium and magnesium active oxides with slime moisture interaction, system temperature increases to 95-110 °C, and part of moisture evaporates and removed in form of steam [1-3].

On offered way of high-damp ferriferous slime dehydration of JSC “ArselorMittal Temirtau” converter gas purifications technological preparation scheme for slime utilization on agglfactory as ferriferous material is developed [4, Application 3, fig. 3.2 p. 40 ], the technical-economic report for separation construction on preparation for utilization of this slime is executed [4, Application 3. p. 44-83]. Further researches determined new consistent patterns, allowed to develop without roasted way of ferriferous agglomerate material and self-restoring briquettes production. Essence of the way, which is one of scientific novelty’s basic provisions, is combination of dehydration’s processes, mix self-curing with shaping process by imposing of external pressure upon hardening mix in compression molds with receiving agglomerate material in briquettes form. Offered technology doesn’t demand drying and roasting, set of strength properties occurs on air within day in process of material cooling. The Innovative patent RK N 23987 [5], the Innovative patent RK N 25103 [6] is taken out. The result of new research have developed a new more efficient resource-energy-saving technological scheme of production agglomerated iron-carbon-containing material for technologies of metallurgical production.

Developed innovative technologies for the preparation of moisture slime for recycling were presented in the Catalogue of the exhibition of achievements of the domestic industry "the Development of mining and metallurgy and coal industry"[7], in Proceedings of all-Russian conference "research in the field of

processing and recycling of industrial wastes and from the school for young scientists [8] and presented in the monograph "Resurse-energysaving waste processing technologies in metallurgical production [9].

During carrying out researches is developed laboratory complex for fine high-damp materials briquetting, realizing basic provisions of the developed way, i.e. combination of dehydration, self-curing and shaping processes in one cycle. Patent for useful model № 586 [10].

In world practice production technologies of ferriferous briquette are known, but they differ from technology offered by us of preliminary dehydration expensive and difficult technologies use (thermal, vacuum) and multistage of technologies of an agglomeration, which are high-power-intensive and expensive technologies [11]. The closest to offered technology is the production technology of metallurgical self-restoring briquette of the Russian firm "EkoMashGIO". Unlike offered technology ferriferous slime with humidity of 15-20% is used, is applicable for the stale slimes taken from slime store. In essence offered technological scheme of "EkoMashGIO" doesn't exclude transportation of ferriferous pulp on multikilometer mud line and warehousing in slime store. Besides, as a astringent and strengthening material in the "EkoMashGEO" technology is used cement that raises the price of the cost of metallurgical briquette. [12].

### **Technical section and a description of the technology**

The slurry pulp from technology or systems of wet gas purifications is pumped over directly on offered installation (separation) ( figure 1), where the slurry pulp is condensed in pressure head hydro clones to humidity of 40-50% and the condensed slime goes to the conveyor where also from dosing bunkers dust-like lime and / or dust-like dolomite, and also elimination coke breeze or dust-like coal is loaded. From the conveyor materials move in screw mixer-activator where process chemical dehydration is made. From the mixer the dehydrated warmed slurry and limy mix arrives on roll or vibration press where the agglomerate material with residual humidity of 5-9% is formed. Briquettes are stored on pallets for cooling and durability of pressure at air temperature. The clarified water from hydro cyclone is pumped over and comes back to technological process.

The offered technology, in essence, allows to create closed system of water supply not through pond clarifier (slime store), through offered installation (separation), that considerably cuts down water expenses, labour and energy consumption on transportation of slurry pulp on multikilometer mud line in slime store and clarified water back for technology, and also costs of service pump and mud line and slime store. Thus ferriferous slime in form of agglomerate composite material can be used as substitute of iron ore concentrate in through technology of steel smelting and cast iron. There is excluded allocation of land under slime store for slimes warehousing and provided fuller utilization of production technogenic waste.

The proposed project is the basis for the creation of resource-saving, low-waste, closed and environmentally friendly inland metallurgical processes that solve not only the problems of raw materials, the maximum involvement of waste in the economic turnover, but also environmental problems of the region.

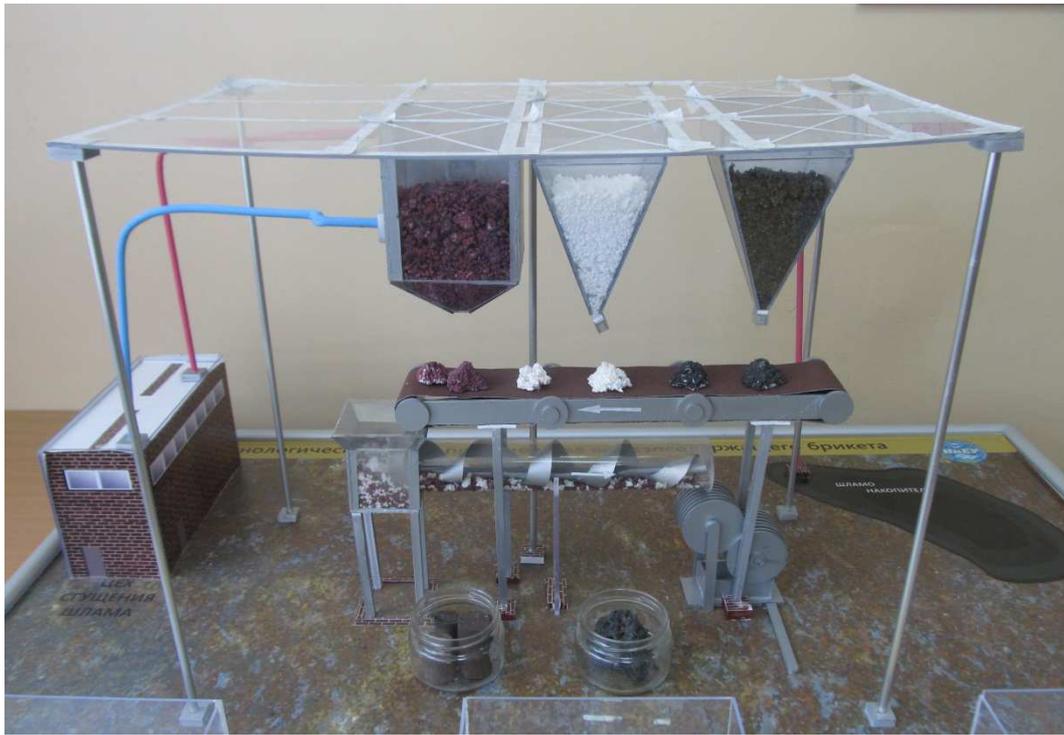


Figure 1 - Sample layout of the technological scheme of processing iron-containing slime

Competitiveness of offered technology in comparison with similar foreign analogs consists in the following:

- exception of transportation and slime warehousing in slime store and slime processing in close proximity to formation source;
- decrease of labour and energy consumption on transportation and slime warehousing, service slurry pump, mud line and a slime store;
- need of slime's drying before production of iron ore briquettes disappears:
- single-stage process of dehydration, self-curing and shaping with receiving complex of stamflux and carboniferous agglomerate material in one production cycle;
- use as a dehydrating and astringent material waste of calcium and magnesium containing dusts (dust-like waste), eliminations of coke or coal of own production;
- need of drying and roasting of agglomerate material disappears.

As a result of implementation of the project will be sold products in the form of secondary iron-carbon-containing agglomerated material and iron-carbon alloy as a substitute for iron ore materials and scrap for steel production and iron and alloys.

Ferrous agglomerated material and iron-carbon alloy cleaner on the content of harmful impurities (sulfur, phosphorus, non-ferrous metals), waste rock, mill scale and has at its compounds oxides of calcium, magnesium, aluminum, which will reduce the consumption of fluxing materials technology metallurgical production.

Production is focused on metallurgical enterprises for the production of steel and rolled of Kazakhstan.

The proposed subproject eliminates the storage of iron-containing slime in secondarily or slurry on the fields to return in technogenic waste production waste, to acquire new marketable products and to reduce the consumption of natural iron ore and fluxing materials and sieves not only technological and environmental problems of metallurgical production. The proposed technological scheme of processing will reduce environmental charges for storage of waste, reduce the amount of unbalance waters and the pollution and underground.

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