

AP23487471. Research and development of technology for obtaining lining from technogenic waste of steelmaking production for furnaces of the metallurgical industry. sc.sp. – Arinova S.K.

Relevance

Currently, the foundry and metallurgical industries of Kazakhstan require more than 500 thousand tons of refractory materials annually. The main factors leading to premature wear of these materials are their insufficient thermal resistance, low density, and destruction under the influence of molten metal.

To improve the thermal resistance of refractories, the use of steelmaking production waste is increasingly being applied. Kazakhstan has already accumulated 32 billion tons of industrial waste, and this volume continues to grow. A significant portion (70%) consists of technogenic-mineral formations. In the Karaganda region, 110.7 million tons of this waste are concentrated, of which only 42% is recycled, and the rest is stored on industrial sites. Recycling and utilizing technogenic waste in metallurgy, particularly for furnace lining, can be a solution to this problem. This approach will reduce the anthropogenic impact on the environment near metallurgical enterprises, decrease resource and energy consumption of production processes, and increase environmental and economic efficiency.

Project objective: Development of the composition and production technology of furnace lining based on waste from the metallurgical industry, with increased strength and density using mineral raw materials of the Republic of Kazakhstan.

Results achieved:

Prototypes with different levels of man-made waste were obtained. Steelmaking slag, which is characterized by a high content of calcium silicates, was used as an additive that increases the heat resistance of refractory materials. Studies have shown that it is most advisable to use a fraction of fireclay scrap 0.8-0.9 mm (60%) as the main filler; fine-grained fireclay clay (0.2-0.3 mm, 10%); clay suspension with a moisture content of 7-8% (30%), which ensures the production of high-quality refractory material. In this case, it is advisable to press the samples with a pressure of 22-23 MPa, sinter at a temperature of 1250-1270 ° C for 10-12 hours. Some dependences between strength and heat resistance have been obtained. The conducted studies have shown the fundamental possibility of using low-quality coal ash as a component of the charge for the production of refractories. The use of coal ash in an amount of 10-30% by weight in a mixture with clay for the manufacture of refractories makes it possible to maintain the compressive strength and density of samples at the level of existing refractories of the SHA class (comparison sample), but at the same time reduce open porosity, reduce the proportion of large pores larger than 10,000 nm, which provides higher slag resistance. The microstructure of the samples was studied, which showed that the experimental sample of chamotte clay had a more homogeneous structure and fewer rounded pores.

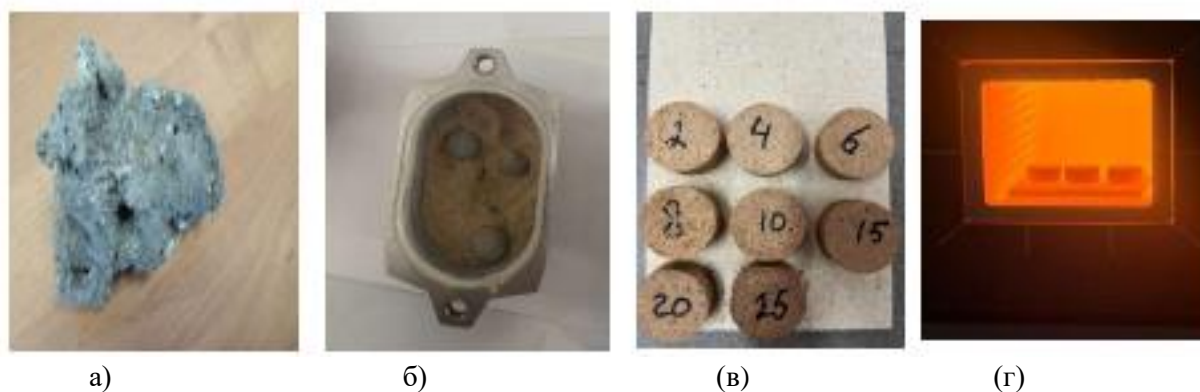
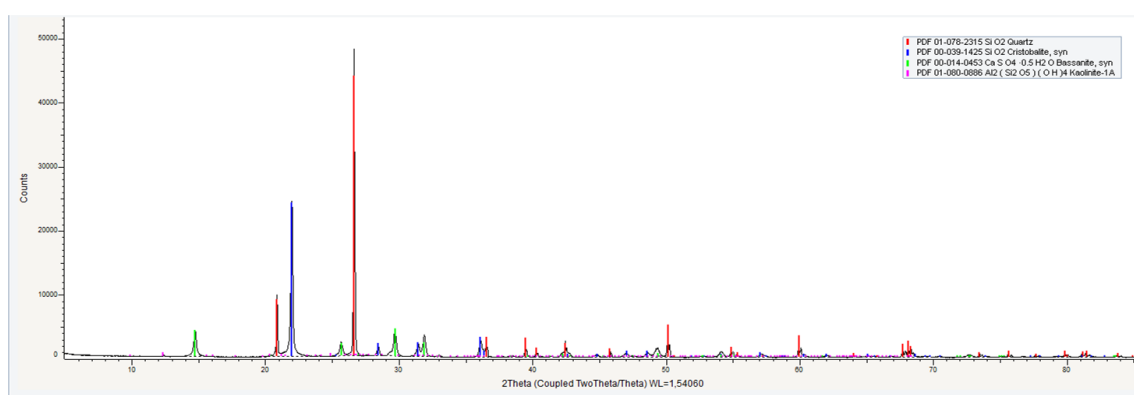
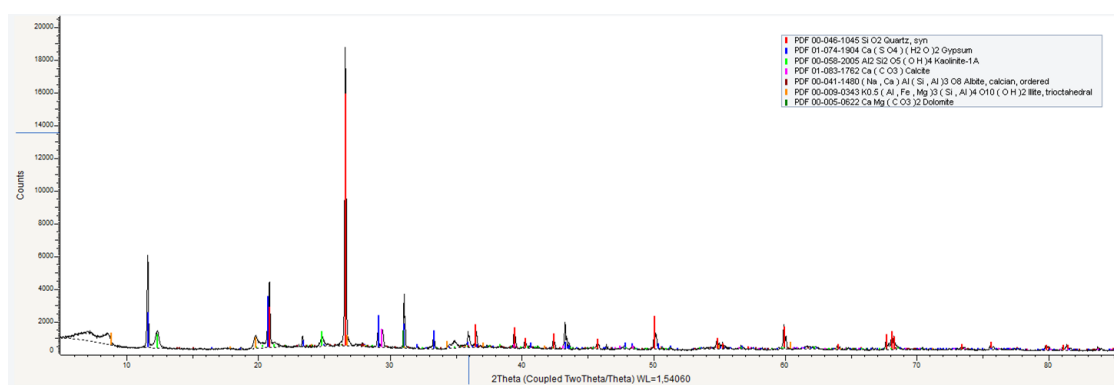


Figure 1. (a) The original sample; (b) a mixture of raw materials; (c) the general appearance of the briquettes; and (d) sintered samples.



a)



b)

Figure 2. (a) X-ray of ash; (b) X-ray of clay sample

List of publications:

1. Arinova S.K., Kvon S.S., Kulikov V.Yu., Altynova A.E. Utilization of Coal Ash for Production of Refractory Bricks // Journal of Composites Science, 2025. – № 9(275). – Pp. 1-16. (Scopus 76th percentile).

2. Arinova S.K., Kulikov V., Kvon St.S., Altynova A.E. Studying the compositions and modes of manufacturing refractory products using steel products using steel production slag // Acta Metallurgica Slovaca, 2024. – No. 4. – pp. 74-77 (Scopus 53 percentile).

3. Arinova S.K., Altynova A.E. Investigation of the properties of refractory materials based on waste from metallurgical production // Science and Technology of Kazakhstan: Publishing House of Toraigyrov University. – 2025. – No. 1. – pp. 222-229. (KOKSNVO).

The Research Group

It includes 6 performers, 3 of them are under the age of 40, 5 people have an academic degree.

The consultants are:

- Ph.D., Associate Professor. Kovalev P.V. (Peter the Great SPbPU, Saint Petersburg, Russia)

Information for potential users:

The obtained scientific results can be applied in the development of new production facilities and sites of metallurgical and foundry industries.

Scope of application:

The scope of application of this program is foundry metallurgical and machine-building enterprises.

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