The article presents the results of laboratory tests on the use of fluxing agents for improving the sintering technology of refractory chromite ore in Kazakhstan. It is shown that reduction to solve the most efficient thermal process level through the use of fluxing agents having a low melting temperature and low temperature promote the formation of compounds in interaction with components of the ore phase. As an effective flux is proposed to use the calcined colemanite and basaltic rocks. The optimal cost fluxing agents, ensuring reduction of the thermal level the firing process at 100 °C.

**Key words**: chemical composition, chromite ores, pellet production, fluxes, Kazakhstan

**INTRODUCTION**

In terms of quality of lump raw material shortages for reliable source of raw materials ferroalloy plants, increasingly becomes important task involving the production of substandard size chromite ore fines, the amount of which is 50 % or more of the mined ore. However, issues fines agglomeration, chromite ore of Donskoi GOK to date remain valid.

Difficulty agglomeration Kazakhstan ores calcined methods due to their high melting point (1 500 °C and higher) due re-fractroriness both ore phase (Cr-spinel) and the host rock, mainly represented by serpentine (3MgO · 2SiO2 · nH2O), passing on firing forsterite 2MgO · 2SiO2, having a melting point of ~ 1 900 °C.

The chemical composition of the mineral constituents of chromite ore deposits “40 years of the Kazakh SSR”, which now form the basis of ore base ferroalloy plants in Kazakhstan are presented in Table 1.

Sintering them to obtain durable agglomerates material occurs at temperatures above 1 400 - 1 500 °C. However, increasing the pellet sintering temperature or sintering in the layer by increasing the fuel flow leads to serious complications in the operation of firing equipment. For this reason, hitherto unsolved issues on an output at full capacity in a factory producing chromite pellets Don GOKa operated by Outokumpu Technology, with a firing temperature of 1 400 °C [1].

More effective is the reduction of the melting point of the charge, and accordingly, the process temperature and by introducing various fluxing agents having a low melting point and low temperature promote the formation of compounds in interaction with components of the ore phase. As the most widely used fluxes silicon- and aluminum-containing materials [2, 3]. Their choice is justified by the fact that these components are used in the smelting of ferrochrome slag for adjusting mode and eventually charge dilution at agglomeration of the main component is performed partially or wholly by reducing the amount of flux in the smelting.

They are tested as fluxes fusible Turkish colemanite (mp. ~ 1 004 °C) and basalt rock, are used mainly as raw materials for the silicate industry, and for the comparative analysis of quartzite screenings, which are successfully used in the agglomeration chromite fines [4].

The chemical composition of the mixture components is presented in Table 2.

The reason for using basalt as binder materials are the results of the analysis of its mineral composition, which revealed that almost all varieties of basalt rocks in the system CaO – MgO - Al2O3 - SiO2 sufficiently covers elementary tetrahedron anorthite (CaO · Al2O3 · 2 SiO2) - diopside (CaO · MgO · 2 SiO2) - enstatite (MgO · 2 SiO2) - SiO2, where an extensive area of compositions having a melting temperature 1 200 – 1 300 °C[4]. It proposed as a siliceous flux basalt deposit “Dubersay” Aktobe region whose composition is shown in Table 2 has a melting point of ~ 1 450 °C. However, the ratio of components therein such that in the system CaO – MgO - Al2O3 - SiO2 with increasing content of MgO and 10% of its composition falls in the range of low temperature eutectics (CaO - 13 - 20 %, SiO2 - 55 - 60 %, Al2O3 - 15 - 20 %, MgO - 10 - 12 %) with a melting temperature 1 200 – 1 300 °C. The development of this process will facilitate the intimate contact of finely divided flux and chromite ore host rock which contains 36 – 38 % MgO, in the granulation process and, consequently, the early liquid phase formation during sintering. Another important factor is the proximity of depos-
its of basalt from the consumer. For comparison, we also conducted experiments using quartzite screenings.

**METHODS**

Laboratory experiments to simulate the production process parameters and study the effect of different flux quality chromeite pellets performed using chromeite concentrate particle size of 0 - 3 mm, which was finished to size by output class -0,074 mm 79,5 %. Fluxes were ground to a particle size of output class – 0,074 mm 90,5 %. Chemical composition of experimental materials presented in Table 2.

Pelletizing was carried out in lab batches tumbling granulator 600 mm diameter, 200 mm in length. Drum speed was 27 r / min, which is equivalent to the rotation speed industrial drum of 2,8 m diameter equal to 12 rev / min.

Wet strength and dry pellet strength was determined on a tensile testing machine Type P – 20 min. The compressive strength of the fired pellets was determined on a tensile testing machine Type P – 20 min. The firing temperature 1 300 °C crushing strength with the addition of a base charge of 2,5 % coke fines grew from 115 to 132 kg / pel, while remaining below the requirements of the DUT (not less than 150 kg / s). Use as an additive of natural colemanite led to negative results due to the pellet cracking during firing. This effect is caused by the explosive character of colemanite decomposition upon removal of hydrate moisture. This process proceeds in the temperature range 300 – 550 °C.

Addition of 0,5 and 1,0 % of natural colemanite strength chromeite pellets at baseline. With increasing amounts of natural colemanite in the charge (up to 3 %, expe-rience № 5) strength of fired pellets had fallen to 36 kg / pel. Fracture in pellets in the basic experiment (experiment 1 № experience № 2) was absent, and with addition of 3 % of natural colemanite fracture was 100 %. Laboratory test results showed that the use of natural colemanite for improving the quality of the fired pellets and to reduce the thermal level of the firing process is impractical. To reduce the effect of cracking of the fired pellets colemanite was calcined in a muffle furnace at a temperature of 500 °C. The additive in the charge production chromeite pellets 0,5 - 1,0 % calcined colemanite without loss of strength both wet and dry pellets, substantially increased the strength of the fired pellets. Already at the 0,5 % addition of colemanite calcined at 1 300 °C firing, which is 100 °C below the production, provided strength characteristics corresponding to factory specifications (strength not lower than 150 kg / pel) - 163 kg / pel. When the boron content is increase-d to 1,0 % the flux strength of fired pellets increased to 222 kg / pel.

Positive results for improving the quality chromeite pellets obtained by using as reinforcing fluxing agents basalt rocks. It is shown experimentally that the addition of 2,5 – 5,0 % to the charge instead of ben-tonite and basalt coke fines (experiment № 8, № 9) at a temperature of 1 300 °C firing and product is a fully sin-
tered material is streaked with the liquid phase throughout the volume and strength fired pellets was 175 - 182 kg / pel, which is substantially higher specification. As we tested hardening additive fines quartzite, which has been successfully used at present in the manufacture of chromite sinter at Aksu ferroalloy [4]. However, the effect of the oxidative roasting chromite pellets as agglomeration when unmet. Addition of 10 % quartzite strength of fired pellets at 1 300 °C was 130 kg / pel. This is evidently due to insufficient development of metabolic reactions to form low-temperature phase fayalite (2 Fe∙SiO2, T - 1 205 °C) due to diffusion of ferrous iron in the slag phase chrome spinels [5]. This process does not receive development due to the oxidative environment the firing process and, as a consequence, oxidation of divalent iron to trivalent.

CONCLUSION
Thus, laboratory tests the results obtained indicate that the calcined colemanite, basalt rocks are effective reinforcing additives. Entering into the batch production of chromite pellets calcined colemanite 0,5 – 1,0 % and 2,5 – 5,0 % bas-alt rocks raised indicators crushing strength to a level satisfying the technical conditions at 1 300 °C, which is below 100 °C production. Reducing the level of the thermal process will improve the resistance of the firing equipment, gas savings, improvement of productivity by lowering the height of the bed, for tape protection from exposure to high temperatures.

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REFERENCES

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