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GLASS CERAMIC PROPPING AGENT

Propping agent (proppant) is granular material used in oil production by hydraulic fracturing. The most common are aluminosilicate and magnesia-quartz proppants. The main properties of proppants are sphericity, roundness, mechanical strength and acid resistance. Glass-ceramic materials obtained on the basis of natural raw materials have high mechanical strength and chemical resistance, and therefore are promising materials for the production of proppants [1].

For the synthesis of glass-ceramic propants, it is necessary to use rapidly crystallizing glasses with a low viscosity, which ensure the formation of a monomineral composition of the obtained product. Multiphase systems degrade the mechanical strength and chemical resistance of materials.

As the main component for the synthesis of glasses, granitoid screenings of the Mikashevichi building stone deposit in the amount of 70–90 wt. % To control the rheological properties of the melt, hardening rate, and crystallization ability, soda ash, chalk, and also chromium oxide was additionally introduced into the charge as a crystallization initiator.

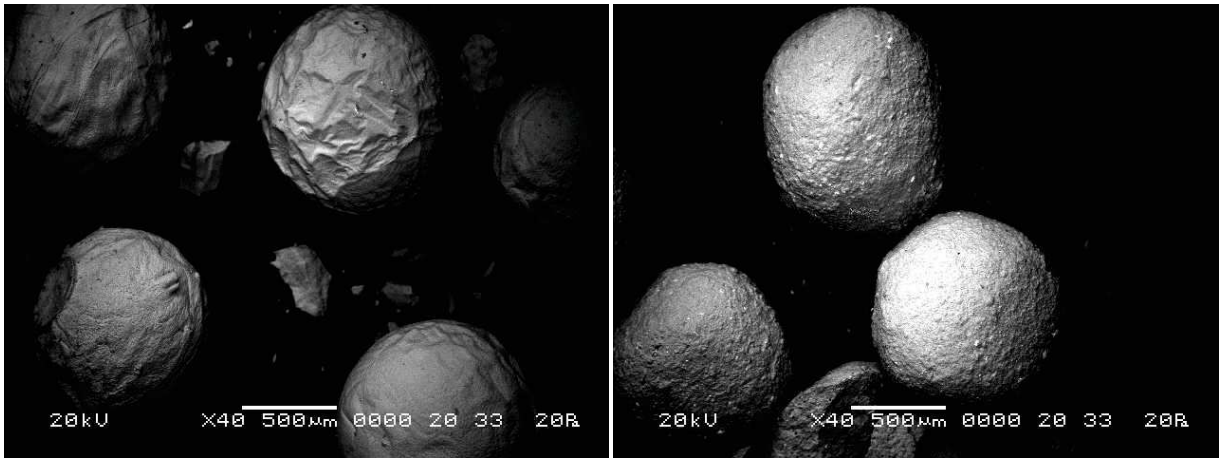
The technology for producing glass ceramics includes the synthesis of glass of a given chemical composition, the molding of materials from a melt with their subsequent directed crystallization to create products with a given set of properties. The technology is used in all cases when a material or product can be molded directly from a melt by known methods.

Glass melting to obtain glass-ceramic proppants was carried out in a gas flame furnace at a temperature of 1450 ± 10 ° C. The molding was carried out by dispersing the melt jet, followed by directed bulk crystallization of the spheres for 10–30 min at temperatures of 800–850 ° C. Using this molding method provides high sphericity and roundness compared to traditional methods of molding ceramic proppants (Figuge 1).

The synthesized glass-ceramic proppants have high mechanical strength (more than 600 MPa), high crush resistance at a pressure of 5000 psi (less than 0.3 % of broken granules) and low solubility in a mixture of HF and HCl (2.0 %).

High chemical stability and mechanical strength is ensured by the formation of a crystalline pyroxene solid solution of the augite type ((Ca, Mg, Fe^{2+}) (Mg, Fe^{2+}, Al, Fe^{3+}) [(Si, $Al)_2O_6$] during crystallization.

To assess the quality of the obtained glass-ceramic proppants, the basic properties of various magnesia-quartz and aluminosilicate proppants were studied. The results of the study showed that crushing resistance at a pressure of 5000 psi of magnesian-quartz proppants is 3-4 % of the destroyed granules, aluminosilicate granules - 2-3 %. The solubility in a mixture of HF and HCl is 8–9 % for magnesia-quartz propants, and 7–8 % for aluminosilicate.



(a) (b)

Figure 1 - SEM images of glass-ceramic (a) and ceramic (b) proppants with magnification x40

Thus, the glass-ceramic materials based on augite surpass the currently used aluminosilicate and magnesian-quartz proppants in basic operational properties. In addition, when forming spherical particles by the highly efficient method of dispersing the melt, the obtained proppants are characterized by an almost perfect spherical shape, which is difficult to achieve when molding ceramic proppants.

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THE GAS-PULSE-REAGENT PROCESSING OF WELLS

At the present time, water for local or centralized water supply systems is mainly extracted from underground aquifers by water wells. These structures must be highly efficient, durable and environmentally friendly. The extraction of water from underground sources has a number of advantages, however, the geological conditions of occurrence of aquifers, the violation of their hydrodynamic regime due to wells operation, directly affect the decrease in productivity and lifetime of water intake facilities.

Thus, as the result their specific capacity inevitably decreases. The reason for this is mechanical, chemical and biological colmatation. The bulk of deposits ate concentrated in the openings of the well screen and in the pores of the gravel pack surrounding it, which significantly decrease the flow of water into the well or its failure. Regular maintenance allows to increase their lifetime and prevent yield reduction.

Pulse methods sufficiently provide high degree of rehabilitation of specific capacity, when wells have short lifetime operations. However, pulse methods are ineffective to long operated wells. In this case the most appropriate combined processing, which include consistent or simultaneous pulse-reagent effect on sediments.

To that end, the pulse-reagent method of rehabilitation of specific capacity, based on hydrogen and oxygen gas mixture explosion in reagent, was proposed in Belarusian National Technical University (Minsk city). The equipment to realize this method consists of immersion explosion chamber with a spark plug and reflector, winch, that lowered chamber into the filter zone, remote electrolyzer, to produce and deliver by the special hoses gas mixture to the