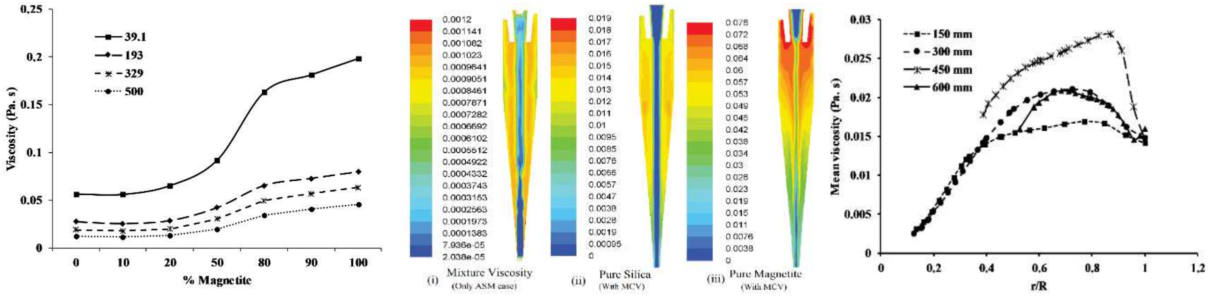

Figure 1: (a) Experimental viscosity data with the change in % magnetite at various shear rates. (b) Viscosity contour of (i) Mixture in only ASM case (ii) pure silica and (iii) magnetite in a 20% solids classification system. (Pa. s) (c) Mean viscosity presented radially.

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ANALYSIS OF THE POSSIBILITY OF PRODUCING LARGE-CRYSTAL FLUORINE ALUMINUM

Fluoride compounds occupy one of the most important places in modern chemical technology and technology. Fluorine is an essential companion of phosphorus-containing raw materials. The reserves of fluorine in phosphate raw materials are more than 100 times higher than their reserves in the contents of fluorspar.

The technological scheme for the production of aluminum fluoride consists of the following stages: neutralization of hexafluorosilicic acid with aluminum hydroxide, separation of the suspension with the removal of silica gel, crystallization of aluminum fluoride, filtration and drying of the finished product.

At this stage, companies producing aluminum fluoride have stringent requirements for crystal sizes, which should be at least 45 microns. However, at most plants in the CIS countries, the technology for the production of aluminum fluoride does not allow to obtain crystals larger than 45 microns in excess of 85 wt. % Therefore, the aim of this scientific work was to study the possibility of obtaining coarse-grained aluminum fluoride with crystals of a given size by adjusting the technological parameters of the individual stages of production.

A small number of works has been devoted to the production of aluminum, which are aimed at studying the kinetics of crystallization, establishing the influence of the contents of the initial mixture of acids on the contents of the final product [1], as well as solving technological and economic issues [2, 3].

The main attention was paid to the technological parameters of the stages of neutralization of hexafluorosilicic acid and crystallization of aluminum fluoride, since these stages have a significant effect on the size of crystals and their habitas.

The main parameters were chosen: the molar ratio $Al(OH)_3$: H_2SiF_6, the initial temperature, the speed of rotation of the stirrer, and the duration of the stages of neutralization and crystallization.

In research the influence of the molar ratio, the results showed that the largest crystals are formed at a molar ratio of $Al(OH)_3$: H_2SiF_6 equal to 2.0 Under these conditions, a polydisperse contents with a particle size of 5 to 200 μm is formed, while under other molar ratios, the maximum particle size reached 150 microns. Moreover, more than 75% of the particles have a size of more than 45 μm due to the fact that the unreacted part of hexafluorosilicic acid negatively affects the crystal growth rate, its habitas and other indicators of product quality. Therefore, to perform subsequent syntheses, a stoichiometric molar ratio of 2 was taken.

In research of the influence of changes in the initial temperature in the range of 70-90 °C. It was found that with an increase in the neutralization temperature, a narrowing of the particle size range was established, while the proportion of particles greater than 45 μm increased from 75 to 85%. This result is due to the fact that at a lower temperature, aluminum fluoride sent for filtration begins to crystallize already at the filtration stage.

In research the effects of the duration of neutralization in the range of 20-30 min and the speed of rotation of the mixer 50-100 rpm did not show a noticeable effect on the size of the crystals of aluminum fluoride.

Based on a research of the influence of technological parameters on the size of crystals formed at the stage of neutralization of hexafluorosilicic acid with aluminum hydroxide, the optimal values of the studied parameters are established:

- molar ratio of $Al(OH)_3$: H_2SiF_6 at the stage of neutralization, equal to 2;
- the initial temperature of the stage of neutralization is not less than 80 ° C;

At the crystallization stage, the influence of such parameters as temperature, duration and speed of mixing was investigated.

The results of the research of the effect of crystallization temperature on particle size showed that, at a temperature of 95 °C, a significant increase in crystal size occurs. So, at a crystallization temperature of 80 °C, a polydisperse contents is formed with a particle size of 5 to 200 μm, and at 95 ° C - from 5 to 500 μm, while the average particle size has increased from 60 to 85 μm. This is confirmed by published data, which show that crystallization of salts at higher temperatures, all other things being equal, contributes to an increase in the average crystal size in the product. So, the average crystal size rises with increasing crystallization temperature, as evidenced by the results. Therefore, the crystallization process must be carried out at higher temperatures.

Changing the duration of crystallization from 4 to 6 h did not affect the size of the formed particles, which indicates the end of the main crystallization phase.

In research the effect of the mixer rotation speed on the fractional contents of aluminum fluoride, the parameter ranged from 40 to 75 rpm.

The results showed that with an increase in the speed of rotation of the mixer at the stage of crystallization of aluminum fluoride, a decrease in the average and maximum particle sizes is observed, which is explained by an increase in the number of revolutions, and the rate of formation of nuclei also increases due to the inertial emission of unstable "embryos" from the heated ones due to their formation of areas of the maternal environment into neighboring richer and colder areas, where growth of embryos to stable sizes is greatly facilitated. But an increase in the mixing speed has a positive effect on the kinetics of the process.

Based on the study of the influence of parameters on the size of the crystals formed at the stage of crystallization of aluminum fluoride, the optimal values of the parameters are established:

- crystallization temperature - 95 ° C;
- the rotation speed of the mixer at the crystallization stage - 40 rpm./min
- the duration of the crystallization process is 4 hours

Based on the results of the research, it can be concluded that the most important parameters affecting the size of the crystals formed and their habitas are the nature of the crystallizing salt, the intensity of mixing, the degree of supersaturation of the solution, the crystallization temperature and the presence of impurities. One of the main parameters that have a significant effect on the growth rate of individual crystal faces and its habitas is the temperature and intensity of mixing. This is due to the influence of temperature both on the rate of nucleation and on the rate of their growth, moreover, this effect is manifested in the process of crystal growth, since with increasing temperature crystal growth is accelerated to a greater extent than the process of nucleation.

The nature of the growth and size of the crystals formed is determined not only by the crystallization stage, but also by the stage of neutralization of hexafluorosilicic acid with aluminum hydroxide. It was experimentally established that the main parameters affecting the size of the aluminum fluoride crystals are the molar ratio Al (OH) 3: H2SiF6 at the stage of neutralization, the initial temperature of the stage of neutralization, the crystallization temperature and the speed of rotation of the stirrer at the stage of crystallization. The optimal values of these parameters are established, which ensure the production of crystalline aluminum fluoride, corresponding to the normative documentation, with a fractional contents varying in the range from 40 to 140 microns, and a content of particles larger than 45 microns in excess of 95 wt. %

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NUMERICAL MODELLING METHODS FOR EVALUATING THE FORMABILITY OF NEW COMPOSITE MATERIALS

KEYWORDS: TRIP Steel; Zirconia Composite; Numerical Simulation; Crystal Plasticity; Local Deformation Behavior.

In the continuously advancing technological world, there is an increasing demand for materials with desired material properties. High strength and formability materials are in demand in the automotive and aerospace industry. Metal matrix-based composited provide an excellent solution for high energy absorbing structural applications. The mechanical attributes of composite materials depend on the features of every single phase, its geometry and the assembly