AERO-ELECTRODYNAMIC CONCENTRATION OF QUARTZ SAND

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The existing approaches to the wet method of concentration of quartz sands were examined. The results of studies of aero-electrodynamic concentration of quartz sands are reported. Recommendations on using the new technology are given.

The demand for high-quality quartz sand is now increasing constantly. For this reason, the creation of highly efficient methods of concentration of quartz sand is pressing.

Primarily wet methods are now used for concentration of quartz sand, and they consist of the following processes: preparation (crushing, screening, grinding, sorting, firing); basic (gravitational concentration, magnetic separation, flotation); auxiliary (dehydration, thickening, drying, clarification of waters).

The increasing demand for completeness and the complexity of use of mineral resources, as well as rigorous ecological requirements, have made it necessary to include additional processes for treatment of solid wastes and wastewaters in the technological concentration schemes.

High power consumption is characteristic of concentration installations with wet processes.

The prospects for the further development of installations and complexes for concentration of quartz sand are linked with the use of new and promising automated processes, highly efficient and reliable equipment, and perfection of existing technological schemes which ensure ecologically clean and more complete, complex, low-waste, and waste-free processing of quartz sand [1-3].

Processes based on the use of aerodynamics and strong electric fields have recently become widespread. These processes are continuous and are subject to control and regulation, which makes it possible to totally automate production.

Complex studies on concentration of quartz sands from different deposits according to a flow chart (Fig. 1) were conducted in 1991-1993 at the Obninsk Atomic Energy Institute with the participation of the Institute of Physical Energy and the Tekhnologiya Scientific and Industrial Enterprise. New and promising technology for aero-electrodynamic concentration based on the laws of aerodynamics and complexes and installations for its implementation in block execution were developed on this basis [4].

The patent and predictive-estimation studies based on determining the patenting dynamics and rates of the increase in inventions showed that the method and installations for aero-electrodynamic concentration will be the most promising and efficient direction of development in concentration of quartz sands for the next 20-25 years.

The experimental studies of quartz sands were conducted on the following block modules (M1:10-1:20):
- unit for vibration drying and sorting in an infrared radiation field;
- firing unit with sorting in an infrared radiation field;
- unit for electric spark processing in the field of a high-voltage direct electric field;
- unit for electric separation in a corona discharge field;
- aerodynamic processing and separation unit;
- unit for separation in magnetic fields of permanent magnets and electromagnetic fields.
TABLE 1.

<table>
<thead>
<tr>
<th>Material</th>
<th>Concentration by weight, % before concentration</th>
<th>Concentration by weight, % after concentration</th>
<th>Light transmission of glass, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fe₂O₃</td>
<td>Al₂O₃</td>
<td>Fe₂O₃</td>
</tr>
<tr>
<td>Natural sands from the deposits:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaluga</td>
<td>0.31</td>
<td>1.36</td>
<td>0.14</td>
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<tr>
<td>Kaluga</td>
<td>0.17</td>
<td>0.90</td>
<td>0.12</td>
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<td>Ryazan</td>
<td>0.43</td>
<td>1.00</td>
<td>0.15</td>
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<tr>
<td>Tashlin</td>
<td>0.06</td>
<td>0.15</td>
<td>0.05</td>
</tr>
<tr>
<td>Concentrate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nº 1</td>
<td>0.03</td>
<td>0.15</td>
<td>0.02</td>
</tr>
<tr>
<td>Nº 2</td>
<td>0.02</td>
<td>0.10</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Aerodynamic concentration of quartz sand (ADCS)

Fig. 1. Flow chart of studies of aero-electrodynamic concentration of quartz sand.

The degree of concentration of the quartz sands was estimated based on the amount of iron and aluminum oxides in them and based on the integral light transmission in the visible region of the spectrum of samples of glasses fabricated from concentrated sands.

The concentration of iron oxide was determined by photocolorimetric, atomic absorption, and x-ray fluorescent methods.

The analysis was conducted according to GOST 22552.2-77. The photocolorimetric method is based on the formation of a yellow iron complex with sulfosalicylic acid in ammonia medium at pH = 8-11.5. The optical density of the colored solution was measured on a KFK-2 photocolorimeter using a dark blue light filter with a transmission region of 400-450 nm and a cuvette depth of 50 mm.

Atomic absorption determination of the concentration of iron oxide in the quartz sands was conducted on a Hitachi (Japan) atomic absorption spectrophotometer (model 180-80) at the wavelength of 248.3 nm, with a 0.2 nm slit width in air—acetylene flame. The sample of sand was decomposed with a mixture of sulfuric and hydrofluoric acids (GOST 22552.2-77).

A Karl Zeiss Jena (Germany) VRA-30 spectrometer was used in x-ray fluorescent determination of the concentration of iron oxide.