EFFECT OF FREQUENCY AND OSCILLATION AMPLITUDE ON MOLDABILITY OF ALUMINA - FOAM - POLYSTYRENE BODIES

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Experiments were done to study the influence of vibration on the strength of bodies and to establish the optimum original moisture content facilitating immediate deshuttering of freshly molded products. We used technical alumina (Soviet and Hungarian), foamed polystyrene in fractions not more than 3 mm and sulfite lye with a density of 1.01-1.02 g/cm$^3$. The Soviet alumina was obtained from the Tikhvinsk Factory.

The properties of the alumina are shown in Table 1. The technical alumina was ground in a tube mill for 2 h.

The batch composition was 100% technical alumina, 8% foamed polystyrene and 1% sulfite lye (on 100%). The materials were blended for 8-10 min in a blade mixer.

The workability of the body was studied using the instrument shown in Fig. 1. The cylinder of the Suttard instrument was placed in the metal mold at the top, and secured; it was first filled with the body under investigation. Then the upper part of the instrument, consisting of the support and rod sliding in its clutch, was secured in position, so that the flat disk was on the end (piston). Using the piston a specific pressure was created on the body ($p = 0.2 \text{ kg/cm}^2$) corresponding to the pressure on it during molding. A gap of 15 mm was left between the lower end of the cylinder and the base of the mold. The instrument was fitted to the vibrating table, and the vibrators were switched on. A stopwatch was used to determine the time for levelling out the body in the cylinder and the molds.

Test Results. It is known that neither the frequency nor the amplitude taken separately determine the effectiveness of the vibration on concrete mixtures (by effectiveness of action of vibration we understand the increase in density and strength of the material or reduction in the vibration time). Only a combination of these two dynamic parameters has a decisive influence on the vibro-densification [1].

Fig. 1. Plan of the instrument used to determine the workability of alumina-foamed polystyrene bodies. 1) Suttard instrument cylinder; 2) metal mold measuring 7 × 7 × 7 cm; 3) laboratory vibrating platform; 4) body being tested; 5) level of body at which the test is considered to be complete; 6) piston for creating pressure on the body.
TABLE 1. Characteristics of Technical Alumina

<table>
<thead>
<tr>
<th>Alumina</th>
<th>$\text{Al}_2\text{O}_3$ content, %</th>
<th>Content, % fractions, $\mu_m$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\alpha$</td>
<td>$\gamma$</td>
</tr>
<tr>
<td>Soviet</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>Hungarian</td>
<td>85-90</td>
<td>15-10</td>
</tr>
</tbody>
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Fractions: $18-2 \mu_m$ Predominant grain size: $8,4-5,6 \mu_m$

Fig. 2. Relationship between the workability of alumina-foam polystyrene bodies of various moisture contents and the amplitude and oscillation frequency at 1000 (a) 3000 (b) and 6000 oscillations per min (c). The pressure on the body was 0.2 kg/cm². The moisture contents were: 1) 19%, 2) 22%, 3) 30%; ○ Hungarian alumina; ● Soviet alumina.

Because of the absence of experimental data characterizing the influence of oscillations of various frequencies on the densification of the materials under review, experiments were done at frequencies of 1000, 3000, and 6000 oscillations per minute.

Figure 2 shows the influence of the frequency and amplitude of the vibration device on the workability of the bodies having various moisture contents. An increase in the amplitude above a certain limit is irrational, since there is no great increase in the mobility of the body. At the same time with amplitudes below the stated maximum we do not achieve complete deflocculation of the bodies, and the vibration time is increased. The values for the limiting amplitudes depend on the frequency of oscillations, the application of the load, and the value of the specific pressure developed by it and the moisture content of the bodies.

Fig. 3. Workability of alumina-foamed polystyrene bodies as a function of the frequency of oscillations $n$ with an amplitude of 0.5 (1) and 1.0 mm (2). Pressure on the body 0.2 kg/cm².

Fig. 4. Relationship between the compressive strength of the green products $c_{\text{comp}}$ (1) and workability of the bodies (2) and the oscillation amplitude. Moisture content of the bodies 15%.