An innovative dosing system for abrasive slurry is presented. This system allows the dosing and dispensing process to be controlled on the surface of the lapping plate. The system consists of a high-pressure tank equipped with a pneumatic propulsion mixer which ensures continuous mixing of the abrasive suspension. The system also includes a device for applying the component for the lapping plate and electronic control of the forced dosage process.

KEYWORDS: lapping the flat surfaces, forced dosage abrasive slurry

At present, flat lapping is realized, among others, on single-disk lapping plate. This method of surface shaping requires not only special equipment, but also the use of suitable abrasive suspensions. Professional components offered by many manufacturers are available in the form of pastes, suspensions or loose abrasive powders. Abrasive components are intended for treatment of parts made of different materials [2]. This is directly linked with the choice of their dosage.

On the basis of the descriptions contained in the literature [3], it can be noted that the dosage of suspension in the treatment zone is carried out mainly by drip or continuous method (pressure) using a pump, which draws it from a tank and provides a working surface of the lapping area with large excess. This situation has financial implications, since a significant portion of dosed abrasive suspension does not participate in the lapping process at all [1].

Traditional system of dispensing the abrasive suspension

The abrasive suspension dosing process in the traditional system, e.g. in the Abralap 380 (fig. 1), is carried out using a pump (fig. 2), which draws the prepared substance from the tank. This dosage regimen (in the machine) brings the flow rate approximately 400 ml/min. The manufacturer has not offered a solution that would allow control of the amount of administered suspension.

Forced dosing system for abrasive suspension

On the basis of analysis of the system used in the machine Abralap 380, a different (forced) method of dosing the abrasive was developed (fig. 3).

This solution preserves the existing system of workpiece placement (fig. 4). Another method of delivering the suspension to a device directly applying the abrasive layer to a lapping plate (fig. 5) was proposed.
The solution also allows mixing of the suspension in the tank continuously. This is particularly important for the preparation of suspension based on grains or abrasive micro-spheres (fig. 6). The sedimentation problem does not occur in the case of nano-grains.

Modification of the dispensing system for the abrasive slurry also included the method of applying it to the lapping plate. This application is carried out by means of a device enabling the application of an abrasive layer of predetermined thickness for one turning of the lapping plate (fig. 7).

The dosing process is controlled via an electronic system. This applies to the amount of abrasive suspension applied to the process of lapping. This solution also allows to control the shape of the applied layer and its position on the disc surface (figs. 7–9).
TABLE. Forced dispensing parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content of abrasive grains in suspension, %</td>
<td>10</td>
</tr>
<tr>
<td>Volume ratio of machine oil to kerosene</td>
<td>2:1</td>
</tr>
<tr>
<td>Kinematic viscosity of liquid, mPa</td>
<td>32</td>
</tr>
<tr>
<td>Suspension pressure in the tank, bar</td>
<td>0.8</td>
</tr>
<tr>
<td>Rotational speed of the stirrer, rpm</td>
<td>100÷120</td>
</tr>
<tr>
<td>Nozzle diameter dosing the suspension, mm</td>
<td>2</td>
</tr>
<tr>
<td>Application pressure of the abrasive layer, bar</td>
<td>2.8</td>
</tr>
<tr>
<td>Time of application of one abrasive layer, s</td>
<td>3</td>
</tr>
</tbody>
</table>

Fig. 10 shows a graphical representation of the difference in wear of the abrasive suspension (under the same conditions of ceramic elements processing) with different dosing methods.

Fig. 11. Workpiece material loss after 10 minutes of lapping (1 – traditional dosage, 2 – forced dosing)

Conclusions

Based on the analysis of the proposed method of forced abrasive suspension application on the Abralap 380 single disc lapping machine, several advantages of this solution can be mentioned:

- abrasive wear was reduced by approximately 70% as compared to conventional dosing (at a specific time of lapping),
- the application of abrasive suspension is planned and repetitive,
- the system allows to control the time interval between the time of applying the next layer,
- the system allows to apply a layer of fixed thickness,
- a continuous mixing system counteracts the sedimentation of the abrasive in the tank.

The proposed solution demonstrates high efficiency in suspension savings, which improves the economic efficiency of the machining process.

REFERENCES