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PROBLEMS IN SHAPING THE QUALITY OF GLASS SURFACES DURING MECHANICAL PROCESSING

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Annotation. This work presents an analysis of the effect of abrasive material, chemical composition of glass, lubrication-cooling technological means on the process of mechanical processing of glass materials.

Key words: glass, chemical composition, abrasive material, granularity, cutting speed, lubrication-cooling technological tool.

Introduction. Information about the influence of technological conditions on the process of glass grinding is provided by foreign scientists: Altshuller V.M., Apasenko V.I., Burman L.L., Kachalov N.N., Burmistrov V.V., Vakser D.B., Shrabchenko A. .I., Maslov V.P., Rogov V.V., Filatov Yu.D., Khrulkov V.A., Shukin E.D., Ed N. and others. presented in their works, they made a great contribution to solving the problems of improving the quality and efficiency of processing brittle non-metallic materials. Below is a summary summarizing the main findings from these studies.

Effect of abrasive material . The grinding process can be influenced, first of all, by the abrasive, its grain size and the homogeneity of the grain size. Bonded abrasives are also affected by some special properties, primarily hardness and porosity.

Different grades of polishing powders differ in their physical and mechanical properties, which gives different efficiency in polishing and different quality in polished surfaces. Hardness, brittleness, crushing strength and the shape of the grains are important in grinding [1]. The set of these properties makes it possible to sort abrasives in the following order: sand, corundum, ruby, silicon carbide, boron carbide, diamond. If we take the abrasiveness of sand to be equal to one unit, then 20 microns of electrocorundum. grain size is 2.5, silicon carbide is 3.5, and boron carbide is 4. The greater the abrasiveness of the material , the lower its optimal consumption.

The quality of the polished surface is inversely proportional to the polishing of the glass: the more active this abrasive is, the more deep grooves appear on the polished surface. The roughness of polished glass surfaces is reduced depending on the hardness of abrasive powders. According to their effect, they can be placed in the following descending order: diamond, boron carbide, silicon carbide, corundum, ruby and sand. The last one gives the highest quality in polishing.

The grinding speed is greatly influenced by the grain size of the abrasive. Research results show that the grinding speed increases with the increase in grain size. This relationship is linear between 3 and 20 μm. When working with very large grains, grinding is slowed down.

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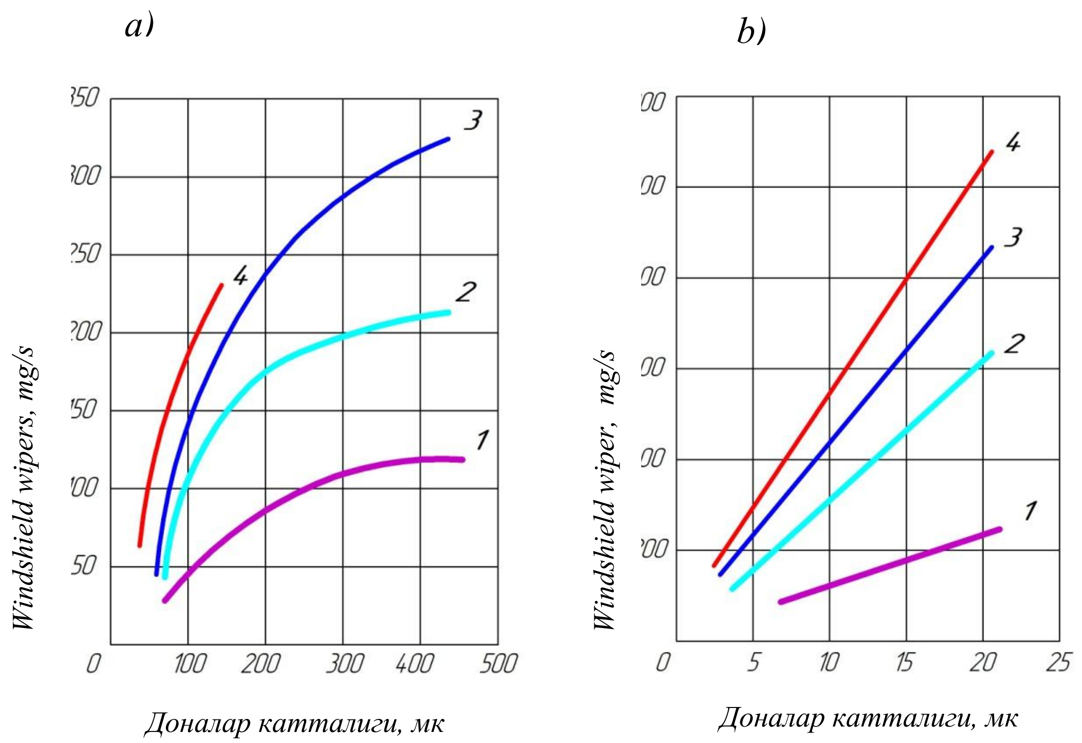
Surface roughness h is directly proportional to grain size *D - H = k·D. The value of the constant k* depends on the appearance of the abrasive: it is equal to 0.17 for sand, 0.22 for ruby, and 0.27 for corundum.

The reason for the increase in speed and roughness in coarse grinding is due to the fact that the coarse grinding particles are stronger and harder to break. Because of this, they can exert great pressure on the glass, causing a much deeper crack.

In glass processing with bonded abrasive, the hardness and porosity of the bonded abrasive are of great importance. Carbocorundum washers machining lead crystal glass research results show that larger abrasive soft washers have the highest grinding ability. But in grain work, soft is not suitable, because they quickly lose the sharpness of the shape and are easily painted. It is necessary to constantly adjust them, which leads to time consumption and shortening of the service life of the abrasive disc.

A typical property of a bonded abrasive is the change in its grinding ability over time. In this case, glass grinding with free abrasive is homogeneous for a certain period of time, the longer the work lasts, the performance of the combined abrasive decreases proportionally to the duration of grinding. The reason for the decrease in the working capacity of the grinding wheel is the impeding of particles on the surface of the tool. The removal of impenetrable particles from the grinding wheel due to hardness and porosity is very slow, because the working surface does not have time to clean itself and the grinding performance is reduced.



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First figure. Dependence of the speed of polishing of the glass: from the amount of a-polishing grains. From the amount of 1-sand, 2-corundum, 3-ruby, 4-silicon carbide, b-micro powder particles. 1-sand, 2-corundum, 3-silicon carbide, 4-boron carbide.

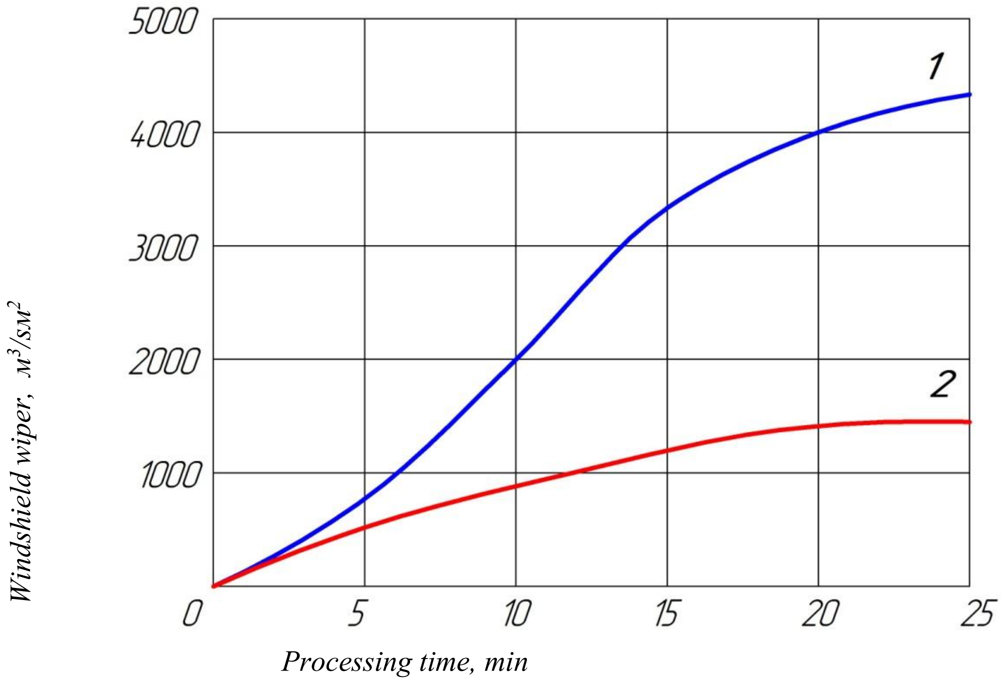

Figure 2. The window jingle speed dependence on the duration of treatment with bound abrasives . 1-white red corundum, grain size 320; white corundum, grain size 320.

The effect of the chemical composition of the glass. Grinding under the same processing conditions depends primarily on its chemical composition. Swellings of different composition have different rolling properties [2]. The general rule is as follows: with an increase in the percentage of silicon oxide (SiO_2) and boron oxide (B_2O_3) in the composition, the hardness of the glass increases, as a result, the rate of grinding decreases. Metal oxides such as calcium oxide (CaO), sodium oxide (Na_2O), especially lead oxide (PbO) reduce hardness and accelerate grinding.

Effect of pressure and rotation speed. When machining with a free abrasive, pressure and speed only affect the machining process. The quality of the polished surface does not depend on these factors. As the pressure increases, the number of rotations of the bottle increases. But when the pressure is higher than 700-900 g/cm^2, the efficiency of grinding decreases due to the difficulty of the abrasive to enter the space between the glass and the grinding wheel.

When working with an abrasive compound that is proportional to the working pressure, the speed of glass grinding increases. It is known that in both methods, an increase in the speed of grinding at high pressure is the formation of deformation in the contact area as a result of a tighter adhesion of the tool and the zagotovka. Deformation leads to an increase in the number of effective particles affecting the surface of the glass unit.

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The connection of the rotation to the rotation speed has a completely different appearance. There are certain optimum spin rates for each type of spin, and if they are followed, spin will be at its best. The acceptable speed also depends on the type of glass. According to research [3], the acceptable speed limit is around 8 to 12 *m/s* . At a lower or higher speed, the speed of spinning the bottle decreases. An increase in speed has a positive effect on surface roughness.

The presence of an acceptable speed in grinding with a bonded abrasive is represented by the heat effect in the grinding process. As a result of the friction of the puck with the glass, heat is released, which raises the temperature of the friction surface. After exceeding a certain speed, the release of heat increases so that the glass in the treated area softens, becomes less brittle, and therefore the speed of grinding decreases.

Effect of lubrication-cooling technological means (MSTV). The grinding fluid performs an important mechanical function: it washes away the grinding product (glass and abrasive particles produced by grinding) and removes heat. In addition, it has a physico-chemical effect on the processing area, reduces the state of stress-deformation in the contact area, accelerates or slows down the grinding process, changes the quality of the processing surface.

Effect of the technological process on the defects of the formed surfaces: At the modern stage of the development of scientific research, which places high demands on the quality of the treated surfaces, the study of the surface layer defects after grinding is gaining importance. Microscopic examination of the polishing effect of individual particles shows what particles are left on the surface and subsurface of the original flat glass. On the outer surface, under a specific relief, bulges and depressions are formed, and this relief cracks and cracks are directed towards the inside of the glass. The size of the micro-bubbles in the relief layer (in the area of cracks) is longer than the visible light wave. In these micro irregularities, light is scattered and the polished glass surface becomes dull and opaque.

It is known from the above that the abrasive effect is not limited to the cracking of the surface layer, but extends to its interior as well. As a result of grinding beyond the visible layer of the relief layer, cracks appear in the subsurface layer - "cracked layer", which is located below the relief layer, but is three times thicker than it. The integrity of the glass is broken both in the relief layer and in the crack layer. For this reason, these layers are sometimes called the "disrupted layer".

In [1], the formula that determines the correlation between the broken pencil $H \cong 4hN$ and the relief layer depth *h with 10% accuracy is given* : The depth of the relief layer corresponds to the $R_{max\ value}$ of the roughness of the glass surface after processing . The reduction of tortuosity in plating results in a reduction of the depth of the defect layer.

Most of the scientific work is concerned with the influence of the abrasive grain size on the depth of the flaw layer, leaving aside the physical phenomena that occur in the material being processed and cause the development of the flaw layer. The reliability of the information about the defect parameters depends on the methods used to study the surface layer of the material.

The organization of the conducted researches and the enrichment with the results allows to conclude about the defect on the surface being formed, therefore, the labor of processing the products made of technical glass and citadel depends on the level of impact force on the processed material. In turn, the energy capacity is determined by two categories of factors: physical and mechanical properties of the processed material (hardness, strength, brittleness, initial defects, appearance and

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specific characteristics of previous processing); technological parameters of processing processes (cutting scheme and parameters, technological and operational characteristics of the used tools, properties of the technological environment). These, in turn, affect the surface defect parameters being formed.

Decreasing the stress-strain state of the surface in the treated area, for example, by using effective MSTVs or by using elastic tools, is the main way to reduce its defects. One of the important areas of research is prediction of layer defects based on mathematical modeling in the field of processing [4].

The use of diamond-abrasive tools allows to achieve high quality indicators and accuracy in processing. In order to reveal the technological possibilities of diamond-abrasive tools, it is necessary to consider the effect of processing parameters on the quality of the processed surface and the model representation of this effect.

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