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COMBINED METHOD OF TURNING BILLS FROM POLYMER MATERIALS

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ABSTRACT

Existing methods of processing plastic parts are considered. A combined method of processing by cutting polymeric materials is proposed. It consists in sequential mechanical and thermal action on the work piece before processing it with a cutting tool. The results of the studies carried out within the framework of the method under consideration indicate its feasibility and effectiveness.

One of the directions of scientific and technological progress in mechanical engineering is the use of parts made of polymer materials. However, there is an insufficient use of such parts in units and mechanisms due to the presence of the problem of ensuring dimensional accuracy and high quality of working surfaces. Mechanical processing of polymeric materials, in particular turning, carried out on the basis of conventional technological solutions, does not provide a solution to the indicated problem, since the process of cutting metals is significantly different from cutting plastics.

As is known, when processing polymeric materials by cutting, peculiarities arise that are a consequence of the physicochemical properties of the processed material and lead to the formation of defects on its outer surface [1]. Such defects include melting, tears, chips and burns on the treated surface. Their presence to a large extent interferes with obtaining a high-quality finished surface.

Thus, in order to solve the problem of ensuring a high quality of the surface of parts made of polymeric materials processed by cutting, it is necessary to develop and apply new cutting methods to remove a given layer of material. They consist in the simultaneous influence of several phenomena, different in their essence, or in the combination of different methods of energy supply.

In the technology of processing metals and plastics, combined physical and chemical methods are widely used [1, 2, 3], the essence of which is the effect on the surface of the processed product with energy sources or an aggressive environment that chemically interacts with

the material of the product. The main methods of physical and chemical treatment include: heat treatment, treatment with a pulsed energy source, etching treatment, mechanic chemical treatment.

The performed theoretical analysis of the combined methods of processing parts made of polymers allows us to draw the following conclusions:

- the currently known methods are designed to eliminate defects in the technological process of obtaining polymer products - for cleaning products in order to remove inlets and other elements of the gating system, removing burrs and burrs along the contours of the product, crushing and rounding the edges, hardening the surface and giving it an attractive appearance;

- the practical implementation of known methods is associated with the presence of complex and expensive special equipment, the operation of which is carried out using fire hazardous, explosive and corrosive environments.

As is known, the primary act of destruction of a polymer material is the stress of a chemical bond under the influence of a mechanical field [4]. Thermal fluctuations, i.e., local sharp increases in internal energy, cause a break in the tense bond. The rupture probability is determined by the value of the temperature and the magnitude of the applied voltage. The higher the temperature, the more likely it will rupture.

This article proposes a combined method of turning work pieces made of polymeric materials, the essence of which is that the work pieces proposed for processing are preliminarily subjected to mechanical and thermal effects. By adjusting the parameters of the applied voltage and the temperature of the thermal effect on the material, the formation of primary micro cracks is ensured, at the tops of which there are local zones of overvoltage of chemical bonds, that is, a "weakened" structure of the material is formed, in which part of the bonds is destroyed, and part is stressed. This leads to a decrease in the activation energy of the polymer bonds and, with further interaction of the material with the cutting wedge of the tool, to a decrease in the cutting force. The dimensions of the plastic deformation zone in front of the cutting wedge and micro cracks in the cut material allowance decrease, the main crack acquires a more stable direction of development along the cut line, which is a prerequisite for a decrease in the roughness of the processed surface, since the probability of formation of tears, chips and similar defects is reduced.

We have carried out experimental studies of material turning after its preliminary thermomechanical processing. Capron, a representative of thermoplastic plastics, which is widely used in mechanical engineering for the manufacture of a wide range of parts, was chosen as the material under study. The quality of the turning process was controlled by the value of the roughness parameter Ra. The cutting speed when turning capron blanks with a diameter of 25 and 50 mm was 100 and 160 m / s, respectively. Cutting depth - 1 mm. The feed was varied from 0.075 to 0.275 mm / rev.

Initially, standard samples of capron were processed by turning. The basic values of the roughness parameter Ra are obtained, which are 12.5 and 8.4 μm for work pieces with a diameter of 25 and 50

mm, respectively. Then the samples were processed, which were subjected to stretching for a certain time. The value of the applied load was determined experimentally from the condition that the sample did not form a "neck" during tension, taking into account the ultimate strength of the material. After mechanical action, the samples were heated by a jet of hot air to a certain temperature, the value of which was limited by the brittleness and glass transition temperatures of the material under study.

Immediately after heating, the samples were subjected to turning.

The figure shows the results of experimental studies on the dynamics of changes in the roughness parameter of the machined surfaces of capron, depending on the value of the longitudinal feed.

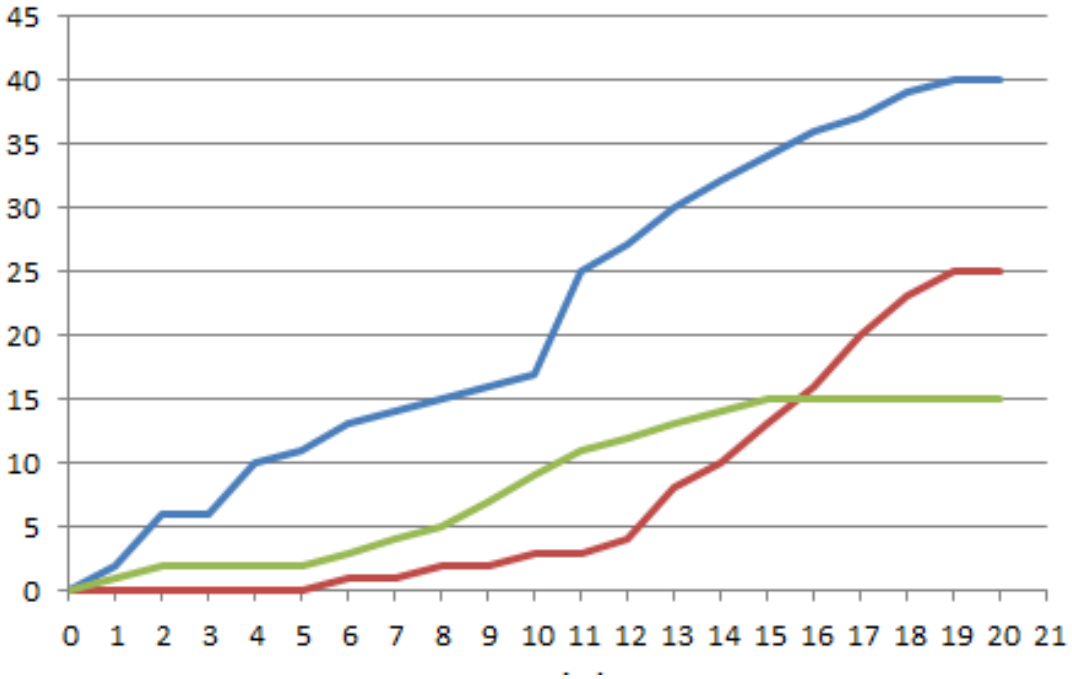

Fig.1.Dynamics of variation of the roughness parameter Ra of the machined surface of the capron work piece: 1, 3 - conventional processing of work pieces with a diameter of 25 and 50 mm; 2, 4 - combined processing of work pieces with a diameter of 25 and 50 mm

The analysis of the presented data allows us to conclude that it is advisable to use the proposed method of combined processing by cutting polymeric materials, which is confirmed by a significant decrease in the Ra value in the entire range of investigated feeds both for work pieces with a diameter of 25 mm and for work pieces with a diameter of 50 mm.

In addition, from the data obtained, it follows that the optimal feed rate during the processing of capron is in the range from 0.2 to 0.25 mm / rev, as evidenced by the minimum values of the roughness parameter corresponding to this range, and the subsequent sharp increase in this parameter.

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