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Increasing Durability of Working Elements of Dividing Dies

Fayzimatov Shukhrat Numanovich, Abdullaev Bakhodir Ikromjonovich, Yusupov Sardorbek Ma'rufovich

P.G. Doctor of technical sciences, professor Department of "Mechanical engineering and automation", Fergana Polytechnic Institute, Fergana, Uzbekistan
Assistant Department of "Mechanical engineering", Andijan Mechanical Institute, Andijan, Uzbekistan
Doctoral student of the department of "Mechanical engineering and automation", Fergana Polytechnic Institute, Fergana, Uzbekistan

ABSTRACT: The article discusses a set of requirements for the properties of the surface layer of the working part of a stamp for sheet stamping. For die steels, the most important are high wear resistance, toughness and strength. The review of methods of finishing and hardening processing by surface plastic deformation of matrices and punches is given. The most effective method should be considered diamond smoothing. The main tasks are formulated, the solution of which will improve the operational properties of technological equipment.

KEY WORDS: diamond smoothing, die tip, die, punch, initial surface, finishing, hardening by surface plastic deformation, deposited metal.

I.INTRODUCTION

In the modern world, to increase the quality and increase the wear resistance and durability of mechanical engineering and automotive products, it is of particular importance to ensure the geometric parameters of the parts during their manufacture.

Thus, at present, the main directions in modern engineering production is the creation of high-performance and reliable machines with high performance characteristics based on the manufacture of parts and blanks with a high level of physical, mechanical, technological, and consumer properties.

II. SIGNIFICANCE OF THE SYSTEM

At the present stage of the scientific and technological process, wear resistance, strength, toughness and other characteristics of tool materials in some cases do not allow high-performance processing of workpieces. In this regard, along with other methods, it is necessary to develop a direction to increase the wear resistance and service life of working parts of dies.

In the blank production at machine-building enterprises, the stamping tool is widely used; the object of research in this work is the separation stamps used at the enterprises of Uz-Hanwoo Engineering JV and Uz-Sungwoo JV. This type of die tooling at these enterprises the largest application of 50-60% of the total number of stamps.

To identify the level of wear resistance and service life and the causes of premature failure, separation dies and correspondingly stamped parts used in the automotive industry and manufactured at the enterprises of Uz-Hanwoo Engineering LLC and Uz-Sungwoo LLC were selected.

III. LITERATURE SURVEY

In the process of research, a nomenclature of parts was selected, which were classified according to the principle of comparability of the kind, properties and physical and mechanical characteristics of the workpiece materials, the degree of complexity and contour of the separation of the stamp, and the accuracy of their parts.

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IV. METHODOLOGY

In the manufacture of parts from sheet blanks, separation and forming operations are performed. In modern production, a significant part of the separation stamping has been replaced by laser and plasma cutting systems. New technologies provide high quality workpieces, quick readjustment of production, high versatility. However, in mass and large-scale production, separation stamping is advisable because of the high productivity and good quality of the edge of the part.

To ensure high performance, the material of the matrix and punches must have a certain set of mechanical properties. High wear resistance can be achieved due to the high hardness of the surface of the tool. Impact resistance can be obtained by using a material with high impact strength. The endurance, strength, rigidity of the tool, as well as the stability of its size are also important. To ensure the necessary properties, die steels are subjected to complex thermomechanical effects, annealing, forging, hardening, and tempering are performed. However, it is difficult to obtain a tool with a high complex of properties in the entire volume of the material. It is most advisable to make a tool of composite construction or to increase the hardness and wear resistance of the surface layer due to various methods of surface hardening.

The resistance of the working parts of the punches and dies of the separating dies can be increased by applying the methods shown in Figure 1.

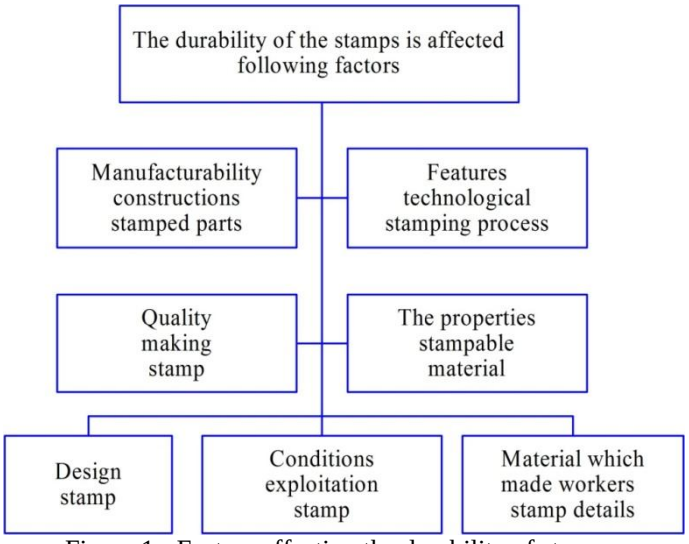

Figure 1 - Factors affecting the durability of stamps.

Figure 2. Punches wear patterns

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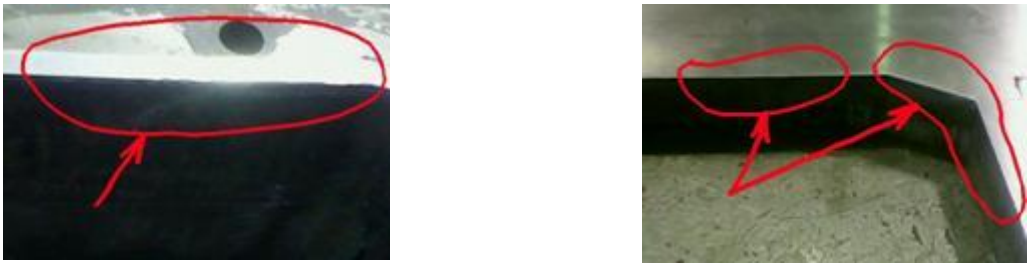

Figure 3. Pattern wear patterns

The reasons for low durability are: firstly, intensive natural wear and tear of the working parts of dies made from traditional tool steels that do not meet the requirements of operation, and secondly, premature wear and tear due to the influence of design and technological factors, i.e., factors associated with errors in the design, manufacture and assembly of dies, as well as failure to comply with the instructions for their operation.

It is possible to propose several methods of surface treatment of the working parts of dies - surface plastic deformation, chemical-thermal treatment (XTO), electroerosive alloying, laser heat treatment, and also the application of various wear-resistant coatings.

As a result of diamond smoothing, a surface is formed with irregularities of a gentle streamlined shape, which cannot be obtained with blade and abrasive processing methods. A specific microrelief in combination with high microhardness and residual compressive stresses in a thin surface layer provides a significant increase in the wear resistance of the working parts of the dies [1]. As a result of the experiments, a number of dependences of the roughness Ra on the smoothing strength of Ru, the radius of the working part of the diamond rcф and the feed S (Figure 5) were obtained when smoothing the side working surfaces of punch punches made of U10A steel, heat-treated to HRC 50–55. The results of production tests of sanded and ironed punches when punching holes with a diameter of 4 mm in a piece of steel 20 with a thickness of 1.6 mm are shown in Figure 6. It can be seen from the results that the wear of the ironed punches is about 2–3 times less than the sanded ones. The increase in wear resistance of ironed punches is explained by the hardening of the metal in a thin surface layer, the improvement of the lubrication and heat removal conditions from the plastic deformation zone. This method of hardening can be applied to dies for cutting and punching blanks of simple configuration.

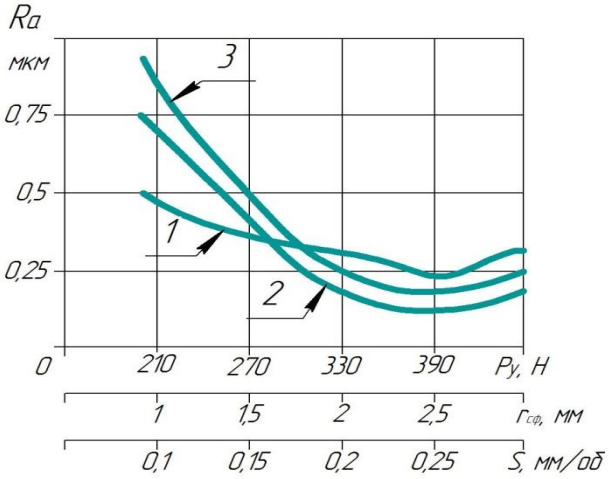

Figure 4. The dependence of the surface roughness Ra on the smoothing strength Py (1), the radius of the working part of the diamond $r_{сф}$ (2) and the feed S (3)

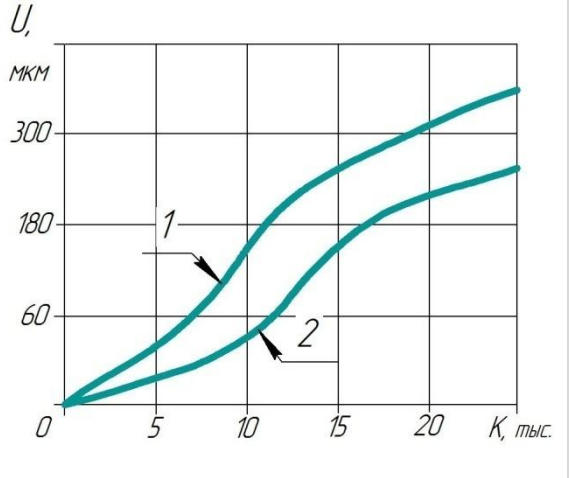

Figure 5. Change in the linear wear of the U punch depending on the number K of punched holes: 1 - polished; 2 - ironed punches

The dimensions of the punches and dies made from the studied steels, especially from U10A, during the operation of the stamp both increase and decrease in comparison with the executive dimensions. It can be assumed that a slight increase in the size of the punch is due to the fact that the contact surface area located in a narrow zone along

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the cutting edges and subject to high specific forces undergoes plastic deformation under certain conditions, which exceeds the dimensional wear of the cutting faces of the matrix and punch. Such wear can be attributed to crushing, which consists mainly in plastic deformation at a depth of 1 - 2 mm, and sometimes more.

The dimensions of the working parts of the die and punch also change under the influence of thermal stresses that occur during successive cyclic heating and cooling of the working parts of the die and punch during operation of the die.

Figure 6 illustrates the change in the size of the bilateral clearance depending on the number of stamped parts. The wear of the cutting faces of the matrix and the punch under certain conditions is blocked by the plastic deformation of the tool collapse along the cutting edges in the zone of high specific forces. Therefore, a sort of periodic self-healing of the gap between the matrix and the punch occurs.

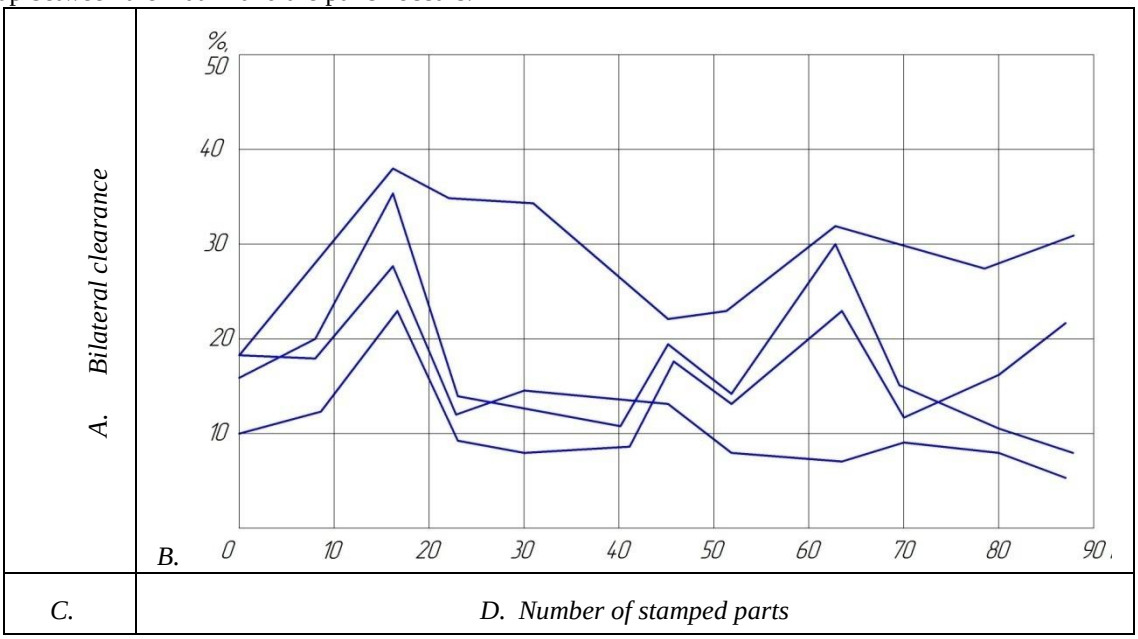

Figure 6. Changing the bilateral clearance depending on the number of stamped parts made of U10A steel.

V. EXPERIMENTAL RESULTS

During the stamp testing period it is impossible to be limited to a small number of stamped parts, since a small number of stampings will not give a complete picture of the work of the stamp. It is necessary to make at least 50–70 stampings and, if all of them are of satisfactory quality, remove the stamp from the press. A lot of defects in the finished parts are caused by incorrect installation of the stamp on the press.

The first sign of improper installation of the stamp on the press will be one-sided friction on the guide columns, the appearance of a shiny cut surface on either side of the part (which indicates that there is no clearance on this side) and the blunting of the cutting edges of punches and dies in this section. This defect is usually a consequence of the skewness of the press table, the unevenness or unevenness of the gaskets under the stamp and the displacement of the upper part of the stamp relative to the lower.

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