Web of Scholars: Multidimensional Research Journal (MRJ)
Volume: 02 Issue: 03 | 2023 ISNN: (2751-7543)
http://innosci.org

High Performance Punching Process

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Annotation: *The article talks about the types of metal processing, with which you can get finished products of the desired geometric shape and size. Analyzes comparing the production of parts by cutting and cold forging by extrusion are given. Programs are given that allow creating a mathematical model of the technological process, varying the process parameters and obtaining the necessary results.*

Keywords: *Volumetric cold stamping, cutting, extrusion, hydraulic press, macrostructure lines.*

In industrialized countries, cold and incomplete hot forging has become widespread. The number of parts produced by cold extrusion is constantly increasing. This is due to the indisputable advantage of cold forging fig. 1.

Calculations show that for the production of 1 kg of a part by cutting, the amount of energy is required by 40-50 MJ more than with cold extrusion, i.e. when cutting, the excess energy consumption is equivalent to the energy content of 1 kg of oil.

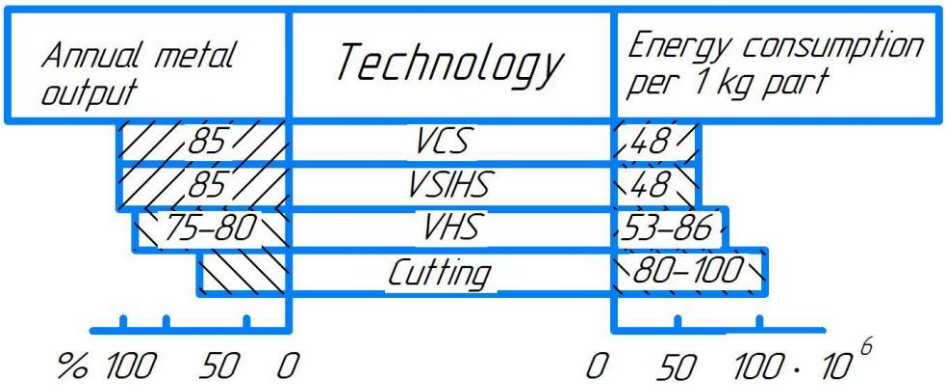

Fig. 1. Consumption of material and energy in the application of various types of processing

The consumption of material in the manufacture of parts by cutting is 40-50% higher, and the required labor costs are several times greater than in cold forging. From the point of view of the accuracy of the products, the VCS methods are continuously approaching the cutting methods of fig. 2.

From fig. 2 it can be seen that the dimensional accuracy of parts achieved with cold extrusion is approaching the accuracy achieved with cutting.

In international practice, cold extrusion has spread, first of all, in those industries in which the serial production ranges from several hundred thousand to many million pieces per year, i.e. in conditions of mass and large-scale production. The volume of production in the shops of cold extrusion exceeds 10000 tons per year.

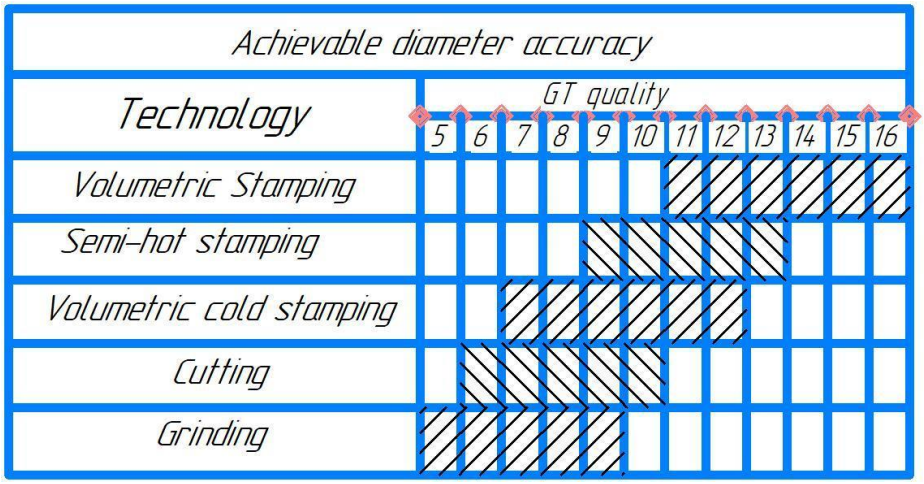

Fig. 2. Achievable accuracy when applying various types of processing

The development of technology and equipment for VCS by extrusion has made it possible to expand the scope of this method in large-scale, and in some cases, in medium-scale production.

In addition to improving the technical, economic and operational performance of parts when they are manufactured by the VCS methods, the environmental frequency of the technology is of great importance.

Depending on the nature of the metal flow, a classification of the VCS processes is given fig.3. The use of these processes sequentially or simultaneously makes it possible to produce that large variety of forgings, which is necessary to meet the needs of production.

Metal flow in extrusion processes is complex and depends on a large number of factors. In the processes under consideration, plastic flow is determined by the scheme of forces acting on the workpiece, the geometry of the workpiece and working tool, mechanical, including plastic properties of the metal, and other factors.

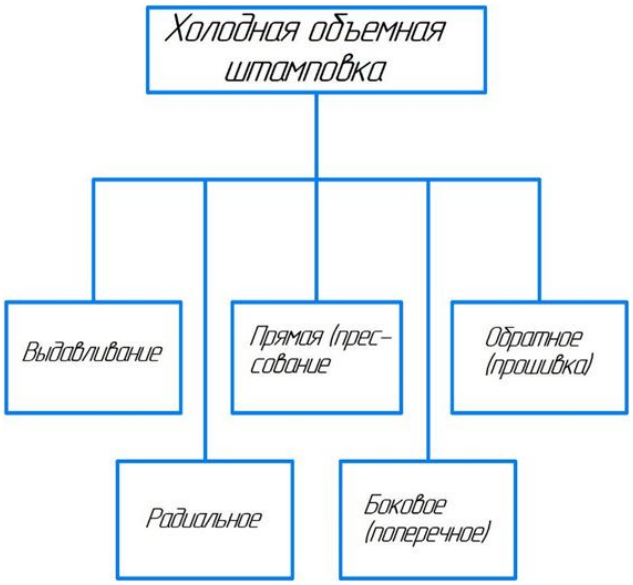

Fig. 3. Classification of cold extrusion operations

In connection with the one of the important stages is the choice and justification of the correspondence of the mathematical model to the considered real process. When choosing an overly complex mathematical model that takes into account the influence of a large number of various factors, it will inevitably lead to the need for simplifications in the course of solving or the

use of high-speed computing technology and will not allow obtaining the expected result. This means that the computer model must take into account the most significant factors.

At present, in the production of fasteners by VCS methods, the issues of ensuring high quality, strength and reliability of products, reducing the time for introducing new products into production, as well as reducing production costs are relevant. The design of technological processes for fasteners includes the solution of a number of complex problems: determination of the stress-strain state; material structure prediction; optimization of stamping transitions and prevention of the possibility of technological failures; determination of stamping forces, load and nature of tool deformation, etc.

The use of traditional methods for designing technological processes and the introduction into production does not always allow solving the above problems and ensuring the optimal combination of the required quality of the finished part, minimum time and production costs.

One of the effective approaches to solving these problems is the integrated use of computer-aided design systems based on advanced computer technologies: CAD and CAE systems - software systems for automated engineering analysis of forging processes (QForm, DEFORM, eesy-2-form, eesy-form, SuperForg/SuperForm, MSC.SuperForge, FORGE, FINEL, etc.). These programs make it possible to simulate the plastic flow of material for hot, semi-hot and cold processes, and these can be both isothermal processes.

You can simulate complex technological operations involving prefabricated workpieces and any number of tools. It is possible to calculate several tools, as well as taking into account the preload in the prefabricated tool. You can also specify almost any equipment - hydraulic presses, hammers, screw presses, crank presses, rolling mills, etc.

The specialized software systems listed above provide ample opportunities for processing results, evaluating the process for the presence of defects, and analyzing the flow of material. The results of the calculation, including graphs of forces and work, distribution fields of stresses, strains and temperatures, the macrostructure of the part and the movement of individual points, can be presented graphically and tabularly. Results can be displayed as graphs, numbers, hard copies, and animations for reporting purposes.

When using these software systems, it is possible to optimize the tool geometry, initial dimensions and material of the workpiece, equipment parameters, lubricants and other process parameters before the manufacture of tooling and industrial testing of new technology, which can significantly reduce the cost of preparing production and introducing a new one. technologies.

The results of computer simulation of the metal flow and the formation of the macrostructure during CSS in the QForm software package have good convergence and agreement with the data of the real cold heading process.

Modeling in the eesy-2-form program (CPM GmbH, Germany) is intended for modeling and analysis of cold forming processes of fasteners and other fittings. This program allows you to simulate the plastic flow of materials during various technological operations. The calculation results include force and work graphs, stress, strain and temperature distribution fields, distribution of macrostructure lines, etc. Simulation results can be displayed in the form of graphs, tables, hard copies and animations.

Thus, the use of the specialized software package esy-2-form for modeling technological processes allows quickly and with high accuracy to determine the main parameters of the processes and the presence of possible defects, as well as to improve the technology while saving resources and time.

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