DESIGN OF TECHNOLOGICAL PROCESSES FOR MANUFACTURING PARTS BY COLD PRESSING

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Rezumat. *Procesul tehnologic reprezintă ansamblul de operații mecanice, fizice, chimice, care prin acțiune simultană sau succesivă transformă materiile prime în bunuri sau realizează asamblarea, repararea ori întreținerea unui sistem tehnic. Deformarea plastică este metoda de prelucrare prin care se realizează deformarea permanentă fără fisurare a materialelor, prin aplicarea forțelor exterioare. În orice situație reală, pentru prelucrarea unui anumit reper pot fi utilizate mai multe variante tehnologice. Chiar dacă toate aceste variante ar fi fezabile, numai una din acestea este optimă. În contextul evoluţiei industriale actuale şi a concurenţei acerbe în toate domeniile, concepția integrată a produselor aduce mari servicii calității produselor şi competitivităţii firmelor implicate într-un asemenea demers. Concepția asistată, cu componentele sale din domeniul ingineriei: CAD, CAM, CAE, prin conexiunile sale cu celelalte domenii inginereşti, obține informații deosebit de importante, dificil de obținut pe cale pur abstractă. Funcțiile sistemului CAM (Computer Aided Manufacturing) sunt: comanda fabricației și a atelierelor de fabricație, comanda posturilor de lucru, a fluxurilor materiale, comanda depozitelor și a procesului de transport.*

Abstract. *The technological process represents the set of mechanical, physical, chemical operations, which by simultaneous or successive action transform the raw materials into goods or perform the assembly, repair or maintenance of a technical system. Plastic deformation is the processing method by which the permanent deformation without cracking of the materials is achieved, by applying external forces. In any real situation, several technological variants can be used to process a certain part. Even if all these options were valid, only one of them is optimal. In the context of the current industrial evolution and the fierce competition in all fields, the integrated design of the products brings great services to the quality of the products and to the competitiveness of the companies involved in such an approach. The assisted conception, with its components in the field of engineering: CAD, CAM, CAE, through its connections with the other fields of engineering, obtains very important information, difficult to obtain in a purely abstract way. The functions of the CAM (Computer Aided Manufacturing) system are: control of workshops manufacturing, control of workstations, material flows, warehouses and transportation process.*

Keywords: Design, Technological process, Parts manufacturing, Machine tools, Cold pressing.

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1. Introduction

The topic of this theme "Design of technological processes for the manufacture of parts by cold pressing", is carried out within GIC NOSAG METAL Company.

This paper consists of three parts. Part I is the bibliographic study and includes the presentation of general aspects of cold plastic deformation. Part II presents product quality control, and Part III emphasize personal interpretations and conclusions.

The objectives of the paper refer to the development of a new product called "Connecting wire" and clarifies a number of issues regarding the launch of the series production in good conditions.

Part I - BIBLIOGRAPHIC STUDY

Classification of cold plastic deformation processes

Cold forming of metal materials is the method of processing by cutting, deformation or combinations thereof, without chip removal and without preheating the materials.

Depending on the type of deformation of the processed material, there are two main groups of processes: processing with detachment (cutting) of the material and processing by plastic deformation.

The cutting processes, being executed with punches, are called stamping processes, and the deformation processes, being performed with the help of molds, are called molding processes.

The diagram from Figure 1 shows the classification scheme of cold plastic deformation processes.

Preparation of materials used on cold plastic deformation process

The materials used in cold forming are sheets, strips, bars, wires and other rolled profiles made of ferrous or non-ferrous metals.

The surface of the metal must be perfectly smooth, cleanly laminated, free of wrinkles, exfoliation and other mechanical damage. It must also be free of oxides or non-metallic inclusions.

In terms of their shape, size and tolerances, the material must meet the standards of the appropriate standards for the assortment of the material. During cold pressing operations, the characteristics of the material change, in the sense that the breaking strength increases and the elongation decreases, which results in a reduction of the deformation capacity of the material.

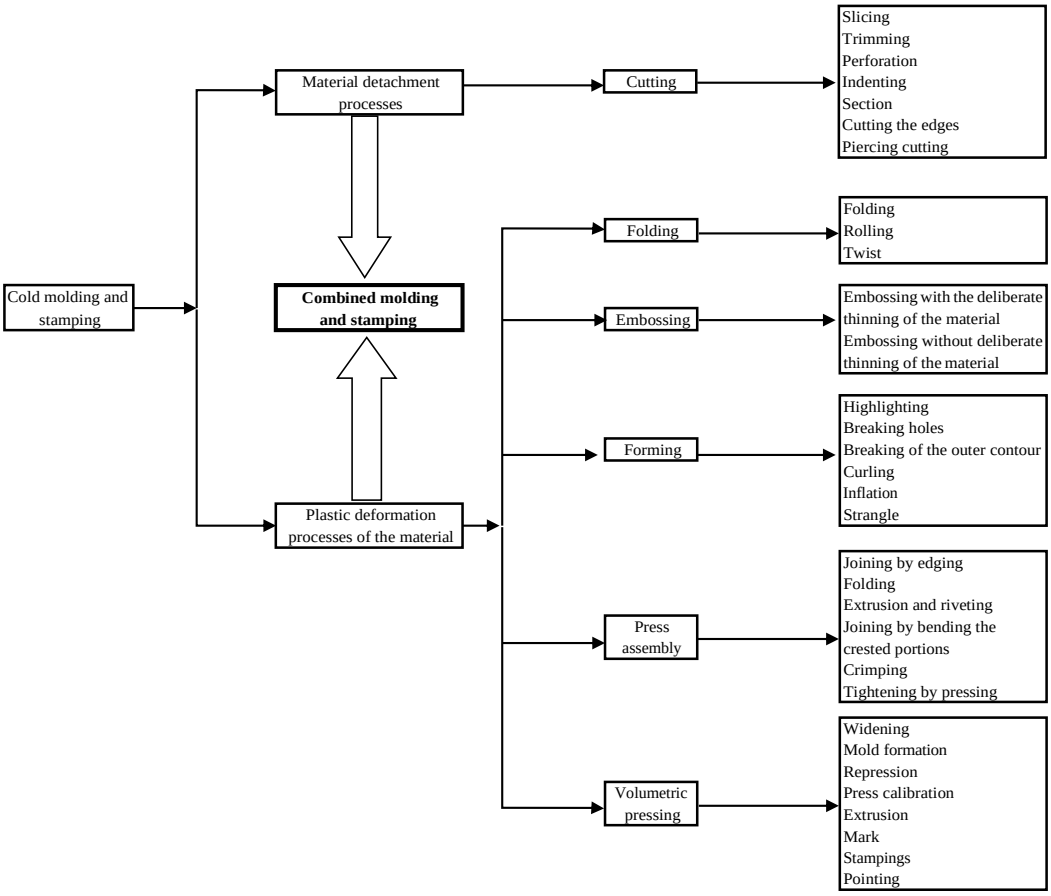

Fig. 1. Classification scheme of cold plastic deformation process

Tools and devices used in cold pressing operations

Stamps are used for the execution of cutting operations, and molds are used for the execution of plastic deformation operations, both types being able to be executed in a varied constructive range.

The basic elements of the dies have the role of fixing the die on the press on which the cutting operation is performed and to guide the moving elements towards the fixed ones. The main elements are: base plate, top plate, punch plate, guide plate, mounting plug, columns and guide bushes (Fig.2).

The active elements of a die are the punch and the active plate. They are made of alloy steels or heat-treated tool steels to increase hardness.

The auxiliary elements are: pressure plate; the release agent; tightening ring; the thrower; throwing rod; the stopper; elastic elements; screws and pins.

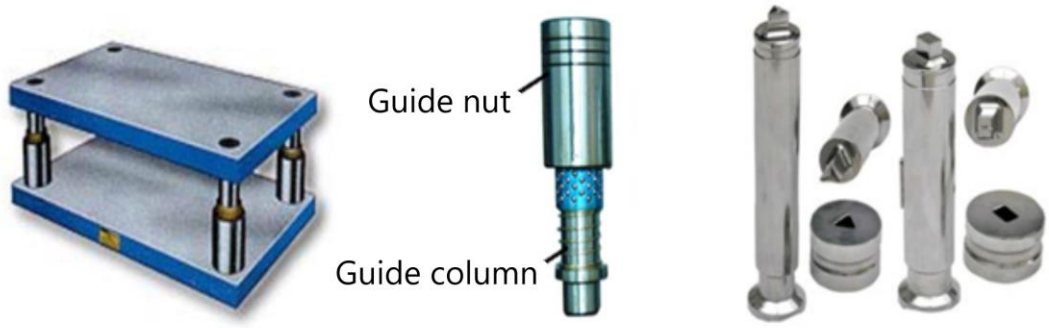

Fig. 2. Tools and devices used in cold pressing operations

Technological process design

Any activity is done through a technology.

Technology means a sequence of actions designed to achieve the intended purpose in any activity such as, for example, the realization of a product or service, the acquisition of knowledge, the conduct of experimental research.

The design of technological processes for cold pressing process is a particularly important step in the preparation of manufacturing. It depends to a large extent on the designed technological process to ensure the obtaining of the part with the technical conditions imposed by the execution drawing at a low cost, with a high productivity, for a given manufacturing case-study.

Part II – PRODUCT QUALITY CONTROL

In machine building, as in other industrial fields, product quality control is organized in two forms: after processing (also called passive) or during processing (called active).

a) Passive control consists in checking the accuracy of the parts after the whole batch has been processed, in which case the prevention of scrap is excluded (hence the notion of "passive").

b) The active control is carried out during the processing of the parts from the batch and aims at directing the technological process, in order to avoid the appearance of scrap. The control can be performed during the actual processing (without removing the part from the work device) or immediately after processing, the measurement information, being used in this case to adjust the technological system to obtain the next part.

Passive control can be done in the following variants:

- 100% control of the finished parts, which is applied in the following situations:
  - sorting by size groups, for selective assembly (used for high kinematic precision products: bearings, pistons, cylinder liners of motor vehicles, main shafts of machine tools, etc.);
  - to control the parameters of the parts of great importance (for example in the aeronautical industry);
  - when the dimensional spreading field, due to improper equipment, exceeds the prescribed tolerance range.
- control by sampling, which is applied to the receipt of batches of parts by the beneficiaries or after the operations in which the active control is performed, as well as to the control of some parameters of lesser importance for the operation of the product.
- statistical control, is applied in cases of determining the stability of the processing process, in order to improve it.

Passive control can be performed by universal or special means, automatic or non-automatic.

Active control: due to the increase in quality requirements for the production of products, in recent years the control has shifted from the form "out of process" to the form "in process or with implications in process".

Active control processes "in process or with implications in process" cannot be applied anywhere and in any case, these implying the use of particularly expensive measuring instruments with implications on the cost of the product.

Active control (automatic or non-automatic) is used for the following purposes:

- measuring the dimensions during the process and issuing information when the predetermined quota is reached, when the process stops or possibly moves to another processing phase (from roughing to finishing).
- if the active control is automatic, it is possible to automatically adjust the parameters of the operating mode according to the value of the measured parameter and to stop the process when the predetermined dimension is reached.

There are several criteria for classifying defects:

- Depending on the nature, the defect may be: structural, appearance, packaging, etc. functional defects.
- According to the measurement possibilities: they are divided into measurable and attributive defects
- According to the cause that led to their appearance, it is classified into: material defects, technological defects, defects caused by the operator, defects caused by equipment, defects of measurement, etc.
- Depending on the impact, the defects are divided into:

- Critical defects - those defects that prevent the performance of the functions of the product, being likely to lead to a lack of security for the beneficiary. Products with such defects should not be delivered, as they will certainly generate complaints from the beneficiaries and may compromise the image of the manufacturer.
- Major (main) defects - are those defects that, without being critical, risk causing deficiencies or reducing the possibilities of using the product. They are noticeable by the beneficiary, causing him shortcomings and can lead to the generation of complaints.
- Minor type A defects (secondary) - are those defects that do not greatly reduce the possibilities of using the product. They are notified by the beneficiary, but their presence will lead to the generation of complaints.
- Minor type B defects (minor) - are those defects that do not reduce the possibilities of using the product. In general, these defects are not reported by the beneficiary and do not generate complaints.
  - According to the effects produced, it is classified as remediable or irreparable defects.
  - According to the frequency of occurrence, it is classified as random defects or systematic defects.
  - After the period of occurrence, the defects are classified into: run-in, maturity, old age or wear.

Analysis, evaluation and improvement of product quality; Cause-effect diagram.

The cause-and-effect diagram, also called the "fish bone" diagram, the "fish skeleton" diagram, or the Ishikawa diagram, is a tool used to analyze and graph the relationship between an effect and the causes that led to it.

The diagram is made when there is only one problem to be analyzed, and the possible causes that determined its appearance can be ranked. Thus, the cause-effect diagram is a graphical representation of the relationship between the problem and the causes that generated it.

In the construction of the diagram, the problem (effect) is the "fish's head", and the causes and sub-causes (level 1 causes, level 2 causes, etc.) form its bone structure (Fig. 3).

Thus, the diagram clearly illustrates the relationship between a particular identified effect and its potential causes.

The cause-and-effect diagram is used:

- to understand the factors that influence a phenomenon or process;
- for analyzing a defect in terms of the causes that can cause it;
- to identify the families of causes that can influence the appearance of a defect and the selection among them of the most probable ones, in order to eliminate them;
- as a communication and training medium;

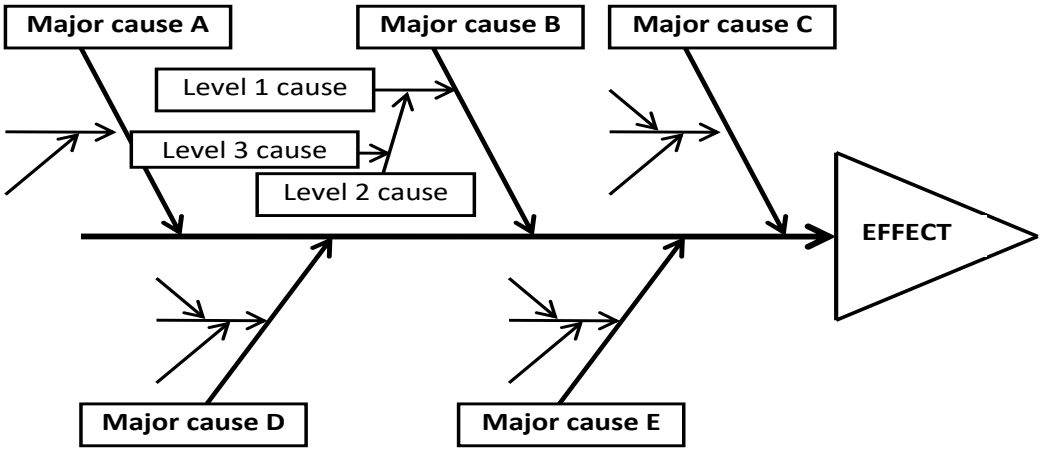

Fig. 3 .The skeleton of a cause-and-effect diagram.

In practice, the following types of cause-and-effect diagrams are used:

5M cause-effect diagram, in which the basic bone structure includes Means, Worker, Methods, Materials and Environment.

Some users add a sixth dimension, Management resulting in a **6M** chart, or even a seventh dimension Financial means, reaching a **7M** chart.
In the case of non-productive areas, the 4P diagram (Policies, Procedures, Personnel, Position) is considered more appropriate.

Part III - PERSONAL INTERPRETATIONS AND CONCLUSIONS

Quality is undoubtedly a key factor in the context of globalization and international competition. According to SR EN ISO 9001:2015 the quality is:
"The extent to which a set of inherent characteristics meets the requirements". There is no quality in itself, only entities that possess quality.

The benefits of eliminating improper part quality are:

- reducing the amount of material used to make the batch of parts;
- improving customer satisfaction;
- lower costs for reprocessing (retouching and disposal of scrap);
- less extra time.

Plastic deformation is the processing method by which the permanent deformation without cracking of the materials is achieved, by applying external forces.
In any real situation, several technological variants can be used to process a certain part. Even if all these options were valid, only one of them is optimal.
In the context of the current industrial evolution and the fierce competition in all fields, the integrated design of the products brings great services to the quality of the products and to the competitiveness of the companies involved in such approach.

The designed technological process must ensure that all the requirements indicated by the execution drawing of the part are met.
The assisted conception, with its components in the field of engineering: CAD, CAM, CAE, through its connections with the other fields of engineering, obtains very important information, difficult to obtain in a purely abstract way.
The functions of the CAM (Computer Aided Manufacturing) system are:

- control of manufacturing and manufacturing workshops,
- control of workstations,
- control of material flows,
- control of warehouses and transport,
- control of the process.

The future development of the theme refers to the development of a new product called "connecting wire" and the launch in series production in good conditions.

This paper challenge is how to approach and solve problems and clarifies a number of issues regarding the launch in series production of the "Connecting Wire" part. The functional role of the product is to connect the seat and back of a car seat and to allow the seat to be folded down.

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