

COLD FORGING TECHNOLOGY APPLIED IN MECHANICAL ENGINEERING

CÔNG NGHỆ DẬP KHỐI NGUỘI ỨNG DỤNG TRONG CƠ KHÍ CHẾ TẠO

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ABSTRACT

In recent years, the cold forging technology has made great progress, this technology has the advantage of forging out parts with high precision, good surface quality, and improving the mechanical properties. The number of products manufactured by cold forging in important industrial sectors such as automobile, aviation, and defense ... is increasing. This paper refers to the necessary requirements for materials, equipment, and die structure to be applied in practical manufacture. With the development of peripheral technologies, such as material engineering, die tool or lubricant manufacturing, many parts will be fabricated with this technology.

Keywords: Cold forging, net-shape forging, metal forming.

TÓM TẮT

Trong những năm gần đây, công nghệ dập khối nguội đã có những bước phát triển lớn. Công nghệ này có ưu điểm là dập ra chi tiết có độ chính xác cao, chất lượng bề mặt tốt, nâng cao cơ tính sau dập. Số lượng sản phẩm được chế tạo bằng dập khối nguội trong các lĩnh vực công nghiệp quan trọng như ô tô, hàng không, quốc phòng... ngày càng tăng. Nội dung nghiên cứu trong bài báo này đề cập đến các yêu cầu cần thiết về vật liệu, thiết bị, kết cấu khuôn dập để có thể ứng dụng vào thực tế sản xuất. Với sự phát triển của các công nghệ ngoại vi, như kỹ thuật vật liệu, kỹ thuật chế tạo dụng cụ hoặc chất bôi trơn thì nhiều chi tiết sẽ được chế tạo bằng công nghệ này.

Từ khóa: Dập khối nguội; Dập chính xác; Gia công áp lực.

1. INTRODUCTION

Bulk forming is usually stamped in hot state (above the recrystallization temperature of metals) to improve ductility, reduce stamping force. However, with the development of material technology, die processing, and stamping equipment as well as the requirements on quality of stamping products ... so many

block-shaped parts are now being studied for cold forging (room temperature). In addition to the common advantages of bulk forming technology, cold forging has outstanding advantages compared to hot forging: better surface quality, improved mechanical properties (cold-harden), higher precision, and improved working environment [1, 2].

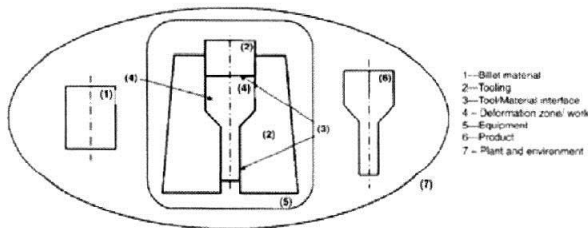


Fig. 1. Cold forging as a system [3]

However, cold forging also faces certain difficulties. Because the deformation characteristics of bulk metal is in the cold state, the strain and stress is very high, requiring equipment with large technological forces, tool materials also require high strength and hardness due to work with high technology force. The paper focuses on analyzing the requirements, characteristics and applicability of cold forging, to make the basis for Vietnamese technicians.

2. COLD FORGING TECHNOLOGY

2.1. Concepts and classifications

The cold forging is characterized by the initiate condition of forming process at room temperature and without any external thermal effects. In addition to these above technical definitions, the cold forging process could be defined as the stamping process at lower temperature than recrystallization temperature of the material.

Cold forging technology could be classified to: upsetting, extrusion, thread rolling (fig. 2).

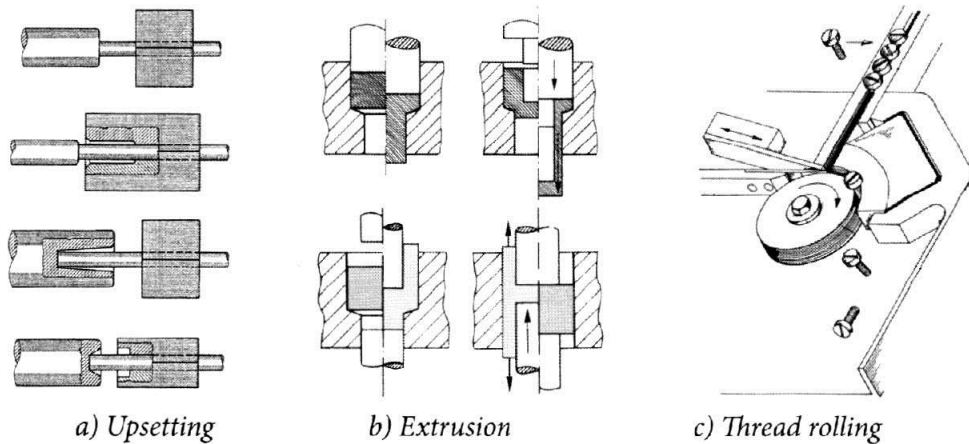


Fig. 2. Various types of cold forging techniques [3, 5]

2.2. Materials suitable for Cold Forging

All metals that exhibit ductility at room temperature can be cold forged. This group consists primarily of steels and aluminum alloys. However, alloys of copper, zinc, tin, titanium, beryllium, and nickel also can be cold forged for special applications [3]. Including:

Carbon steels – Low to Medium Carbon Steels up to 0.60% carbon, Stainless steels – 300 and 400 Series, Alloy steels of suitable mechanical properties and ductility, Copper & its alloys, Aluminum & its alloys. Materials for cold forging can be supplied as rolled or drawn rod or wire as well as in the form of sheared or sawed-off billets.

2.3. Equipment

The equipment used in hot forging technology can be used for cold forging. However, depending on each forging operation, we use the right type of equipment. In cold forging technology, there are basically three types of presses: hydraulic, mechanical, and screw presses.

2.4. Die construction and lubrication

The high pressure force exerted to the tool shorten the die lifespan. To increase the die lifespan, we must use high-alloy steel, with great strength and low abrasion. The die must ensure high surface finish and precision.

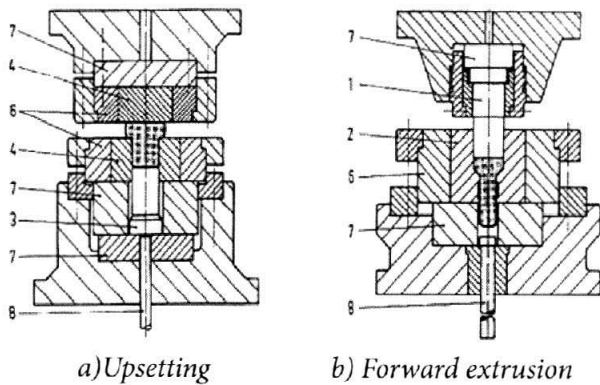


Fig. 3 Die construction [3]

- 1- Punch, 2- Die (Die insert and container), 3- Counter punch,
- 4- Heading punch/Heading die, 5- Mandrel, 6- Stress ring (s),
- 7- Pressure pad, 8- Ejector.

Lubrication in cold forging plays an important role, lubrication reduces force and increases metal deformation. In addition, the lubrication also increases the lifespan of the die. In terms of die structure, in order to increase the durability of the tool, we use multi-layer tibial tensioners to create preliminary stress, increase die lifespan as well as save metal in manufacturing the tool [fig. 4].

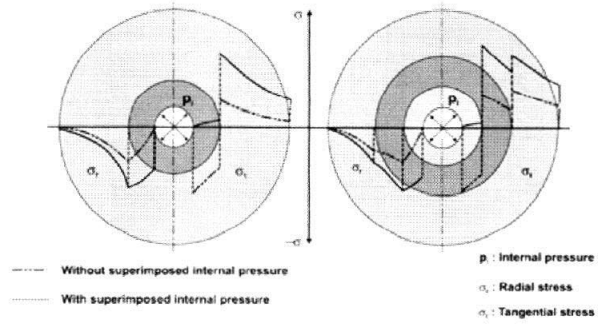


Fig. 4. Theoretical stress progressions with one (left) and two (right) reinforcement rings, with and without internal pressure [4]

2.5. Applications

Cold forging technology is used to manufacture parts such as joints, gears, stepped shafts, bolts, ... in many industrial fields such as Automotive industry, Military industry, Oil/ Gas industry, Industry of heavy construction machinery, Agricultural machines... Because the forging process operate in the cold state, the degree of deformation is limited and the effect of the strain hardening to deformation, mainly the parts are in the form of a circular, symmetrical shape.

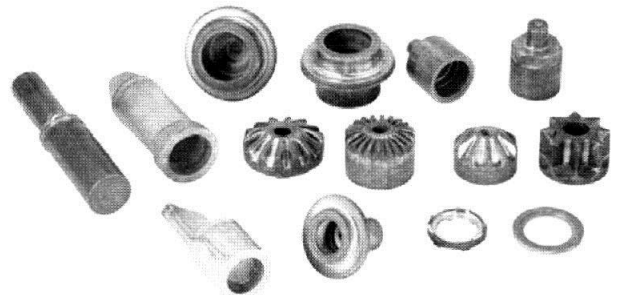


Fig. 5. Some parts are made by cold forging [4]

3. CONCLUSIONS

Research shows this technology can be applied to fabricate parts from ductility metal. However, due to forging in the cold state, the deformation ability of the metal is

low, the pressure in the inside of the die is high, requiring more complicated die design, the die material must have high mechanical properties and abrasion resistance. Reasonable lubricants must be used to reduce friction, facilitate deformation process. Equipment used in cold forging technology has no special requirements, it is possible to use conventional equipment in cold forging.

Compared to hot or warm forging technology, outstanding advantages of cold forging are high precision of stamping products, good surface quality and mechanical properties, no need for additional heating equipment, saving production costs .. Cold forging is a technology worth considering and applying in practical manufacture in Vietnam.

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