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Spinning and flow forming hard-to-deform metal alloys

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The increasing requirements of industry concerning products of hard-to-deform materials result in growing interest in the technologies of spinning and flow forming. Moreover, the tendency to manufacture short series makes those technologies more and more attractive in the case of axisymmetrical products. The paper presents works involved in the preparation of manufacture of new axisymmetrical products of hard-to-deform metal alloys. Those products often have complex shapes, difficult to obtain by the traditional methods of stamping. The elaboration of the new technologies has been preceded by material and technological investigation.

Keywords: *spinning, flow forming, hard-to-deform metal alloys*

1. Introduction

Many industrial branches increase their interest in economical manufacturing of short and medium series of products. Furthermore, the tendency to reduce the weight of products brings greater interest in the application of materials with higher strength or lower specific gravity. Those materials generally reveal higher deformation resistance. In the case of axisymmetrical products, incremental technologies of rotary forming meet the requirements of cost-effective production and the possibility to form hard-to-deform materials.

2. Flow forming technologies

Incremental rotary forming technologies are, first of all, spinning and flow forming.

Spinning means forming a sheet metal disk on a template in one or more passes of the forming roll. This is effected without intended thinning of the wall. Spinning is a very effective method of forming complex shape axisymmetrical products [1].

Flow forming means shaping a product of sheet metal, tube or drawpiece in one are more passes of the forming roll or rolls. The magnitude of wall thinning depends on the properties of the input material and the number of passes.

Flow forming is an effective method of manufacturing short series of precision tubular products of hard-to-deform materials, as well as short series of toothed products and profiled disks [2, 3].

Due to the incremental way of forming, the forming forces necessary in spinning or flow forming are much lower than those necessary in stamping, either with or without wall

thinning. This is due to small, relocating material plastification area and therefore lower friction forces occurring in the process [4]. This results in easier material flow and, consequently, the possibility to obtain larger deformations than in stamping. A consequence of this is the possibility to form hard-to-deform materials by these technologies. Some materials have to be formed at higher temperatures [5]. An interesting solution of local material heating can be the use of a laser beam [6].

One of the requirements present day technologies must meet is short time to start a product. The time can be shortened with the use of process simulation by numerical methods. This increases the technological certainty and eliminates the trial and error methods. However, incremental technologies are much more difficult to simulate due to the complicated process of shaping. Much better results have been obtained in flow forming than in spinning, but full simulation of the rotary forming process has not been solved yet [7, 8].

The Metal Forming Institute deals with spinning and flow forming as well as with the design of machines for those technologies. The machines are characterized by high installed powers and are designed so that adequate stiffness of the template-tool-machine system is assured during the forming process. Some products made by spinning and flow forming as well as a diagram of elongating flow forming can be seen (Figures 1 and 2). In the further part, investigation of flow forming technology for three hard-to-deform materials have been described.

Fig. 1. Examples of spinned and flow formed products

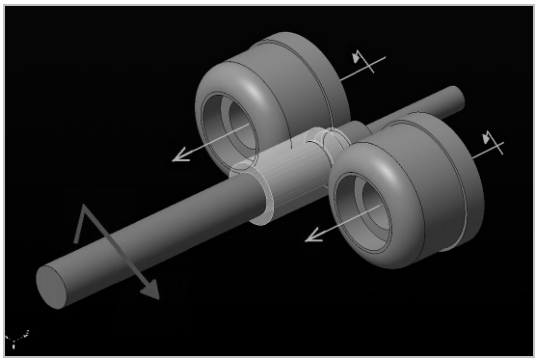

Fig. 2. A diagram of elongating flow forming

3. Examples of flow forming technology investigation for hard-to-deform materials

3.1. Investigation of flow forming of an aluminium alloy [9]

The investigation objective was to elaborate the technology of manufacturing an elongated product (Figure 3) of an aluminium alloy with complex strength properties.

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