

# Principles Of Industrial Metalworking Processes



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## Comparative Analysis of Extrusion Processes by Finite Element Analysis

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### Abstract

Extrusion processes are quite extended in the manufacturing of long products for a wide range of industrial applications. There are different approaches of extrusion processes, depending on either the final shape of the product to obtain or the maximum loading capacity of the equipment to be used. This work presents a comparative study of extrusion processes (solid and cup extrusion), considering both direct and indirect forming conditions and showing the most interesting differences between them. The comparison is realized by Finite Element simulation of the processes, using the code DEFORM F2. The material is a low carbon steel (AISI-1010) and the same extrusion ratio and ram displacement are considered in all cases. By comparing the required forces it can be concluded that required loads are higher in cup extrusion processes than in solid extrusion ones. Regarding the friction load, the maximum contribution due to the die-billet contact in cup extrusion is much higher than in the case of solid extrusion. On the contrary, the maximum friction load contribution due to the container wall is much higher in the case of solid extrusion than in cup extrusion.

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Keywords: extrusion; friction; direct; indirect; FEM

### 1. Introduction

Extrusion processes are one of most extended processes used in the manufacturing of long products for a wide range of industrial applications. There are different approaches of extrusion processes, depending on factors such as the final shape of the product to obtain or the maximum loading capacity of the equipment to be used [1].

Extrusion processes can also be divided into direct/forward and indirect/backward/reverse ones; in direct

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