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Design of flash pocket inserts in an extrusion blow mould based on the results of numerical simulations

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Abstract

The results of heat flow simulation in a flash pocket of an extrusion blow mould, made using ANSYS Polyflow software, are presented in this article. The efficiency of plastic cooling speed depending on the flash pocket profile shape was evaluated on the basis of polymer and mould temperature values.

The simulation was made using the model of a real blow mould with sockets to place the inserts of a different flash pocket profile shape. The simulation of the temperature change near flash pocket zone surface was made. The inserts allow testing the efficiency of polymer cooling in the flash pocket depending on the profile shape in this mould zone. As the result, the prediction of the extrusion blow moulding cycle time can be made. It was found that the most effective cooling of the plastic in the flash pocket can be achieved using the semicircular profile.

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1. Introduction

Extrusion blow moulding process is widely used in manufacturing of the hollow plastic parts. Its main applications are: packaging industry (bottles), automotive (fuel tanks), toys. Since this process is used for high volume or mass production its efficiency should be high. This can be achieved by shortening the cycle time. Multicavity moulds or multi-section machines are used to produce more parts in one cycle but also the efficiency of the mould is very important. One of the factors influencing the production time per part is the efficiency of cooling system in the mould. Most of the materials used in this process are thermoplastics and some time is needed to cool

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down the molten material, flowing out of the extrusion head and then blown inside a mould, until it will solidificate on the mould wall and will be ready to be removed from the mould and to be transported further. The mould cooling should be very intensive, particularly in the flash pocket, where the hot parison is folded and this excessive amount of the material is named a flash. The polymer layer thickness is doubled in this mould zone. The heat transfer from the mould surface to the cooling channels can be significantly increased by the design of the riffled surface in the flash pocket zone. However, different shapes of the profile in this mould zone are used and, except of different machinability, this shape is expected to have a different efficiency of the heat transfer.

1.1. Extrusion blow mould

The products in an extrusion blow moulding process are formed in two steps: first, a hot parison is extruded in the vertical direction on the extruder with the use of an extrusion die. The parison is of the proper diameter and its wall thickness which can vary along its length. Then the parison is blown by the pressurized air inside a blow mould. A classical extrusion blow mould is shown in Fig. 1. Usually these moulds consist of many parts made from different materials. The parts being in contact with the flash should be of high heat transfer coefficient.

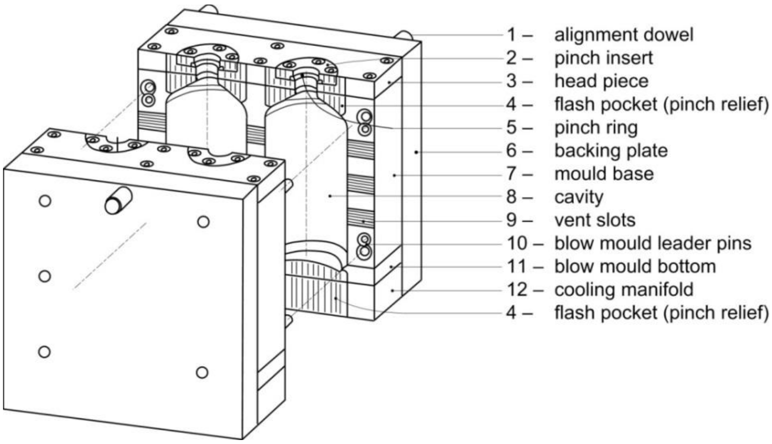

Fig. 1. Scheme of an extrusion blow mould [1, 2].

1.2. Pinch-off zone design

The part of the mould which enables the mould to cut off the excessive material from the manufactured product is called pinch-off zone. It consists of several areas, which are: pinching edge, pressure zone and flash pocket (Fig. 2a.

The role of the pinching edge is to split the flash from the part. The polymer outside the cavity is compressed in the pressure zone and fills the riffled area called flash pocket where is cooled intensively.

The shape and dimensions of flash pocket area is important for the efficient cooling but also for the proper work of the mould. some rules should be followed in the design of the geometrical features. The recommendations for a flash pocket profile design are given in Fig. 2b. The design of the pinch-off zone should be optimized for the particular product and it influences for example the quality of the bond in the bottom of the container [1-5]. The quality of the product can be influenced not only by the mould design by also by the processing conditions [6].

Extrusion blow moulding process can be modeled using finite element method-based software. Although the simulation is not so widely used as in case of injection moulding process, it is possible to predict the final wall thickness of the product after blowing phase [7, 8] and to optimize the parison dimensions to obtain the wall thickness values as uniform as only possible across the part [9].