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Contents

NUMERICAL EVALUATION OF DISTRIBUTIVE MIXING CAPABILITY OF SINGLE SCREW EXTRUDER WITH ROTATIONAL BARREL SEGMENT

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Abstract

Since their massive expansion in the first half of 20th century, extruders have undergone a continuous development, especially in plastic industry. The need to shorten time of developing new products and increase the existent production encourages manufacturers to develop new solution in design of extruder. In 1998 a completely new concept of the design of a single screw extruder (SSE) was introduced, based on kinematic activation of the barrel itself, which meant it could rotate in the direction identical or opposite to the direction of rotation of the screw. This design conception was tagged as rotational barrel segment (RBS).

Goal of this research is to numerically evaluate a new concept of construction in a single screw extruder design, with RBS. Calculating a flow pattern in complex geometries is not easy to perform. As the screw (or RBS) rotates, time-dependent boundaries make FEM simulations more difficult. Even in a steady state operating condition (i.e. constant screw speed), due to the rotation of the screw, the polymer inside the barrel flows at a non-steady periodic condition. Technique called Mesh superposition technique (MST) incorporated in ANSYS® Polyflow™ was applied to solve the polymer melt flow through RBS segment and the distributive mixing performance.

For purpose of this study three types of RBS were evaluated (fig.1), marked as concept-A, concept-B and concept-C. Diameter of the screw (1) was D=25 mm and the length of the RBS section (3) L=3D. Direction of the polymer melt flow is indicated by white arrow, rotation speed of the screw and RBS was 100 rpm, with direction indicated by yellow resp. red arrow. RBS was rotating in opposite direction as the rotation direction of the screw.

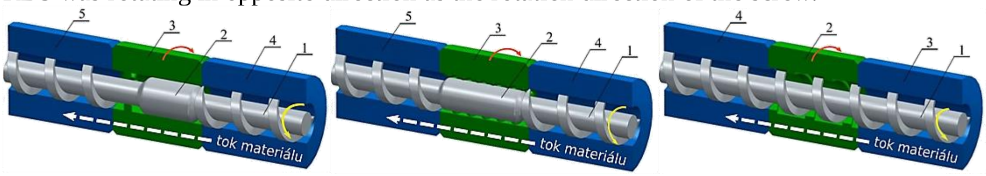

Fig. 1 Types of RBS concepts: concept-A(left), concept-B and concept-C

Extrusion_LDPE_isoth_463K polymer from ANSYS® Polyflow™ database was used as the polymer matrix in calculation of flow phenomena inside RBS section and obtained data were subsequently utilized in distribution mixing analysis. At the start of the time dependent mixing analysis, group of material points was generated at the entry of the flow domain, and the mutual distance between each material point and its nearest neighbor was evaluated (fig.2-4).

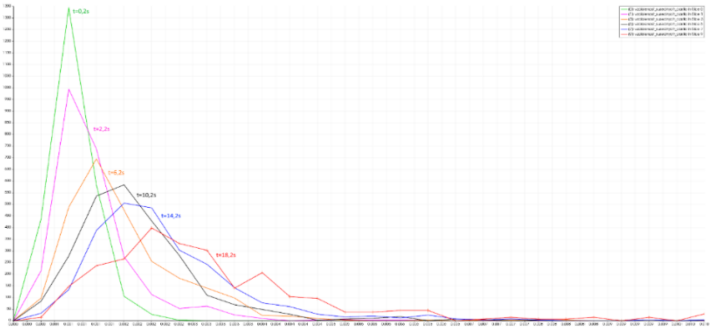

Fig. 2 Function of points distance distribution in RBS concept A

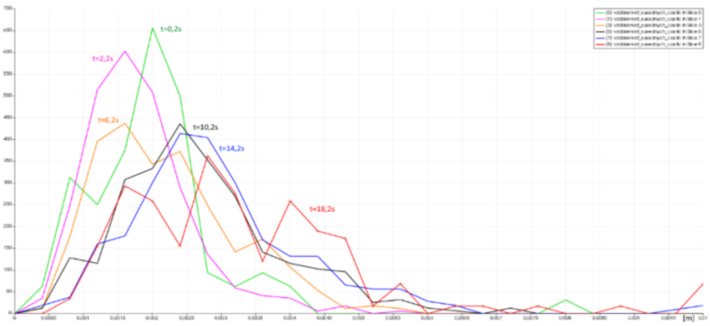

Fig. 3 Function of points distance distribution in RBS concept B

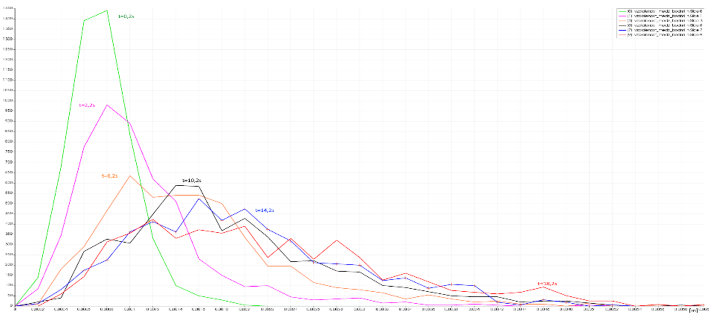

Fig. 4 Function of points distance distribution in RBS concept C

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