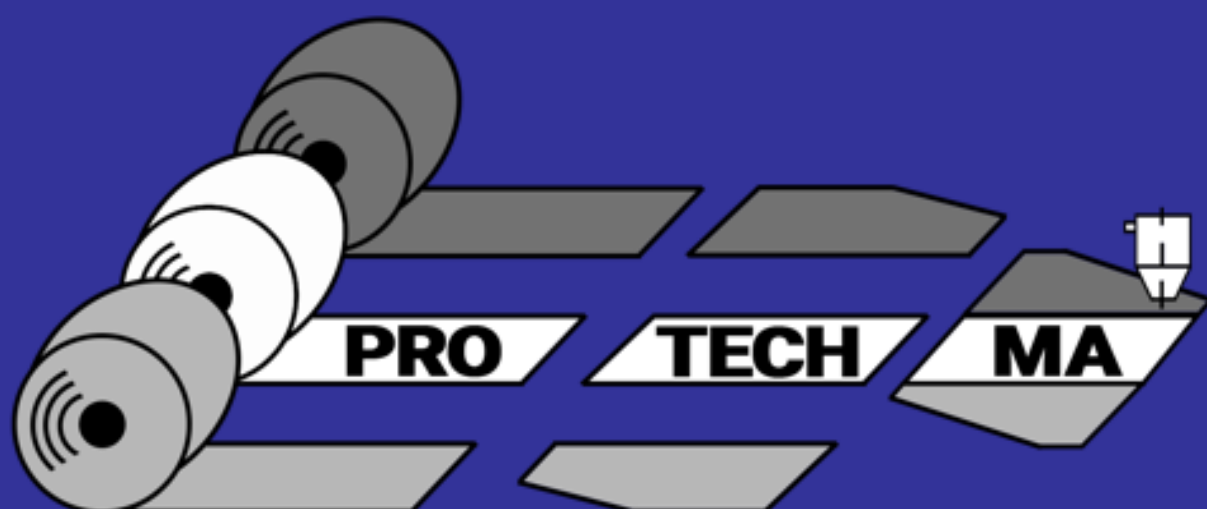


International Scientific Conference

PRO-TECH-MA 2020

PROGRESSIVE TECHNOLOGIES
AND MATERIALS



Rzeszów, POLAND
21th October 2020

PRO-TECH-MA 2020

Proceedings of the extended abstracts

International Scientific Conference

on

Progressive Technologies and Materials

The Conference Organizers

**Department of Materials Forming and Processing
Faculty of Mechanical Engineering and Aeronautics
RZESZÓW UNIVERSITY OF TECHNOLOGY, POLAND**

The Conference Partners

**Department of Materials and Technology
Faculty of Mechanical Engineering
TECHNICAL UNIVERSITY IN KOŠICE, SLOVAKIA**

**Department of Computer Modelling & Metal Forming Technologies
Faculty of Mechanical Engineering
LUBLIN UNIVERSITY OF TECHNOLOGY, POLAND**

Rzeszów, October 2020

INTERNATIONAL SCIENTIFIC COMMITTEE

| | |
|----------------------|---|
| TADEUSZ BALAWENDER | <i>Rzeszow University of Technology, Poland</i> |
| JANETTE BREZINOVÁ | <i>TU Košice, Slovakia</i> |
| LUDMILA DULEBOVÁ | <i>TU Košice, Slovakia</i> |
| EMIL EVIN | <i>TU Košice, Slovakia</i> |
| WIESŁAW FRĄCZ | <i>Rzeszow University of Technology, Poland</i> |
| ANDRZEJ GONTARZ | <i>Lublin University of Technology, Poland</i> |
| VILIAM HRNČIAR | <i>STU Bratislava, Slovakia</i> |
| LUBOŠ KAŠČÁK | <i>TU Košice, Slovakia</i> |
| STANISŁAW KUT | <i>Rzeszow University of Technology, Poland</i> |
| TIBOR KVAČKAJ | <i>TU Košice, Slovakia</i> |
| PETR LENFELD | <i>TU Liberec, Slovakia</i> |
| JANA MAJERNÍKOVÁ | <i>TU Košice, Slovakia</i> |
| ILDIKÓ MAŇKOVÁ | <i>TU Košice, Slovakia</i> |
| JACEK MUCHA | <i>Rzeszow University of Technology, Poland</i> |
| STANISŁAW NOGA | <i>Rzeszow University of Technology, Poland</i> |
| ZBIGNIEW PATER | <i>Lublin University of Technology, Poland</i> |
| JOZEF PETERKA | <i>MTF Trnava, Slovakia</i> |
| JAROSŁAW SĘP | <i>Rzeszow University of Technology, Poland</i> |
| JANUSZ SIKORA | <i>Lublin University of Technology, Poland</i> |
| ANDRZEJ SKRZAT | <i>Rzeszow University of Technology, Poland</i> |
| JÁN SLOTA | <i>TU Košice, Slovakia</i> |
| EMIL SPIŠÁK | <i>TU Košice, Slovakia</i> |
| FELIKS STACHOWICZ | <i>Rzeszow University of Technology, Poland</i> |
| PETER ŠUGÁR | <i>MTF Trnava, Slovakia</i> |
| ROMANA ŚLIWA | <i>Rzeszow University of Technology, Poland</i> |
| TOMASZ TRZEPIECIŃSKI | <i>Rzeszow University of Technology, Poland</i> |
| LUCJAN WITEK | <i>Rzeszow University of Technology, Poland</i> |
| JOZEF ZAJAC | <i>TU Košice, Slovakia</i> |
| JOZEF ŽIVČÁK | <i>TU Košice, Slovakia</i> |

ORGANISING COMMITTEE:

Grażyna Rzyzińska - Head of Organising Committee

Marta Wójcik

Grzegorz Janowski

Luboš Kaščák

Grzegorz Samołyk

Contents

| | |
|---|----|
| Optimization of automobile component production with CAM system..... | 7 |
| <i>Tomáš Jezný, Emil Spišák, Gerhard Mital</i> | |
| Bonding of dissimilar materials..... | 9 |
| <i>Anna Guzanová, Dagmar Draganovská, Erik Janoško, Róbert Moro</i> | |
| Modeling of compression test of natural fibre composite sections | 11 |
| <i>Grażyna Rzyńska, Grzegorz Janowski, Łukasz Bąk</i> | |
| Optimization of the PHBV-hemp fiber biocomposite manufacturing process on the selected example | 13 |
| <i>Grzegorz Janowski, Wiesław Frącz, Łukasz Bąk</i> | |
| The influence of geometrical parameters of a tool on its wear in selected technological processes | 15 |
| <i>Irena Nowotyńska</i> | |
| Numerical evaluation of distributive mixing capability of single screw extruder with rotational barrel segment | 17 |
| <i>Ivan Gajdoš, Emil Spišák, František Greškovič, Ludmila Dulebová, Janusz Sikora</i> | |
| The application of CAM system as a tool in the production of shaped surface | 19 |
| <i>Ján Varga, Emil Spišák, Peter Mulidrán</i> | |
| Verification of methods for determining the depth of plastic deformation of the surface layer | 21 |
| <i>Marek Kowalik, Piotr Paszta</i> | |
| Use of 3D parametric models in the automotive component design process..... | 23 |
| <i>Michal Fabian, František Kupec</i> | |
| Optimising the deep drawing process of box-shaped product by numerical simulation | 25 |
| <i>Miroslav Tomáš, Emil Evin</i> | |
| The coupled Eulerian-Lagrangian analysis of the KOBO extrusion process..... | 27 |
| <i>Marta Wójcik, Andrzej Skrzat</i> | |

| | |
|--|----|
| Friction stir welding of ultrathin AA2024-T3 aluminum sheets using ceramic tool | 29 |
| <i>Piotr Myśliwiec, Romana Ewa Śliwa, Robert Ostrowski</i> | |
| Influence of material models on the springback prediction | 31 |
| <i>Peter Mulidrán, Emil Spišák, Miroslav Tomáš, Ján Varga, Vladimír Rohal'</i> | |
| Evaluation of joinability of micro-alloyed steel HX420LAD | 33 |
| <i>Luboš Kaščák, Denis Cmorej, Emil Spišák</i> | |
| Springback prediction for pure moment bending of aluminium alloy square tube..... | 34 |
| <i>Stanisław Kut, Feliks Stachowicz</i> | |
| Quality assessment of heterogeneous welding joints made by GMAW method..... | 36 |
| <i>Ján Viňáš, Janette Brezinova, Jakub Brezina, Henrich Sailer</i> | |
| Experimental analysis of damping properties of viscoelastic materials | 38 |
| <i>Lucjan Witek, Piotr Łabuński</i> | |
| FEM analysis of chamfer design in hole | 40 |
| <i>Katarzyna Balawender, Jacek Mucha, Mirosław Osetek</i> | |
| Variation of surface roughness and friction behaviour during sheet metal forming of titanium sheets..... | 42 |
| <i>Marcin Szpunar, Robert Ostrowski, Tomasz Trzepieciński, Marek Zwolak</i> | |
| Enhancing the corrosion resistance of plastically deformed steel sheets with new generation coatings | 44 |
| <i>Emil Evin, Miroslav Tomáš</i> | |
| Shaping the microstructure of the extruded metal under various conditions of the KOBO process | 46 |
| <i>Marek Zwolak, Romana Śliwa, Beata Pawłowska</i> | |
| Analysis of a die forging process for producing a scaffolding joint coupler | 47 |
| <i>Grzegorz Winiarski, Tomasz Bulzak</i> | |
| Analysis of the possibility of forging hook slings from scrapped rail | 49 |
| <i>Tomasz Bulzak, Grzegorz Winiarski</i> | |

Using of hsm technology in processing of thin-walled aircraft structures51

Paweł Balon, Edward Rejman, Bartłomiej Kielbasa, Robert Smusz, Bartosz Zacharko

Author's Index53

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

Ivan Gajdoš^{1*}, Emil Spišák¹, František Greškovič¹, Ludmila Dulebová^{1*},
Janusz Sikora²

¹ Technical University of Košice, Faculty of Mechanical Engineering, Department of Technology, Materials and Computer Supported Production, Mäsiarska 74, Košice, Slovakia

² Lublin University of Technology, Department of Polymer Processing, Lublin, Poland

*Corresponding author: ivan.gajdos@tuke.sk, Tel.: +421556023518, Mäsiarska 74, 04001, Košice, Slovakia

Keywords: single screw extruder, distributive mixing, rotational barrel segment, polyflow

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.

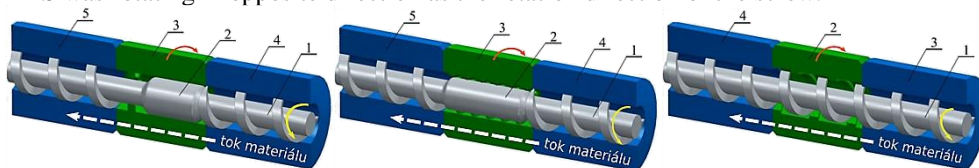


Fig. 1 Types of RBS concepts: concept-A(left), concept-B and concept-C

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).

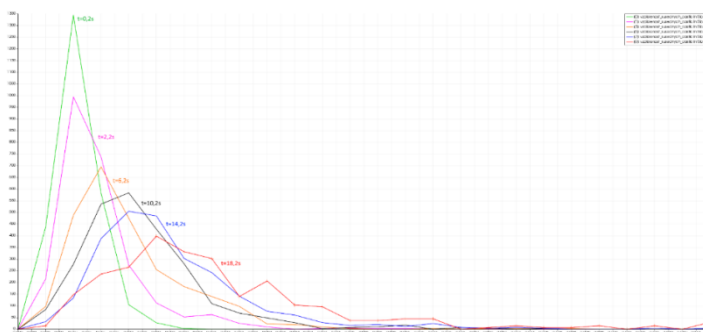


Fig. 2 Function of points distance distribution in RBS concept A

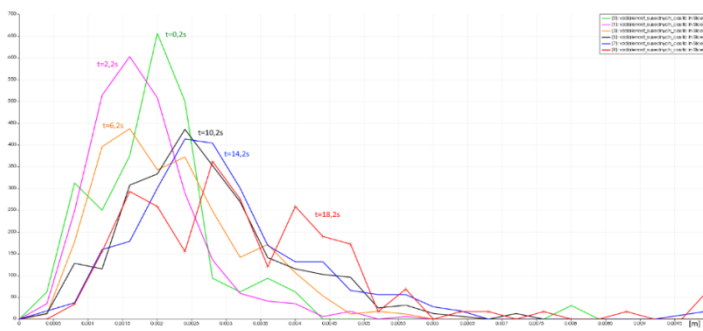


Fig. 3 Function of points distance distribution in RBS concept B

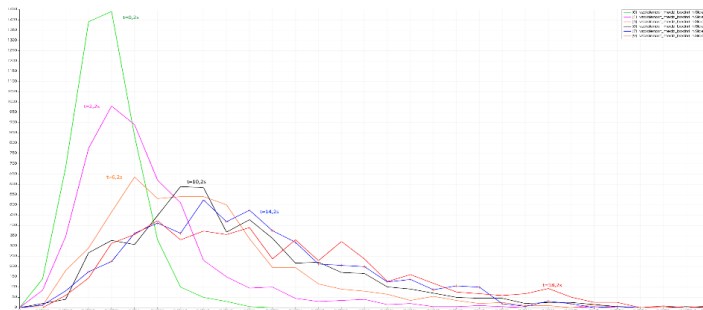


Fig. 4 Function of points distance distribution in RBS concept C

Acknowledgment: The project leading to this application has received funding from the European Union’s Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No734205”.



References:

- [1] I. Gajdoš [et al.]: 3D Finite Elements Simulation of the Single Screw Extruder with Rotational Barrel Segment 2019. In: EUROGEN 2019.
- [2] ANSYS Polyflow 2019 R2®. Available online: <http://ansyshelp.ansys.com> [access: 10.10.2020].