An investigation of polymeric extrudate rheological behaviour using a computational method

Sujit Sharma, Arghya Deb and Santanu Chattopadhyay
[2]Indian Institute of Technology Kharagpur, India

Extrusion is one of the most versatile and economical process for making long rubber profile of different shapes. The die swell is a critical characteristic in processing operations such as extrusion and injection molding for elastomeric products. While flowing through a complex-shaped die, the molten rubber compounds compress and shears intensely, causing die-swelling phenomena on die exit. There are different kinds of swelling during the extrusion process. One is a recoil mechanism due to the elastic nature, and the other is a reorientation of the velocity profile from die inlet to free surface outlet. Thus, extrusion industries usually design the die using conventional methods. These methods typically involve: 1) making the physical prototype of the die, 2) tuning it for flow balancing, and 3) repetitively testing it until attaining the desired product shape. Due to the recursive nature of this three-step designing process, it is relatively expensive and time-consuming. For geometries that are non-symmetrical or complexly shaped, the extrudate changes in terms of the dimension as well as shape, leading towards complexity in the study of die swell behavior of the rubber compound. The Non-Newtonian fluid flow phenomena are of paramount importance to the die designers and engineers to address the issues mentioned above and achieve the product's desired shapes. Nowadays, computational fluid dynamics is becoming the most popular way to visualize fluid flow behavior, even for complex design using the proper materials parameters. This work attempted to develop a possible computational method for simulating the flow and predicted the required die design to obtain the desired extrudate shape using ANSYS Polyflow®. Here, finite element analysis (FEA) of extrusion is performed to assess the product's swelling behavior using proper rheological and thermal boundary conditions. Hence, it can be concluded that this method can be used to increase the extrudate profile's production efficiency by reducing the traditional prototype trial and error method to get the product's desired shape.

Biography

Sujit Sharma was completed his B-tech in Chemical Engineering from NIT Durgapur, India. Then he did his M-tech in Rubber Technology from IIT Kharagpur, India. Now, perusing his PhD in Rubber Technology at IIT Kharagpur under the joint supervision of Prof. Santantu Chattopadhyay and Prof. Arghya Deb. He has received the best paper award at 23rd Rubber Conference, IRMRA. Mumbai, India, December 2018 and best poster award in National Rubber Conference, Kolkata 2019 organized by AIRIA.

sharma.sujitt92@gmail.com