G01.17

A Multi-variable Scale-up Method for Plasticating Extruders

*J. A. Covas, A. Gaspar-Cunha

IPC - Institute for Polymers and Composites, Dept. of Polymer Engineering, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal

To scale-up (or scale-down) is the problem of obtaining identical product performance/characteristics with extruders having different sizes, by prescribing the adequate screw geometry/configuration and/or operating conditions. This procedure is of great practical importance, as it supports, for example: i) the design of large extruders using the results from studies performed in laboratorial machines, ii) the extrapolation of the know how on a given machine to a second one. There are well established scale-up rules and a relative abundant literature on the subject. However, these rules not only contemplate a single property (eg. shear rate), but they also consider either average values for the overall process, or are only valid for a specific functional zone (e.g., melting rate). Plasticating extrusion is of course a complex process, whose optimization must consider several responses simultaneously, even if they are conflicting (e.g., output, quality of mixing, power consumption). Moreover, effective scale-up cannot rely always on average values, but should also consider the evolution along the screw (e.g., melting profile, shear rate) This work approaches scale-up as a multi-criteria optimization problem, where the aim is to obtain the geometry/operating conditions of a given extruder that minimize the differences in performance in relation to a known extruder.