Study of Solids Conveying in Single Screw Extruders Based on Flow Dynamics and Structure of Solid Pellets

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Flow of granular matter is presently a subject of extensive research, due to the characteristics of this type of systems (e.g., dilatancy, segregation, arching, clustering) and relevance to various application areas, such as civil construction, agriculture, food processing, geophysics, pharmacology [1, 2]. The plasticating process in single screw polymer extrusion is one of the areas where this research can help to increase the existing knowledge. In the initial turns of an Archimedes-type screw, loose pellets are conveyed forward. However, traditional analyses assume the movement of an elastic solid plug at constant velocity.

This work follows previous efforts to predict the characteristics of this flow using the Discrete Element Method (DEM) [3, 4]. Two boundary conditions are considered: a) open-discharge, implying that no compaction of the solids occurs and b) close-discharge, leading to a pressure increase. The dynamics and the structure of the flow were studied by computing the cross- and down channel velocity profiles, the coordination number distribution, the output rate, the residence time distribution and the density profile, as a function of the friction force grain-wall, screw speed and pellet size. The model is able to capture the process of plug formation towards the discharge, and its predictions provide an insight into possible flow fluctuations.

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