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BOOK OF ABSTRACT

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Application of the Yield Plastic Model to polymer suspensions

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One of the authors (DJH) has proposed a new rheological model for mineral suspensions with a yield stress, referred to as the "Yield Plastic" model. The basic 3-parameter model contains the Newton, Bingham and Casson models as special cases and can be used to describe slurries normally modelled as Herschel-Bulkley fluids. By using the concept of the base shear rate, the Yield Plastic model will also describe materials with upper and lower viscosity plateaus normally described with the Cross or Carreau models. This paper investigates whether the Yield Plastic model can also be used to describe polymer suspensions.

Rheometric characterizations of carbopol, xanthan gum and carboxymethyl cellulose (CMC) suspensions were carried out. These non-Newtonian materials were fit using the Herschel-Bulkley, Carreau, and power law models respectively. These are the standard models used by investigators to describe these materials. The rheograms were then fit using the Yield Plastic model. The relative accuracy of the "standard" fits to the Yield Plastic fits are discussed, as well as the implications on related studies. For example, in studies on pipe flow of non-Newtonian materials, the use of a single rheological model, rather than three or four standard models, simplifies the search for a laminar-turbulent transition function.

Non-Newtonian flows in laminar regime in chevron plate heat exchangers: the influence of geometrical configuration

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Physical processing brings about irreversible textural and sensorial properties of nearly all the fluids on the food industry. In liquid food processing, plate heat exchangers (PHEs) are commonly used in the heating or cooling stages due to their advantages, such as high efficiency, ease of maintenance and cleaning and flexibility on account of the modular design.

Although, laminar or low Reynolds number flows are usually obtained when liquid foods are processed in PHEs, the behaviour is strongly dependent on the geometrical properties of the chevron plates, namely on the corrugation angle and channel aspect ratio. Fanning friction factor correlations can be helpful on the calculation of wall shear rates developed during the flow of Newtonian or power law fluids inside the PHE channels, which then allows the viscosity evolution of the liquids to be predicted. This is important because most food stuffs exhibit a complex rheological behaviour, the thermal-hydraulic performance of PHEs being greatly dependent on the shear thinning or thickening properties of the processed fluids.

The aim of this work is to study the influence of geometrical properties of chevron plates on the behaviour of power-law fluids during thermal treatment. In order to do so, numerical simulations were performed using 3D geometries, with different geometric properties, that represent a channel of chevron-type PHE. In a first step, the numerical results obtained with Newtonian fluids were compared with data from the literature and a good agreement was found. For thermal and hydraulic fully developed non-Newtonian flows, Nusselt numbers and Fanning friction factors were estimated and the impact of the geometrical properties and flow behaviour index on the wall shear rates was also studied. The values of the flow behaviour index and geometrical properties play an important role on the maximum observed for the ratio between the Nusselt number and Fanning friction factor.