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University of Minho



SIMULATIONS OF STIRRED YOGHURT PROCESSING IN PLATE HEAT EXCHANGERS. PART II: THERMAL BEHAVIOUR

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Thermal processing and manufacturing in the food industry involves heating and cooling of highly viscous fluids. In general, these fluids exhibit complex flow patterns and are dependent on temperature, shear rate, duration of shear and elastic properties. Since the main factor limiting heat transfer is the viscous behaviour of the fluids, models that can capture this are of major interest to optimize heat exchanger design and to proper control of the manufacturing processes. A typical non-Newtonian food fluid is yoghurt, the rheological properties of which are influenced by several factors related with the physical nature of yoghurt and the processing conditions. Rheologically, stirred yoghurt shows a typical Herschel-Bulkley-type behaviour, with a yield stress at low shear rates and a power-law behaviour at higher stresses. Also, its viscosity varies from being highly temperature dependent to being almost temperature independent, depending whether it is being processed at temperatures above or below 22 °C, respectively.

The aim of the second part of this work is to compare the correlations concerning stirred yoghurt convective heat transfer, obtained from numerical approaches, to the ones obtained from previous experimental work carried out in a plate heat exchanger during the cooling stage. These correlations included both rheological and thermal aspects, taking into account the complex flow behaviour of stirred yoghurt.

SIMULATIONS OF STIRRED YOGHURT PROCESSING IN PLATE HEAT EXCHANGERS. PART I: RHEOLOGICAL BEHAVIOUR

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The aim of the first part of this work is to simulate the non-isothermal flow of stirred yoghurt in a plate heat-exchanger. In order to do so, three problems were solved simultaneously: two of heat conduction in the plates and one on non-isothermal flow in the channel. The simulation was carried out using POLYFLOW, the geometrical domain being constituted by three three-dimensional components: superior and inferior plates and the flow channel. The corrugation of the plates was assumed to have a sinusoidal variation along the heat-exchanger.

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