Energy consumption of a continuous flow ohmic heater with advanced process controls

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Ohmic Heating (OH) is a very energy-efficient form of heating compared to conventional methods such as conduction and convection. OH is a Moderate Electric Field (MEF) processing technique in which the applied electric field is ? 1kV/cm. The advantages of OH include rapid heating, reduced food processing times, bacterial inactivation, electroporation, and elimination of unwanted temperature peaks. Compared to other conventional methods of food processing, ohmic heating is over 95% energy efficient and high in energy saving. This paper describes the work to implement advanced real-time control on a continuous flow ohmic heater pilot plant. The comparison of the energy demands between conventional heating methods and different control methods implemented on the continuous flow ohmic heater is conducted. An analysis of the controller performance regarding energy consumption limit is also evaluated.

The application of classical to advanced model-based process controls including Proportional, Integral and Derivative (PID) control, Model Predictive Control (MPC) and adaptive model predictive control (AMPC) on the continuous flow ohmic heater pilot plant gives a template that can be replicated in the industry for efficient energy consumption. The implementation of these controllers is achieved on the programmable logic controller (PLC) hardware system using Open Platform Communications (OPC) and MATLAB. The energy consumption demands, and performance of each real-time controller are evaluated. The analysis of the energy demands of the developed controllers ensure sustainability and gives the option to select the most energy-efficient control methods while the ohmic heater is in operation. This research demonstrates the following:

- development of different real-time control methods to OH
- advantages of different control methods.
- the energy comparison of different control methods

From preliminary results, the energy demand while heating food products of different electrical conductivities, infeed temperatures and flowrates vary with the application of PID, MPC and AMPC techniques. The application of advanced process controls provides the best choice of control technique that ensures a high energy efficient heating process for different food products. This ensures the continuous flow ohmic heater consumes energy optimally and operates with a higher heating efficiency.