ABSTRACT

Milk sterilization is a thermal operation to increase the shelf life of milk by destroying pathogenic, toxicogenic and sporulating microorganisms to a considerable extent. From better quality and nutritional point of view Ultra-High-Temperature (UHT) sterilization is more preferred to in-container sterilization. A small-scale indirect type helical triple tube UHT milk sterilizer (HTTHE) having capacity of 135 l/h was designed and developed. The sterilizer consists of a helical triple tube heating section of length 2.28m and coil diameter of 0.3m, a straight tube holding section of length 1.0m, and a helical double tube cooling section of length 2.08m and coil diameter of 0.3m. The UHT sterilizer was designed for heating milk from 90°C to 150°C in heating section, then holding for 2.64s in holding tube at the sterilization temperature of 150°C and finally cooling from 150°C to 90°C in cooling section. The complete set-up of the UHT sterilizer was installed in the laboratory alongwith the necessary instrument arrangements. The performance evaluation of UHT milk sterilizer was carried out taking *B.stearothermophilus* as index microorganism. 8 log cycle reduction of *B.stearothermophilus* shows the effectiveness of the process. The Whiteness Index and the Yellowness Index of UHT processed milk was measured in CIE Lab color scale throughout the storage period up to two months. The decrease in Whiteness Index and increase in Yellowness Index of milk with storage period indicates the occurrence of amino-sugar browning or Maillard reaction. The viscosity of UHT processed milk was measured by Brookfield Dial Viscometer during storage period up to two months. Since no appreciable rise in viscosity was found after two months of storage period, milk was free from gelation. An iterative technique was developed and simulated to estimate the heat transfer coefficient of a HTTHE. A fouling model was developed taking the concept that the net rate of solids accumulation is the difference between the rate of solids deposition and that of re-entrainment due to attrition by fluid shear forces. The constitutive heat exchanger equations were derived taking enthalpy balance on differential volume elements of fluid in the annular region of HTTHE. The fouling model alongwith the constitutive heat exchanger equations were integrated using Modified Euler's technique. The temperature, fouling deposit and Biot numbers were predicted along the length of heat exchanger with time through simulation.

Keywords: milk, sterilization, helical, triple tube, heat exchanger, microorganism, color, Ultra-High-Temperature, B.stearothermophilus, Whiteness Index, Yellowness Index, Maillard reaction, browning, CIE Lab, viscosity, gelation, heat transfer coefficient, fouling, simulation, Biot number