Abstract

A second-generation laboratory prototype was designed and fabricated that integrates the Cooper Cooling process (rotation of a horizontal beverage container while spraying a jet of cold water) into a freezer door. The system, contained entirely within the freezer door, consists of a chassis that accommodates containers ranging in size from an 8.3-oz energy drink can to a 2-L soda bottle, a 2.5-L water reservoir, and a 1600-cm^3 volume ice tray system consisting of two ice trays and featuring an ice surface area of 0.061 m^2. The freezer thermal zone is used to automate the regeneration of ice for use in the system. A continuous load test consisting of 24 consecutive 12-oz cans was conducted to evaluate the prototype's cooling performance with end-user needs in mind. The system successfully maintained an adequately cold jet temperature for extended periods of continuous Cooper Cooling, cooling ten consecutive 12-oz cans to 6°C or lower. A theoretical heat transfer model was generated to simulate a Cooper Cooling system based upon the prototype's design. The model was used to further analyze the effects of system parameters (reservoir volume, ice volume, ice surface area, chill duration, resting reservoir temperature, overall ice heat transfer coefficient, beverage overall heat transfer coefficient, and beverage container type) and proved to be a useful design tool for future prototypes. The design principles behind the prototype are applicable to future systems and other Cooper Cooler projects ultimately evolving into commercially marketable products.