Abstract

Galactitol, in terms of its phase change enthalpy and temperature, is a promising phase change material (PCM) for medium temperature (150–200 °C) latent heat storage of solar cookers. This study aimed at determining the effect of upper cycle temperature on thermal behavior of galactitol in bulk thermal cycling. Three bulk samples were repetitively melted and frozen with each sample having fixed upper cycle temperature different from the others. Temperature histories of the samples were recorded whereas phase change enthalpies and specific heat capacities were obtained by differential scanning calorimetry. Thermal diffusivities of fresh galactitol within a range of 20–240 °C were determined by a flash diffusivity instrument. The results show that the upper cycle temperature has a great influence on the attainable number of melting and freezing cycles, the degree of subcooling, the rate of change of degree of subcooling as well as the phase change enthalpy and temperature. The upper cycle temperatures above but close to the melting temperature are favorable. The lowest upper cycle temperature was around 200 °C and yielded about 90 thermal cycles feasible for solar cooking at temperatures greater than 150 °C. Therefore, galactitol as a PCM in thermal energy storage of solar cookers that are thermally cycled at least once a day, can afford a lifespan of less than 100 days, which is far lower than lifespans of the other parts of the cooker system. Galactitol was thus found to be unstable and with a too short lifespan for practical application as PCM for medium temperature thermal energy storage purposes.