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Effective heat utilization for energy saving in food and beverage thermal isolated containers

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Abstract

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Abstract:

The purpose of this paper is to create a rapid temperature balancing container which can firstly absorb heat from the stored thing to change its temperature within minutes into a desired value set by the melting temperature and type of the used phase change materials (PCMs), and then keep that temperature last longer as the absorbed heat is later released. Models in different geometrical shapes using a commercial PCM, called PW-70, with melting temperature of 70°C have been made and tested carefully in laboratory. The best results of the four tested models, derived from the multi-layer model, have shown that average temperature of the boiled water which was acting as the stored substance reached the desired range of 55 ~ 65°C within only about 15 minutes and this temperature range lasted within nearly 5 hours. It is also shown that this period is even much longer if the desired temperature value is lower. This is a big advantage compared with the vacuum container without PCM in which the desired range was reached after about 4 hours but lasted for only more than 2 hours. With this good performance, the new design has shown much more effective utilization of heat energy in food or beverage preservation purpose.

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I. Introduction

Containers are used for plenty of purposes, i.e., for segregating things from surroundings in the same ambient atmospheric conditions or to keep things in a certain condition to last longer. In food and drinking industry, the need of containers that can help maintain inside temperature at a specific value stably for a long time for the best product quality is necessary. These containers usually have a multilayer structure with one or more layers of high thermal resistance material inserted in the middle. In this group, a high-level vacuum layer has shown its outstanding thermal performance and, furthermore, it helps reduce the need of thermal insulators. Although it is more difficult to produce vacuum-wall containers due to the requirement of mechanical durability which must be strong enough against the pressure difference between vacuum layer and atmosphere, and thus their cost is also higher, their thermal efficiency is worth those difficulties. Their wide use is proved by the development of their market. However, vacuum containers still have some disadvantages, one of which is their slow temperature descent. Fig. 1 shows experimental data of a typical vacuum container available in the market. If the original temperature of the stored material is much higher than the desired temperature, it will take much time for the stored substance to reach the desired

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