

**ENHANCED PERFORMANCE OF SOLAR VACCINE REFRIGERATOR USING  
PHASE CHANGE MATERIALS**

**ABSTRACT**

A phase change material (PCM) is a substance with a high heat of fusion which, melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. Heat is absorbed or released when the material changes from solid to liquid and vice versa; thus, PCMs are a kind of latent heat storage units. The use of latent heat storage is especially suited to the storage of energy to prolong food preservation time and also use the excessive stored energy to improve the refrigerator cooling cycle by its release at appropriate time. The principle of latent heat storage using phase change materials (PCMs) can be incorporated into a thermal storage system suitable for using refrigerators. Also, there is an increase in the coefficient of performance of the system. So, our primary objective is to design a working model of the compact refrigerator of suitable capacity incorporating the concept of PCM. Some of the applications are that they are used in thermal energy storage, conditioning of buildings, medical applications and automobiles. Refrigerators powered by gas or kerosene have been considered the best option for storing vaccines in remote areas with unreliable electricity. Even so, drawbacks with these devices have made keeping vaccines at temperatures within the safe range of  $+2^{\circ}\text{C}$  to  $+8^{\circ}\text{C}$  both difficult and expensive. Battery-powered solar refrigerators have addressed some of the drawbacks, but the batteries are expensive and have a lifetime of only three to five years. A new refrigerator technology, named “solar direct-drive” (SDD) with phase change materials (PCM), eliminates the limitations. Phase change materials (PCM's) are products that store and release thermal energy during the process of melting and freezing, a characteristic of materials undergoing phase change. When the material is melted, an equal amount of energy is absorbed from the immediate environment as it changes from solid to liquid in the 100lts solar freezer lined with 30kgs of PCM, 6lts of liquid can be stored at below  $4^{\circ}\text{C}$  for 5 non-Sun days.