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Forty Years of Innovations in Energy storage With Phase Change

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Abstract

The world community is raising significant concerns on the continuous increase in energy use, leading to an escalating increase in CO2 emission and hence global warming. Until we succeed in developing new sources of clean energy, we need to conserve energy whenever possible. Most renewable energy sources are intermittent and hence require some sort of storage for efficient use. The global thermal energy storage market size was evaluated at US$4.38 billion in 2019 and is expected to grow sharply.

In this presentation, I will illustrate the development we have made during the last 40 years on energy storage using phase change materials (PCMs). These materials can absorb and store large quantities of thermal energy as latent heat of melting. The talk will cover the early development made in modelling heat transfer with a moving interface, usually associate with phase change, with reference to the use of enthalpy or effective heat capacity methods. Following that, innovations made on micro and macro encapsulation will be described with some details, including the patented UV-enhanced microencapsulation. Some of the most important applications of PCMs such as building will be discussed, showing how these materials could be used to provide comfort, save energy, create peak load shifting with significant benefits especially in the presence of price-based electricity. Computer simulation conducted using Energy Plus will show how PCM could provide heating and cooling benefits worldwide, but with different levels depending on locations. PCM is still expensive to be used in buildings and hence to make it works economically it must be used carefully and not everywhere in the building to achieve a short payback period.