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A Review on the Potential Waste Materials Utilized in the Thermal Energy Storage System as Phase Change Material

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EXTENDED ABSTRACT

Numerous studies on the thermal energy storage (TES) was conducted for decades since it was identified as one of the key solution towards the most effective heat and energy storage system. This is because TES has proven to reduce the mismatch between energy supply and demand by waste energy recovery through the sensible heat, latent heat and thermochemical heat storage. Despite all three TES systems, sensible and latent heat storages considered as the most common heat and energy storage due to their wide applications, provides high energy storage and creates simple process of energy conservation through the phase change material (PCM) system. However, the conventional PCM is still lacking in terms of its economic values and sustainability, environmental issues and the poor heat flow properties. Due to that, many researchers are exploring the use of waste materials as one of the energy storage material component in the TES medium. For example, waste asbestos, fly ashes, steel slags, dross from aluminium industry and waste glass from municipal waste has been discussed and highlighted as potential revalorization of wastes in industrial heat recovery material due to their strength and potential. However, the discussion isn't depth enough and more studies are needed in order to achieve industrial deployment idea of TES potential materials. For example, studies on the waste industrial material in implementation of heat storage system using waste asbestos, fly ashes, steel slags, dross from aluminium industry, and glass from municipal waste has been reviewed which has shown great valorization of waste as TES materials due to their strength and potential. Despite that, their weaknesses and drawback properties still need more studies in order to achieve good performance of TES application. Therefore, in this paper, in-depth studies on the potential and implementation of innovative, cost effective, and environmentally PCM were explored, investigated and reviewed based on different types of waste materials from steel industry, non-metallic mining industry, agricultural industry, and mining and metallurgical industry in the application for the heat and energy storage application. Overall, this review shows potential utilization of waste materials, heat storage and recovery as well as a new route to an efficient, cost-effective and environmentally friendly PCM of TES system.

Keywords: Thermal energy storage (TES); Phase change material (PCM); Waste materials.

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