

Phase Change Materials (PCMs) applications in buildings for human thermal comfort

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Abstract:

Due to South Africa's energy crisis and global climate change challenges, there is currently a major drive towards the use of renewable energy sources, and energy efficient and conservation interventions to ensure energy security for the country. Of all the energy users, the built environment has been identified as one of the largest untapped potential in energy efficiency opportunities and in reducing green-house gas emissions (Eskom, 2014). It has been estimated that as much as 30-40% of the world's primary energy is consumed by the building sector. The biggest use in this sector is in heating and cooling applications, which contributes to at least a third of greenhouse gas emissions (Waqas and Din, 2013). In South Africa, the largest single end-use contribution to energy consumption especially in commercial buildings (includes office buildings, shopping centers, restaurants, and others) is from Heating, Ventilation and Air conditioning (HVAC) accounting as much as 26% of the total energy use (this excludes lighting, geysers, motors, pumps, and other specialised uses) (Milford, n.d.). South Africa is still dependent on conventional HVAC systems such as split unit air-conditioning systems, resistance heaters and centralised chiller plants which have high energy demands contributing an estimated 5400 MW (megawatts) nationally to electricity demand in peak periods (Eskom, 2010). This figure is expected to increase due to climate change (Osterman, et al., 2012). The South African climate change model predicted that by mid-century the South African coast will warm by around 1 to 2°C and the interior by around 2 to 3°C. By 2100, warming is projected to reach around 3 to 4°C along the coast, and 6 to 7°C in the interior (South Africa department of environmental affairs). There is an urgent need to improve the energy efficiency in buildings and reduce the peak heating and cooling loads. In order to reduce the energy demand of buildings, the South African government has implemented building standards such as SANS 10400-XA and SANS 204 which attempts to save energy by means of the maximum allowable energy consumption per square meter of floor area per building classification for each of the climatic zones of South Africa. This chapter describes Phase Change Materials (PCMs) based thermal energy storage and its applications in buildings to provide passive regulation of indoor air temperature for human thermal comfort.