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Development of Thermal Regulating Textile Material Consisted of Macrocapsulated Phase Change Material

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Abstract : Macrocapsules containing phase change material (PCM) PEG4000 as core and Calcium Alginate as the shell was synthesized by in-situ polymerization process, and their suitability for textile applications was studied. PCM macro-capsules were sandwiched between two polyurethane foams at regular intervals, and the sandwiched foams were subsequently covered with 100% cotton woven fabrics. According to the mathematical modelling and calculations 46 capsules were required to provide cooling for a period of 2 hours at 56ºC, so a panel of 10 cm x 10 cm area with 25 parts (having 5 capsules in each for 9 parts are 16 parts spaced for air permeability) were effectively merged into one textile material without changing the textile's original properties. First, the available cooling techniques related to textiles were considered and the best cooling techniques suiting the Sri Lankan climatic conditions were selected using a survey conducted for Sri Lankan Public based on ASHRAE-55-2010 standard and it consisted of 19 questions under 3 sections categorized as general information, thermal comfort sensation and requirement of Personal Cooling Garments (PCG). The results indicated that during daytime, majority of respondents feel warm and during nighttime also majority have responded as slightly warm. The survey also revealed that around 85% of the respondents are willing to accept a PCG. The developed panels were characterized using Fourier-transform infrared spectroscopy (FTIR) and Thermogravimetric Analysis (TGA) tests and the findings from FTIR showed that the macrocapsules consisted of PEG 4000 as the core material and Calcium Alginate as the shell material and findings from TGA showed that the capsules had the average weight percentage for core with 61,9% and shell with 34,7%. After heating both control samples and samples incorporating PCM panels, it was discovered that only the temperature of the control sample increased after 56ºC, whereas the temperature of the sample incorporating PCM panels began to regulate the temperature at 56ºC, preventing a temperature increase beyond 56ºC.

Keywords : phase change materials, thermal regulation, textiles, macrocapsules
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