

DESIGNING MICROCAPSULES TO SAVE ENERGY IN BUILDINGS

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Key Words: microcapsulation, phase change materials, sustainable buildings

Buildings consume the major portion of the world's energy. Improvements in building elements have been proven to significantly reduce this consumption. Integrating phase change materials (PCM) into a building's parts is an effective solution to reduce energy consumption. PCMs help to maintain thermal comfort, reduce heating, cooling loads as well as improve passive storage of solar energy in buildings. Previous studies have concentrated on impregnating PCMs into materials like concrete mixes, gypsum wall boards, plasters, textured finishes, as well as PCM trombe walls, PCM shutters, PCM building blocks, air-based heating systems, floor heating systems, suspended ceiling boards, etc.[1]. The current challenge is to find a suitable PCM that can be safe, thermally effective and at the same time not adversely effect the durability of a building. PCMs may be in microcapsulated form to meet these challenges. The most common PCM studied previously is paraffin, be it in bulk or microencapsulated. Leakage of paraffin from porous structures, the breaking of microcapsules and the low thermal capacities of microencapsulated PCMs are the main problems that have been observed [2]. Paraffin is a fossil fuel derivative; thus, it is unsustainable. This study focuses on bio-based fatty acid mixtures as PCMs. We developed microcapsules of fatty acid mixtures that were tried in concrete mixes. Our design approach involved the following steps: determining and characterizing PCMs with suitable thermal properties; developing a method to synthesize microencapsulated PCMs; and finally incorporate these materials in buildings for improving thermal comfort and energy conservation.

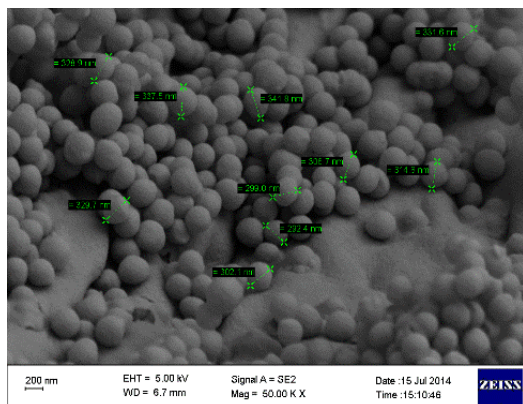


Figure 1 – FE SEM image from crushed concrete specimen with microcapsules

We have succeeded in producing variety of mPCMs within a diameter range of 70 nm to 950 nm. These mPCMs were designed to withstand mixing with coarse aggregates in concrete, while acting as thermo regulators. Emulsion polymerization method was used to microencapsulate these PCMs. Different shell materials were tested. Field Emission Scanning Electron Microscopy (FE SEM) image obtained from crushed concrete specimen with our microcapsules (Fig. 1) showed that spherical shape was retained and the diameter was in the range of 290-350 nm. Mechanical strength tests showed that up to 10% by weight of microcapsule can be added to concretes and stay within allowable limits of C 25/30 type concretes. Initial results from monitoring of test buildings with the microcapsules in Adana, Turkey showed that, at noon - when the ambient temperature and solar irradiation was at its highest level- a 2°C temperature difference was achieved.

Acknowledgements

The authors would like to acknowledge the support provided by TUBITAK under the Project No 111M557, Çukurova University BAP Project No FDK-2015-3278 and Kambeton Co.

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