Title	TECHNO-ECONOMIC AND ENVIRONMENTAL INVESTIGATION OF AUTOCLAVED AERATED CONCRETE CONSISTING OF SUGAR SEDIMENT AND PHASE CHANGE MATERIAL
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ABSTRACT

The purpose of this current study was twofold. First, to include waste sugar sediment as a component in Autoclaved Aerated Concrete and study the effect on the mechanical and physical properties, and thermal effectiveness, of the concrete, to achieve an improved autoclaved concrete as compared to commercial Autoclaved Aerated Concrete. Subsequently, to study the thermal effectiveness and insulative properties of applying Phase Change Material (PCM) as a coating on the Improved Autoclaved Aerated Concrete.

Sugar sediment waste was incorporated into the raw material mix for the production of Autoclaved Aerated Concrete and was demonstrated by extensive testing to provide greater compressive strength than conventional materials, and an extended heat transfer time lag. The optimum sugar sediment content was tested by replacing sand and lime in various percentages. The resultant product showed a maximum compressive strength of around 6.1 N/mm^2, and the highest proportion of tobermorite phase of 28.9%. The higher strength can be confirmed by a higher crystalline tobermorite phase. The Autoclaved Aerated Concrete consisting of sugar sediment was a finer needle-like crystalline morphology. It was also demonstrated that the time for the heat wave to propagate from the outer wall to the inner wall was extended.

The subsequent phase of the investigation was to study the dynamics of heat transfer and the cooling load of air conditioning plants by coating phase change material (PCM) on to the exterior surface of four commonly used building materials. Four simulated houses with different wall materials (Brick, cement block, AAC and Improved AAC with PCM coating) were constructed on which the tests were conducted. The investigation demonstrated that by coating phase change material (PCM) on to the exterior surface of the building materials a significant increase in the thermal effectiveness of the building materials was achieved. This was determined by comparing the heat flux at the indoor surface. The increase in thermal effectiveness was the greatest when PCM was applied to the AAC. The energy savings were measured at 29.6% reduction when compared with the uncoated AAC, 38.9% when compared with uncoated brick, and 47.6% when compared with uncoated cement block. The energy payback period for the uncoated AAC as compared to the uncoated brick was and the PCM coated AAC as compared to the uncoated brick was reduced from approximately 9.91 years to 4.11 years, respectively. The internal rate of return as compared to the uncoated brick increased from 9.290% to 13.568% when AAC was coated by PCM, indicating substantial energy saving by the recovery of the stored heat energy of PCM.

The environmental impacts and effects of using waste sugar sediment, an industrial waste product, and of the use of PCM, were considered and analysed in both phases of the study using the Life Cycle Assessment Process.