El-Sebaii, A.A., Al-Amir, S., Al-Marzouki, F.M., Faidah, A.S., Al-Ghamdi, A.A., Al-Heniti, S.
Fast thermal cycling of acetanilide and magnesium chloride hexahydrate for indoor solar cooking
(2009) *Energy Conversion and Management*, 50 (12), pp. 3104-3111.

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Abstract
Solar cookers are broadly divided into a direct or focusing type, indirect or box-type and advanced solar cookers. The focusing and box-type solar cookers are for outdoor applications. The advanced solar cookers have the advantage of being usable indoors and thus solve one of the problems, which impede the social acceptance of solar cookers. The advanced type solar cookers are employing additional solar units that increase the cost. Therefore, the solar cooker must contain a heat storage medium to store thermal energy for use during off-sunshine hours. The main aim of this study is to investigate the influence of the melting/solidification fast cycling of the commercial grade acetanilide C8H9NO (Tm = 116 °C) and magnesium chloride hexahydrate MgCl2·6H2O (Tm = 116.7 °C) on their thermo-physical properties; such as melting point and latent heat of fusion, to be used as storage media inside solar cookers. Five hundred cycles have been performed. The thermo-physical properties are measured using the differential scanning calorimetric technique. The compatibility of the selected phase change materials (PCMs) with the containing material is also studied via the surface investigation, using the SIM technique, of aluminum and stainless steel samples embedded in the PCM during cycling. It is inferred that acetanilide is a promising PCM for cooking indoors and during law intensity solar radiation periods with good compatibility with aluminum as a containing material. However, MgCl2·6H2O is not stable during its thermal cycling (even with the extra water principle) due to the phase segregation problem; therefore, it is not recommended as a storage material inside solar cookers for cooking indoors. It is also indicated that MgCl2·6H2O is not compatible with either aluminum or stainless steel. 

Author Keywords
Acetanilide; Compatibility; Phase change materials; Salt hydrates; Thermal cycling

ISSN: 01968904
CODEN: ECMAD
DOI: 10.1016/j.enconman.2009.08.020
Document Type: Article
Source: Scopus