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A promising biosourced, organic phase change material for seasonal storage

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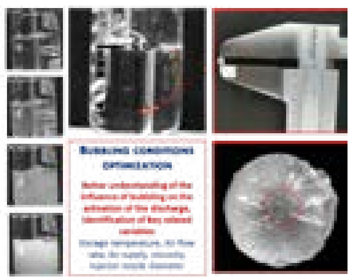
BioMCP aims to study bio sourced phase change materials for the thermal energy storage in buildings and heating networks. Thermal energy storage is one of the key elements to optimize the use of available energy resources (especially renewable ones) and to improve the energy efficiency of buildings. Phase change materials (PCMs) used for the thermal energy storage are an important class of materials which substantially contribute to the efficient use and conservation of waste heat and solar energy. In this framework, our objective is to develop and study new bio sourced phase change materials, able to compete with water as storage material and presenting improved performances in comparison with currently used PCM (ie: low cost, high energy density, low ecological impact). Among bio-based materials, Xylitol has a high potential as a thermal energy material. Its melting point is inferior to 95°C which allows combining the storage unit containing Xylitol with cheap solar collectors. Its latent heat is superior to 263 J.g-1 and its total energy density is 4-5 times higher than the one of water (110-150 kWh.m-3 whereas it is approximately 30 kWh.m-3 for water on a seasonal basis). Its high and stable undercooling allows long-term storage in a metastable state with reduced thermal losses and a negligible risk of spontaneous discharge. However, the activation of the energy discharge process (crystallization activation) is difficult and the subsequent crystallization rates (discharge powers) are very low. Our work in the framework of the FP7 EU SAM.SSA Project, coordinated by Elena Palomo Del Barrio, aims at finding out an easy to implement and efficient solution to discharge the storage unit at the required power when needed. This means being able to trigger nucleation at any time (or temperature) followed by a crystallization of the entire phase change material in due time. Different techniques to crystallize Xylitol have hence been considered. Finally, the feasibility of an innovative, efficient and low intrusive technique to activate the energy discharge is proven. Bubble agitation is a very promising technique. Our work focuses on providing a better understanding of the influence of bubbling on crystallization, on identifying key related variables and on paving the way for bubbling conditions optimization.



Recent Publications

1. Duquesne M, Palomo Del Barrio E and Godin A (2019) Nucleation triggering of highly undercooled xylitol using an air lift reactor for seasonal thermal energy storage. Applied Sciences 9(2): 267-277.
2. Godin A, Duquesne M, Palomo del Barrio E, Achchaq F and Monneyron P (2017) Bubble agitation as a new low intrusive method to crystallize glass-forming materials. Energy Procedia 139:352-357.

3. Zhang H, Duquesne M, Godin A, Niedermaier S, Palomo Del Barrio E, Nedea S V, Rindt C C M (2017) Experimental and in silico characterization of xylitol as seasonal heat storage material. Fluid Phase Equilibria 436:55-68.

Biography

Marie Duquesne defended her PhD "Resolution and reduction of a non-linear energy storage model by adsorption on zeolites" in 2013 at the University of Bordeaux. She is Associated Professor at the Institute of Technology of Bordeaux since 2015 and Researcher at TREFLE in Department Fluids and Transfers of I2M at the Institute of Mechanics and Engineering. She has expertise in thermal energy storage at low-to-medium temperatures. She contributed to the ANR Project SIMINTHEC in National Project from 2008 to 2011; European FP7 SAM.SSA Project from 2012 to 2015 and contributes to the Interreg SUDOE European SUDOKET Project from 2018 to 2021 and to the Region Nouvelle Aquitaine BioMCP project from 2018 to 2021. Her areas of research interest are Thermal energy storage; Phase change materials; Charge and discharge processes and imaging techniques.

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