Thermophysical Properties of Poly(2-hydroxyethyl methacrylate) Hydrogels as a Methane Storage Material

Shuanshi Fan [C], Yi Huang, Yanhong Wang[S] and Xuemei Lang
School of Chemical Engineering, South China University of Technology, Guangzhou, China
ssfan@scut.edu.cn

Poly(2-hydroxyethyl methacrylate) (PHEMA), a synthetic crosslinked hydrogel, with outstanding ability to absorb and retain a high water content and still maintain their solid state, has been studied as scaffold for methane gas hydrates. The high water content, excellent hydrophilicity and interconnected pores of these hydrogels could be ideal to support the methane hydrate formation and to enhance gas permeation and interactions with water molecules. The heat released during the formation of per kilogram of methane hydrate is as much as 438.54±13.78 kJ. Whether the heat can be removed from the hydrate-hydrogel system in time is critical to the formation of methane gas hydrates. In this work, thermal conductivity is investigated for different temperatures and monomer contents to better understand thermal behaviors of PHEMA hydrogel during the hydrate formation process. Several theoretical models were applied to calculate hydrogel's thermal conductivity and the prediction results were compared with experimental values. Results were found that thermal conductivity strongly depends on monomer content and ambient temperature. With monomer content ranging from 100 wt% to 5 wt%, thermal conductivity can increase from 0.13 W/(m·K) to 0.59 W/(m·K). At some point below 273 K, the thermal conductivity of all hydrogel samples experiences a sudden rise to around 1.50 W/(m·K), about 200% larger. Other thermophysical properties like heat capacity and thermal stability were also investigated using differential scanning calorimetry and thermogravimetric analysis respectively.