



Clathrate hydrate tuning for technological purposes

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Gas hydrates are being increasingly considered as convenient media for gas storage and transportation as the knowledge of their properties increases, in particular as relates to methane and hydrogen. Clathrate hydrates may also represent a feasible sequestration technology for carbon dioxide, due to a well defined P/T range of stability, and several research programs are addressing this possibility. Though the understanding of the molecular structure and supramolecular interactions which are responsible of most properties of hydrates have been elucidated in recent years, the underlying theoretical physico-chemical framework is still poor, especially as relates to the role of "conditioners" (inhibitors and promoters) from the molecular/supramolecular point of view.

In the present communication we show some results from our research approach which is mainly focused on the supramolecular properties of clathrate hydrate systems - and their conditioners - as a way to get access to a controlled modulation of the formation, dissociation and stabilization of gas hydrates. In particular, this communication will deal with:

- (a) a novel, compact apparatus for studying the main parameters of formation and dissociation of gas hydrates in a one-pot experiment, which can be easily and rapidly carried out on board of a drilling ship;[1]
- (b) the effects of amphiphile molecules (surfactants) as inhibitors or promoters of gas hydrate formation;[2]
- (c) a novel nanotechnology for a reliable and quick production of hydrogen hydrates, and its application to fuel cells;[3,4] and
- (d) the development of a clathrate hydrate technology for the sequestration and geological storage of man-made CO₂, possibly with concomitant recovery of natural gas from NG hydrate fields. Furthermore, the feasibility of catalyzing the reduction of carbon dioxide to energy-rich species by hydrates is being investigated.

[1] Di Profio, P., Germani, R., Savelli, G., International Patent Application PCT/IT2006/000274

[2] Di Profio P., Arca S., Germani R., Savelli G., 2005, "Surfactant promoting effects on clathrate hydrate formation: are micelles really involved?", Chem. Eng. Sci., 60, pp. 4141-4145

[3] Di Profio P., Arca S., Germani R., Savelli G., 2006, "Novel Nanostructured Media for Gas Storage and Transport: Clathrate Hydrates of Methane and Hydrogen", J. Fuel Cell Sci. & Tech., February 2007, vol. 4.

[4] Di Profio, P., Germani, R., Savelli, G., EP07010346.