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P5.035

TRANSPORT OF HYDRATE SLURRY AT HIGH WATER CUT

A.M. MELCHUNA [(1)], A. CAMEIRAO[(1)], J.M. HERRI[(1)], Y. OUBBAS[(1)], P. GLENAT[(2)]

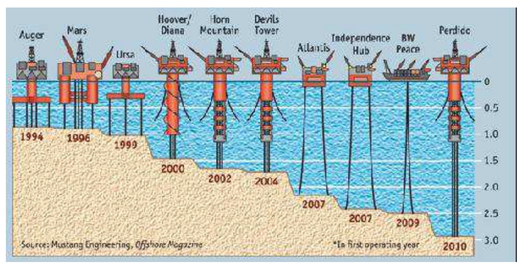
1. Gas Hydrate Dynamics Centre, Ecole Nationale Supérieure des Mines de Saint-Etienne, 158 Cours Fauriel, 42023 Saint-Etienne, France,

2. TOTAL – CSTJF, Avenue Larribau, 64018 PAU Cedex, France

Context

The increase on the offshore extraction of petroleum in deeper conditions represents a great concern in flow assurance, as it favors the conditions of hydrate formation (low temperature and high pressure).

Nowadays, another concern appears; as the oil/gas fields matures and the fraction of water increases.



Objective

- To present the preliminary results of a experimental study of methane hydrate formation at high water cut.
- To observe the influence of a dispersant additive (anti-agglomerant – AA) in this kind of system.

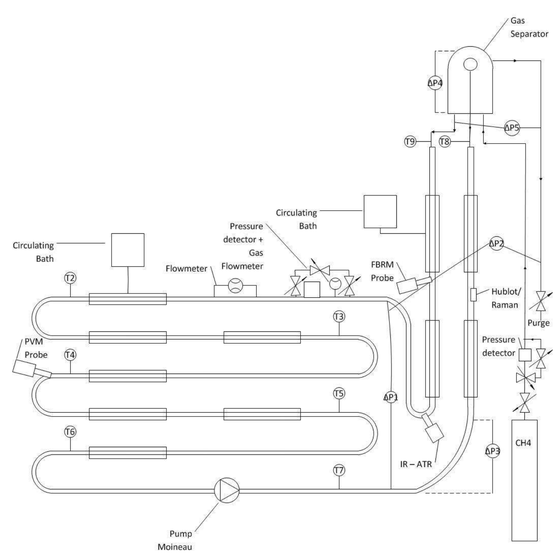
Experimental Method

Experimental Conditions

Without AA	Flow Rate (L/h)
Water Cut (%)	
90	200
	400
80	200
	400
70	200
	400
60	200
	400

With AA	Flow Rate (L/h)	Additive (% vs. w)
Water Cut (%)		
90	200	0.005
	400	0.005
80	200	0.01
	400	0.01
70	200	0.01
	400	0.01
60	200	0.01
	400	0.01

Experimental Apparatus



Experimental Results

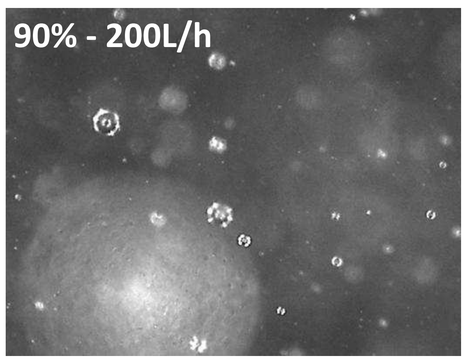
Emulsification and Rheological Study

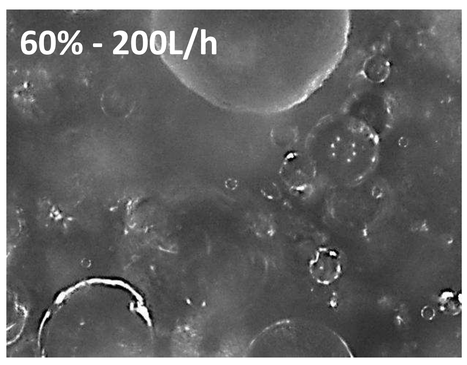
Water Cut (%)	Flow Rate (L/h)	Without AA Average Chord Length (µm)	With AA Average Chord Length (µm)
90	200	25	8
	400	26	9
80	200	22	10
	400	19	9
70	200	28	8
	400	23	10
60	200	27	9
	400	23	9

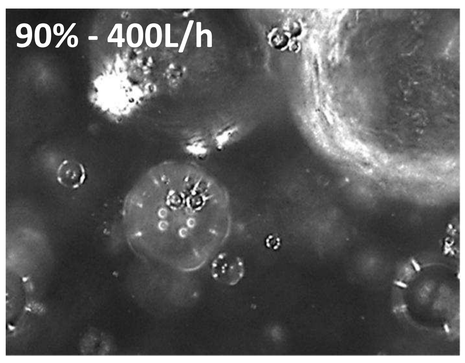
Without AA	Viscosity (mPa.s)
Water Cut (%)	
90	4.61
80	4.83
70	4.58
60	4.46

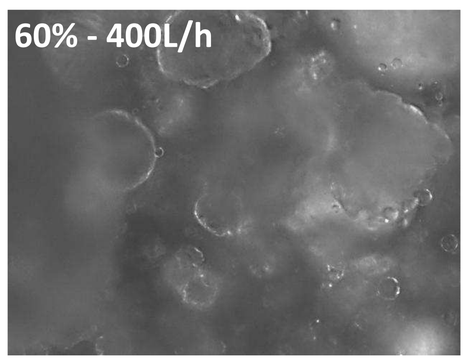
With AA	Viscosity (mPa.s)	Additive (% vs. w)
Water Cut (%)		
90	4.03	0.005
80	3.76	0.01
70	5.28	0.01
60	5.83	0.01

PVM Images from Crystallization (1050 x 800µm)



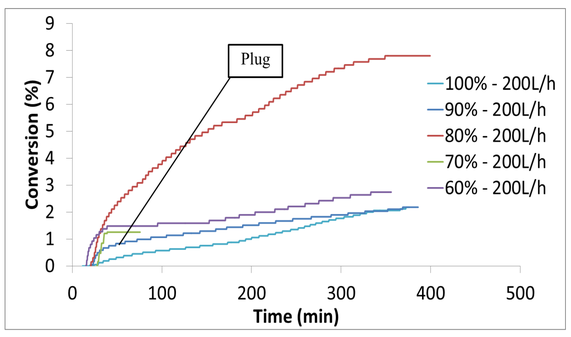


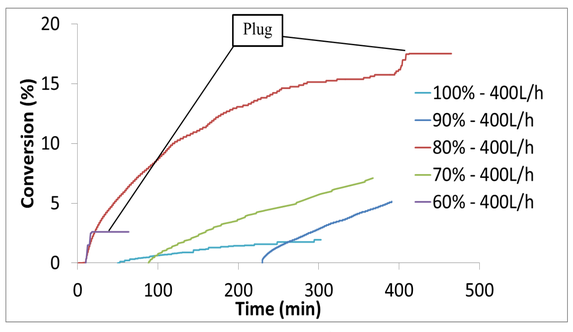




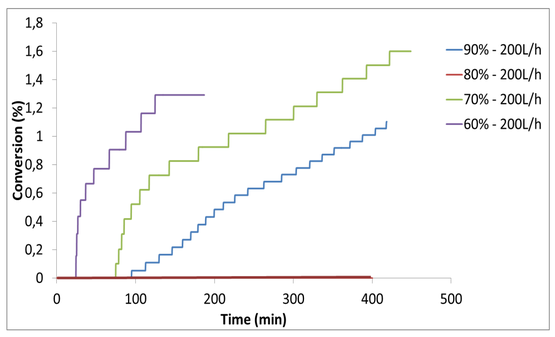
Crystallization

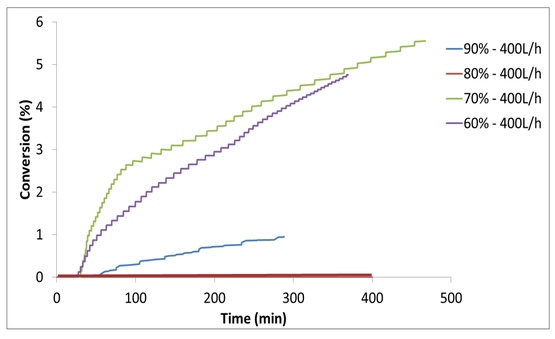
Without AA



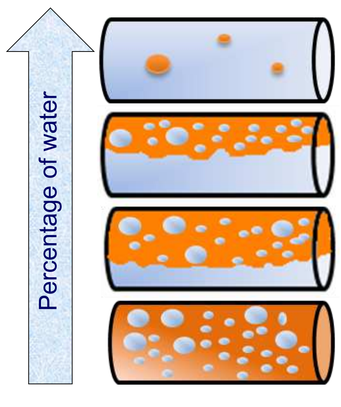


With AA

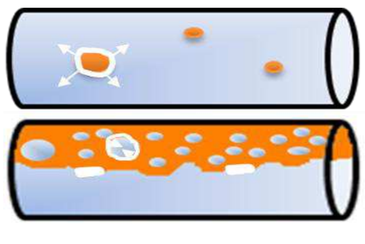




- Emulsion Model:



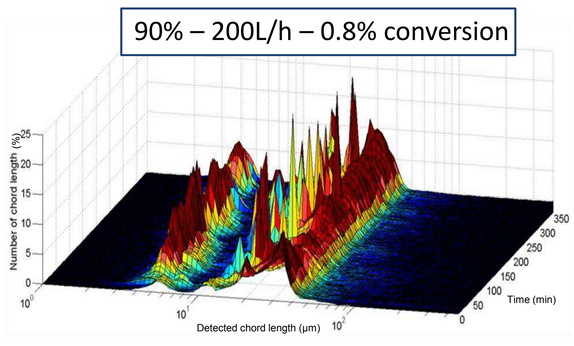
- Crystallization Model:



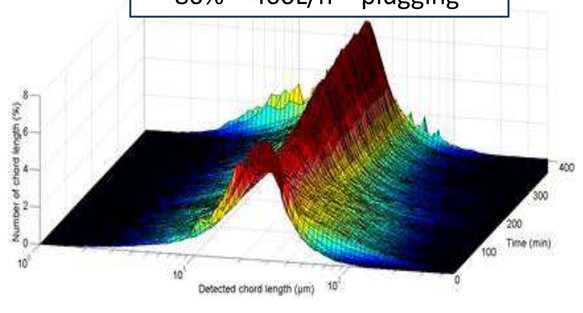
Chord Length Distribution

Without AA

90% – 200L/h – 0.8% conversion

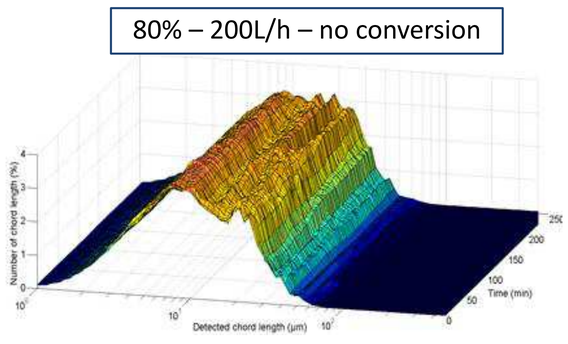


80% – 400L/h – plugging

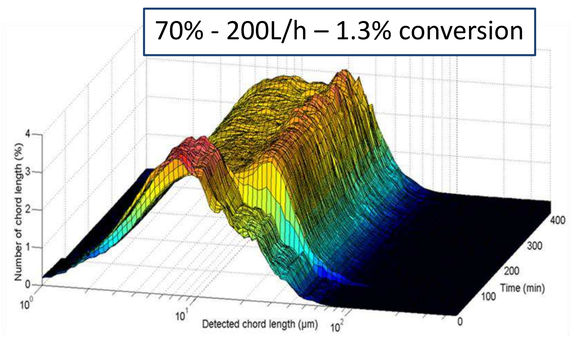


With AA

80% – 200L/h – no conversion



70% - 200L/h – 1.3% conversion



Conclusions

- The higher is water cut, the slower & less important is the hydrate formation.
- The percentage of additive seems to be more important at low water cut.
- The FBRM probe allows to differentiate between experimental results with and without AA.
- The PVM probe allows the observation of the emulsions and crystallizations without AA.

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