Please use the following format for the title of the file so as to ease the management of the web site.

ECXX_LABYY_ NOMChercheur_ Numer
ECXX = ECLi, ECL, ECM, ECN, ECP
LABYY = acronyme du laboratoire
NOMChercheur = nom du chercheur émetteur du sujet
Numer = numéro de la proposition (01, 02, ….) pour le chercheur

PhD Proposal 2017

School: Ecole Centrale de Marseille	
Laboratory: M2P2	**Web site: http://www.m2p2.fr**
Team: Membrane processes	**Head of the team: Pr Philippe Moulin**
Supervisor: E. Carretier	**Email: emilie.carretier@univ-amu.fr**
Collaboration with other partner during this PhD: Jean Philippe Bonnet **In France: industrial partner**	**In China:**

Title: Mass and heat transfer in pervaporation
Scientific field: Chemical engineering, Energy
Key words: Membrane, pervaporation, mass transfer, heat transfer, heat consumption

Details for the subject:

(Maximal length of 2 pages, including images, list of reference, …The pdf file should not exceed 1Mo)

Background, Context:

Pervaporation is a membrane separation process of liquid mixtures through à dense membrane. It is a nonconventional membrane process based on the phase change occurring during the process as the feed is liquid and the permeate is vapor. The mass transport is widely described by the "solution-diffusion" and studies on pervaporation are mostly focused on mass transport and separation mechanisms for the enhancement of mass flux and separation factor.

There are only few studies dealing with the heat transfer in pervaporation and some questions are interesting for the development of this process. The feed temperature reduction is a current phenomenon occurring during pervaporation and it is explained by the fact that the energy consumed in the process is taken from liquid feed. A consequence of the temperature polarization is the mass flux reduction which represents a limitation for the process.

Karlsson et *al* [1]. by a global heat balance of the process found that the enthalpy of vaporization and the energy of expansion are the principal contributions for the heat consumption. The path and behavior of permeant inside the membrane are essential for the understanding of transport mechanisms. P.T. Sumesh et *al.*[2] show that the vaporization of the permeant can be located inside the membrane or at the downstream surface of the membrane depending on the downstream pressure applied.

Research subject, work plan:

In this study, an original experimental set up has been designed for the simultaneous estimation of the heat flux consumption in the liquid feed vessel and the permeate mass flux. For the first results, a commercial PDMS membrane will be used for a single component permeation of water and of ethanol. The static configuration of the setup (without circulation of the feed) allows the measurement of the temperature stratification in the feed liquid.

The heat flux will be calculated by the reverse method calculation (1D semi-infinite field) from the temperature drop in the feed liquid and the Permeate mass flux is directly measured using a differential pressure sensor.

From the first results obtained with pure ethanol, heat and mass fluxes show a linear dependency, and the heat consumption is mostly due to the heat of vaporization of ethanol.

The following step will be to make the same measurement and modeling on binary and ternary mixtures. Another objective of this work will be to visualize thermal effets by IR imaging.

References:

[1]H. O. E. Karlsson, G. Tragardh, Heat transfer in pervaporation, J. of membrane science, 119 (1996) 295-306

[2] P.T. Sumesh, P.K. Bhattacharya, Analysis of phase change during pervaporationwith single component permeation, Colloids and Surfaces A: Physicochem. Eng. Aspects 290 (2006) 263–272