Process intensification of liquid non isothermal processes by using chemical reactor - heat exchangers

**Fact Sheet**

<table>
<thead>
<tr>
<th>Project Information</th>
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<td><strong>L/L HEX</strong></td>
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**Objective**

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To develop, through a total Process Intensification (PI) approach, validated design tools and guidelines for aiding the design and operation of intensified chemical reactor - heat exchangers (HEX reactors) for the energy-efficient, clean processing of two-phase, liquid-liquid (L/L) fast non-isothermal reactions.

**Technical Approach**
To achieve the objectives, it will be necessary to develop new design tools, namely a L/L chemical probe (calibrated reaction scheme) and a mathematical model that describes L/L exothermic reacting flows. As a first step, the kinetics and
thermodynamics of the chemical probe will be incorporated in the model. Validation will be carried out through pilot scale reactive studies on two commercial geometries of compact heat exchanger (CHE). Non-reactive flow studies will enable development of phenomenological correlations for droplet size and droplet size distribution of the dispersed phase, which will be used as inputs for the mathematical model.

Two different L/L industrial processes will be studied, and their key steps and kinetics will be compared with those of the chemical probe. The reaction steps will be incorporated in the model, which will be used for parametersensitivity studies. Heat transfer at the walls of the CHEs will be modelled through a Direct Numerical Simulation (DNS) approach. Results of the model studies will be compared with data that are obtained through industrial plant trials. Thus, the benefits of HEX reactors for L/L processes will be assessed, and the generic results will be incorporated in the design guidelines.

Engineering design studies will be carried out in conjunction with manufacturers of compact heat exchangers (CHEs). Two commercial geometries of CHE will be selected for reactor characterisation. Criteria will be developed for matching CHEs to reactions, and a paper design of CHE will be produced in sufficient detail to enable a full-scale HEX reactor to be built and tested in a future project.

Expected Achievement

* L/L chemical scheme as a diagnostic of both mass and heat transfer rates *
* Mathematical model that can simulate the results of L/L exothermic reactions *
* Guidelines for design of intensified L/L chemical reactor - heat exchangers *
* Design of a multi-channel heat exchanger - reactor *

Exploitation will be achieved mainly through: (i) consultancy throughout the EU’s process industries in the fields of Process Intensification and Enhanced Heat Transfer; (ii) direct application of the project’s deliverables by the participating chemical companies (end users); (iii) development of CHEs as chemical reactors by manufacturers of compact heat exchanger equipment.

Programme(s)

Topic(s)

Funding Scheme

CSC - Cost-sharing contracts

Coordinator

Nimix Limited
Participants (8)

British Hydromechanics Research Group Ltd.
United Kingdom
Address
Cranfield
MK43 0AJ Cranfield -
Bedfordshire

COMMISSARIAT A L'ENERGIE ATOMIQUE
France
Address
17, Rue Des Martyrs 17
38054 Grenoble

Dow Corning SA
Belgium
Address
Zoning Industriel C
7180 Seneffe

Faudat Concept
France
Address
58, Avenue De Wagram
75017 Paris

Hickson and Welch Ltd
United Kingdom
Address
Wheldon Road
WF10 2JT Castleford
IMI Marston Ltd
United Kingdom
Address
Wobaston Road
WV10 6QT Wolverhampton

Université de Nantes
France
Address
Rue Christian-pauc
44306 Nantes

Ziemann-Secathen SA
France
Address
Route De Harskirchen
67260 Sarre-union

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