Press release

Evonik and partners launch the ROMEO research project: a new reactor concept for drastically reducing energy consumption

- Membrane technology expected to eliminate the need for processing reaction products
- ROMEO could reduce energy consumption by up to 80 percent in industrially important reactions
- The EU is providing €6 million in funding

With the ROMEO* research project, which started up in fall, Evonik Industries will be working with eight partners in pursuit of an ambitious goal: the aim of ROMEO is to reduce energy consumption by up to 80 percent and emissions by up to 90 percent in industrially important, catalytic gas-phase reactions. ROMEO revolves around a new reactor concept that utilizes membranes in order to carry out chemical synthesis and processing in a single step—something of a 2-in-1 reactor, in which the product is continuously removed from the reaction mixture as soon as it is formed. The EU is providing €6 million in funding for the research program as part of its Horizon 2020 project.

Over the course of the next four years, the nine partners intend to demonstrate the technical feasibility of the reactor concept test using systems for two industrial gas-phase processes—hydroformylation and the water-gas shift reaction. “If we succeed, it will be a small revolution for chemical process engineering and a huge step toward more sustainable processes,” says Professor Robert Franke, who works in the Performance Materials Segment of Evonik, where he leads innovation management for the hydroformylation process. “Not surprisingly, the project immediately landed in the top 15 percent of all of the projects submitted,” notes Dr. Frank Stenger of Evonik’s Process Engineering Business Line, which will be carrying out Evonik’s end of the project.

Chemicals are typically produced in two steps: once a product is synthesized in a reactor, it is then processed further in a system such as a distillation column. This step tends to be very energy

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intensive. By eliminating it, a 2-in-1 reactor can achieve drastic reductions in energy consumption and the resulting emissions.

A demo plant for hydroformylation and the water-gas shift reaction

The partners intend to use two very different model reactions to show that the reactor concept has broad applications. Evonik will be constructing a demo plant for hydroformylation. This facility will convert olefins and syngas to aldehydes. Among other applications, aldehydes are used as precursors for plasticizer alcohols; Evonik is a leading manufacturer of C9/C10 plasticizer alcohols in Europe. Linde, on the other hand, intends to demonstrate the feasibility of the concept for the water-gas shift reaction, in which carbon monoxide (CO) and water react to form hydrogen (H_2). If the new reactor concept is successful using CO or CO-containing syngas derived from biomass, researchers will have found a way of generating hydrogen from sources such as wood waste.

At the heart of the new concept is a reactor based on bundles of hollow-fiber tubes. A homogenous catalyst is fixed onto a special carrier material and a membrane is applied onto the outside of this. Depending on the properties of the membrane, either the product or byproduct will then pass through the membrane once the reaction has taken place at the catalyst surface.

Expertise along the entire process chain

While the process is astonishingly simple in principle, it holds numerous technical challenges, beginning with the properties of the carrier, catalyst, and membrane, up to and including the modular construction of the reactor intended to simplify later scale-up. The expertise that the research partners bring to the table covers every key point along the entire process chain for implementing the process.

In addition to Evonik, partners include the Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany), the RWTH Aachen University (Germany), the Technical University of Denmark, BioEnergy2020+ GmbH (Austria), LiqTech International A/S (Denmark), the European Membrane House (Belgium), the Agencia

Estatal Consejo Superior de Investigaciones Científicas (Spain), and Linde AG (Germany).

***ROMEO stands for Reactor Optimization by Membrane Enhanced Operation.**

Company information
Evonik, the creative industrial group from Germany, is one of the world leaders in specialty chemicals. Profitable growth and a sustained increase in the value of the company form the heart of Evonik's corporate strategy. Its activities focus on the key megatrends health, nutrition, resource efficiency and globalization. Evonik benefits specifically from its innovative prowess and integrated technology platforms.

Evonik is active in over 100 countries around the world. In fiscal 2014 more than 33,000 employees generated sales of around €12.9 billion and an operating profit (adjusted EBITDA) of about €1.9 billion.

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