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## Hydroformylation with Integrated SILP Catalyst–Membrane Separation Reaction System

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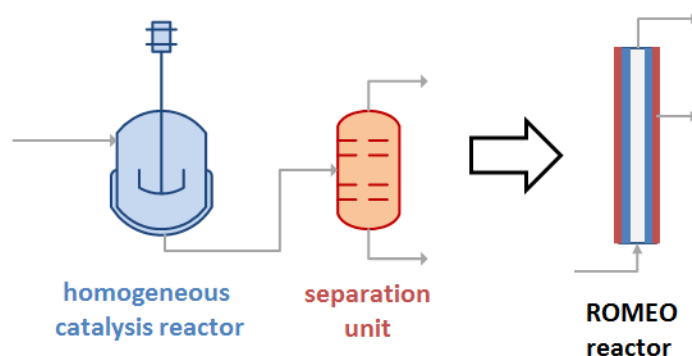
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*Hydroformylation of olefins by syngas to produce aldehydes is an important industrial reaction. A known process issue is the undesired “heavies” formation which diminishes the activity and complicates the process. To circumvent these drawbacks, a new “two-in-one” reactor concept is developed as part of the HORIZON2020 project Reactor Optimisation by Membrane Enhanced Operation.*

### 1. Scope

Catalysis with supported homogeneous catalyst systems has successfully been established over the last decades as an industrially attractive approach conducting both liquid- and gas-phase reactions.<sup>1</sup> Hydroformylation of olefins by syngas to produce aldehydes is a highly important and frequently studied catalytic reaction, and several supported catalyst systems have demonstrated industrial potential.<sup>2</sup> However, the long-term catalytic performance of such systems is often negatively influenced due to the formation of “heavies” by undesired condensation reactions hampering activity and selectivity.

In the HORIZON2020 project Reactor Optimisation by Membrane Enhanced Operation (ROMEEO)<sup>3</sup> a new “two-in-one” reactor concept is being developed. The unique ROMEEO reactor will overcome present challenges in the technology for the hydroformylation process and its industrial application. The ROMEEO reactor technology combines two process steps in one module as depicted in Figure 1.



**Figure 1:** Reactor Optimization by Membrane Enhanced Operation (ROMEEO) technology combines two standard process steps

The ROMEEO reactor is based on a catalytically active membrane. This membrane is combined with a homogeneous catalyst to generate the “two-in-one” reactor module. Depending on the properties of the membrane, either the product or byproduct passes through the membrane once the reaction has taken place at the catalyst surface.



## 2. Results and discussion

The ROMEO reactor modules are prepared by industrially applicable methods, analyzed by non-invasive techniques and tested in olefin hydroformylation. These investigations have in combination demonstrated that the system is catalytically active affording high activity and selectivity.

## 3. Conclusions

In summary, preliminary results indicate that the ROMEO “two-in-one” reactor concept has a great potential to be applied in the chemical industry. Furthermore, a reduction in emissions, energy consumption, space needs and costs in the chemical industry are expected with this new reactor type.

## Acknowledgements

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