KU LEUVEN

Science, Engineering and Technology Group
Department of Chemical Engineering

TECHNOLOGY CLUSTER SUSTAINABLE CHEMICAL PROCESS TECHNOLOGY

Research Profile

The cluster positions itself as the preferential partner of the chemical process industry and environmental technology sector by:

- providing solutions for industry demand-driven topics which require a sufficiently high research component (market pull);
- focusing on the development and translation towards industry of specific technologies;
- aiming to disseminate novel own developed technologies (technology push).

The cluster's research activities answer the major challenges of the chemical sector e.g. the finiteness of resources (including both fossil and inorganic feedstock) and the intensification and efficiency enhancement of existing plants, particularly in view of the fact that most plants in Flanders date back to the second half of the 20th century.

Therefore, the **Technology Cluster Sustainable Chemical Process Technology** focuses its activities within the broad framework of eco-efficiency and closing water, waste and raw material cycles, process intensification and green chemistry. It strengthens its knowledge, industrial network and international visibility through intense internal, multidisciplinary and international collaborations.

Research Topics

- **Laboratory for Process and Environmental Technology - Technology Campus De Nayer**
- **LAB4U - Technology Campus Diepenbeek**
- **Polymer Research Group - Technology Campus Diepenbeek**
- **Chemical Process Technology - Technology Campus Ghent**

Process intensification

Process intensification is a key domain wherein all research groups of the cluster operate at this time. The research line focuses on development, integration, simulation and miniaturisation of several unit operations and on the use of alternative energy forms. The implementation of alternative energy forms includes ultrasound, microwaves and plasma technology, especially for the improvement of heterogeneous systems (L/S, L/V, L/S/V) and biomass valorisation. Unit operations include integrated reaction and separation units, miniaturised and continuous separation processes and organic synthesis (flow chemistry), membrane technology, electroplating, and combination/integration of these technologies at different scales.

Process intensification

The cluster is active in the fields of physicochemical and biological wastewater treatment. Within physicochemical treatment, research on Advanced Oxidation Processes (AOPs) is a main research topic, covering a wide spectrum of chemical, electrochemical and electromagnetic wave technologies and combinations hereof, such as the intensification of AOPs using ultrasonic waves. Besides or in combination with AOPs, membrane technologies are put forward in order to achieve better recovery of components and/or more energy efficient treatment of waste streams. In the field of biological wastewater treatment, attention is focused on the intensification of biological wastewater treatments (both aerobic and anaerobic), mainly by introducing novel physicochemical technologies such as ultrasound, microwave and electrolysis in existing
treatment plants.

Waste and biomass valorisation

Resource recovery is one of the key topics for the future sustainable production of chemicals. The cluster has activities in this field on the conversion of organics to fuels and renewable chemicals on the one hand, and the recovery of inorganic materials and soil remediation processes on the other. Both chemical and biochemical conversion techniques are exploited in this regard. As for organic resource recovery, the main focus is currently laid on anaerobic digestion, but the application of bioconversion techniques for the production of feedstock organics is also gaining importance. Recovery of inorganic products is achieved through membrane processes (electrodialysis) and the application of new energy sources to release e.g. metals from solid waste materials. Also, soil remediation processes are being looked at.

Polymer processing

The polymer processing research line incorporates the use and optimisation of (innovative) injection techniques such as water/gas assisted injection moulding and variothermal injection moulding. The former techniques are used to produce hollow products with injection moulding, while in the latter technique the mould is heated while injecting the polymer, thus improving the process considerably (diminishing of weld lines, better surface gloss, micro details). Further research is being done into material behaviour during processing in general and material behaviour around defects, such as weld lines.

A third topic of interest in this research line is electroplating of plastics for decorative (e.g. plastic lamp casing in cars) and functional (e.g. shielding of electromagnetic fields in connectors for glass fibre cable) purposes.

Process systems engineering

This research focus lies in the domain of design, control and optimisation of industrial chemical and biochemical processes. Given the complexity of these processes, model-based approaches provide a sound fundament for systematic routes towards the necessary improvements. Hence, model-based measurement, control and optimisation schemes are designed in view of economic, ecologic and social sustainability (and the intrinsic trade-offs between these three). Supporting tools for computer-aided process engineering are developed and validated on specific case studies. Although the techniques are generic in nature, specific applications are envisioned in the domains targeted by the cluster (e.g. computing optimal (flow)reaction parameters in order to maximise yield and selectivity in (bio)chemical reactions).

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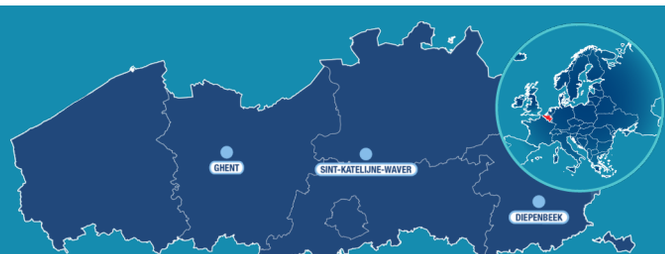

The research groups of the Sustainable Chemical Engineering Technology Cluster are active on the technology campuses in Diepenbeek (LAB4U & Polymer Research Group), Ghent (Chemical Process Technology) and De Nayer Sint-Katelijne-Waver (Laboratory for Process and Environmental Technology).