

Faculty of Science and Engineering

Profile report: Sustainable chemical reactor design and operation

[NL: Duurzaam reactor ontwerp en operatie]

- Discipline: Chemical Process Engineering, Multiphase reactors, Process Design
- Level: Tenure-track assistant professor
- Focus: Education
- Fte: 0.8-1.0 fte

1. Scientific discipline

The design of chemical reactors on the basis of the green chemistry and engineering principles and using renewable carbon sources as input (biomass, CO₂, plastic recycle) is rapidly emerging in the chemical industry. The current position is meant to modernize, in terms of teaching and assessing methods, our learning lines related to the design of green and sustainable chemical reactors (mainly in the Bachelor and Master programmes Chemical Engineering but also for the Bachelor and Master programmes Industrial Engineering and Management).

2. Vacancy

This position is opened by the board of the Faculty of Science and Engineering (PT/gl/22/00181) and will be embedded in the Engineering and Technology institute Groningen (ENTEG), in the cluster Chemical Engineering. The position falls within the framework of the faculty's career system [Career Paths in Science and Engineering](#). As the focus domain of the position is education, the criteria of the career path with a focus on education apply. Please see the link for more information.

3. Selection committee (BAC)

- Prof. dr. G.J.W. Euverink, Professor of Products and Processes for Biotechnology in the Biobased Economy, Educational director, ENTEG
- Prof. dr. B. Jayawardhana, Professor of Mechatronic and Control of Nonlinear Systems, Scientific director, ENTEG;
- Prof. dr. H.J. Heeres, Professor of Green Chemical Reaction Engineering, ENTEG;
- Prof. Dr. R. Bose, Associate Professor of Polymer Engineering, programme director BSc Chemical Engineering, ENTEG
- Prof. Dr. M. Ghanchi Tehrani, professor of Dynamics and Vibration, programme director Msc Mechanical Engineering ENTEG
- Prof dr. V. van Steijn, programme director BSc Chemical engineering, TUDelft
- student (tbd)

Advisors:

- Dr. ir. J.G.M. Winkelman, Director EngD Sustainable Process Design

- Prof. dr. F. Picchioni, Professor of Product Technology, ENTEG
- F. Salverda, HR advisor, ENTEG
- Dr. K.E. Voskamp, Scientific coordinator, ENTEG

4. Area of expertise

Multiphase reactors are well-established for chemical conversions in the chemical industry. However, current processes for transportation fuels and bulk chemicals, the latter mainly used to make important daily-life products like plastics, paints and adhesives, are in majority made from fossil resources. There is a strong need to use renewable carbon in the form of biomass, CO₂ and plastic recyclate as a substitute for such fossil resources. Particularly for biomass, new processes need to be developed as its chemical composition is by far more diverse than for typical fossil resources like oil and natural gas. For instance, the presence of substantial amounts of water and minerals has a major impact on reactor- and process design and needs to be considered. Besides the use of renewable feeds, other green chemistry and engineering principles also need to be taken into account for the design of the reactors, e.g. to minimize waste and energy. This requires new knowledge and strategies, which we need to convey to our students. It is the intention that the candidate to be hired for this position will be involved in implementing these new developments into the relevant courses of our current Bachelor and Master programmes, mainly in Chemical Engineering but also in Industrial Engineering and Management. This will involve courses in reactor design (single and multiphase reactors) with green chemistry and engineering principles in mind.

5. Embedding: institute (and base unit)

The research institute ENTEG (www.rug.nl/enteg) is the engineering science and technology institute of the Faculty of Science and Engineering (FSE) of the University of Groningen. ENTEG research is highly multidisciplinary in nature and focuses on fundamental and engineering research on the development of new and innovative processes and products. The research of ENTEG is conducted in three key research domains:

- Sustainable chemical engineering & biotechnology.
- Mechanical, materials & robotics engineering;
- Optimization, systems & control;

The candidate is expected to contribute to the existing teaching and research activities within the Green Chemical Reaction Engineering (GCRE) group. GCRE currently consists of 1 full professor, 2 associate professors, 2 tenure track assistant professors and a substantial team of PhD-students and postdoctoral fellows.

The staff of the GCRE unit, together with the Product Technology unit of ENTEG, are the core teaching staff for the Bachelor and Master programmes in Industrial Engineering and Management (track Sustainable Process Engineering (SPE)) and Chemical Engineering. The candidate is expected to be involved in both degree programmes, and as such will be involved in hard-core process design activities specifically related to the design of multiphase reactors and green processes involving mainly renewable carbon feeds.

Research within GCRE is focused on the development of highly intensified catalytic methodology and technology for renewable carbon (CO₂, biomass, plastic recycle) conversion to renewable fuels and chemicals. It entails the conversion of biomass to biofuels and biobased chemicals, CO₂ conversion in combination with hydrogen to hydrocarbons and alcohols, and the development of plastic recycle concepts (a.o. (catalytic) pyrolysis) using intensified reactors.

6. Local and (inter)national position

While green chemistry principles find their way into many chemistry curricula around the world, the prevailing emphasis often lies on these chemical principles themselves, with less attention directed towards the engineering aspects. Notably, at various technical universities in the Netherlands, such as Twente and Eindhoven, the curriculum integrates sustainable chemical reaction design within Chemical Engineering programmes and research is conducted in associated research groups. However, these institutions lean heavily towards technological advancement, somewhat neglecting the chemical context. Conversely, within ENTEG's Chemical Engineering units, a distinctly pronounced chemistry and catalysis focus prevails, setting them apart from the 4TU's. This distinction enables ENTEG to seamlessly weave together the tenets of green chemistry and engineering within their process-oriented activities.

7. Expected contributions to teaching

The candidate will, at the level of Assistant Professor, contribute 60% of his/her time to education. More specifically, the candidate is expected to take a leading role in innovating the teaching and assessment methods, for example for the following courses:

- Single Phase reactors (BSc CE)
- Reactor design (BSc IEM)
- Multiphase reactors (MSc CE)

In particular the candidate is expected to critically assess the current teaching and assessment methods and possibly develop more modern ones, relying for example on groups work, modeling elements, as well as hybrid (i.e. partly online, partly onsite) teaching modes, thus reflecting best practices at the industrial level. In addition, the candidate is also expected to develop green chemistry and engineering learning lines in the relevant curricula.

8. Expected contributions to research

The candidate will, at the level of Assistant Professor, contribute 30% of his/her time to set up an own research line within the GCRE unit and related to the ongoing activities in this unit. This embedding ensures that his/her teaching activities are fueled by relevant and state-of-the-art research in the field. This includes the translation of relevant research activities on sustainable reactor design within the relevant educational programmes, as well as the supervision of bachelor and master students in courses with research elements (e.g. bachelor and master research projects).

The research group GCRE is already heavily involved in industrial projects within the renewable carbon domain (biomass, CO₂ and recycle conversion). Several industrial partners, particularly from the North of the Netherlands, are already collaborating with the GCRE staff on this topic. The candidate is expected to strengthen these co-operations and provide a “sustainability”-driven point of view to several existing and future projects.

9. Expected contributions to the organization

The candidate is expected to have an active interest and to provide a positive contribution to the management and organizational tasks of the institute. The candidate will furthermore contribute to the organization of the faculty, for example by participating in working groups and committees, in the domains of education, research and management. The candidate will contribute to relevant organizational activities on the national and international level.