

## Faculty of Science and Engineering

### Profile report: Multiphase Green and sustainable chemical processes

- Discipline: Chemical Process Engineering, Multiphase reactors, Process Design
- Level: Educational tenure-track assistant professor
- Fte: 0,8-1,0 fte

#### 1. Scientific discipline

The design of sustainable chemical processes on the basis of the green chemistry and engineering principles and using renewable carbon sources as input (biomass, CO<sub>2</sub>, plastic recylcate) is rapidly emerging in the chemical industry. The current position is meant to modernizing, in terms of teaching and assessing modes, our learning lines related to green and sustainable multi-phase chemical processes (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 (PT/gl/22/00181) and will be embedded in the Engineering and Technology institute Groningen (ENTEG), basic unit Green Chemical Reaction Engineering. The criteria and conditions pertaining to the position are described in the document [‘Assistant professor with an education profile’](#).

#### 3. Selection committee (BAC)

- Prof. dr. F. Picchioni, Professor Product Technology, Educational director, ENTEG, chair;
- Prof. dr. H.J. Heeres, Professor Chemical Reaction Technology, Scientific director, ENTEG;
- Prof. Dr. P.P. Pescarmona, Professor Sustainable Chemical Products and Catalysis, director MSc Chemical Engineering, ENTEG
- Prof.dr. E.M.J. Verpoorte, Professor Analytical Chemistry and Pharmaceutical Analysis, GRIP
- Prof. Dr. R. Bose, Polymer Engineering, ENTEG
- Prof Dr. R. Van Ommen (TUDelft)
- Student (tba)

Advisors:

- F. Salverda (HR advisor ENTEG)
- Dr. K.E. Voskamp (Scientific coordinator ENTEG)

#### 4. Area of expertise

Multiphase processes 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, CO<sub>2</sub> and plastic recycle as a substitute for such fossil resources. Particularly for biomass, new processes need to be developed as the 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 in great depth. Besides the use of renewable feeds, other green chemistry and engineering principles also need to be considered in the design, e.g. to minimize waste and energy. The design of such green processes involving renewable carbon feeds 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), and process design and development, with the green chemistry and engineering principles in mind.

#### **5. Embedding: institute (and base unit)**

The research institute ENTEG ([www.rug.nl/enteg](http://www.rug.nl/enteg)) is the engineering science and technology institute of the Faculty of Science and Engineering 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:

- the application of fundamental sciences to the design of new (sustainable) product and research in the area of product and production technology for (bio)-based products,
- the development of quantitative and analytical theories and methodologies for model-based design and control of complex industrial processes and systems and,
- advanced production engineering aiming at improving the production processes of increasingly complex materials.

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 is strongly linked to the degree programmes in Chemical Engineering and Industrial Engineering and Management.

Research within GCRE is focused on the development of highly intensified catalytic methodology and technology for renewable carbon (CO<sub>2</sub>, biomass, plastic recycle) conversion to renewable fuels and chemicals. It entails the conversion of biomass to biofuels and biobased chemicals, CO<sub>2</sub> conversion in combination with hydrogen to hydrocarbons and alcohols, and the development of plastic recycle concepts (a.o. (catalytic) pyrolysis).

## **6. Local and (inter)national position**

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 both the Industrial Engineering and Management (track Sustainable Process Design (SPD)) and Chemical Engineering. The Industrial Engineering and Management SPD track furthermore is taught by staff from the IEM design group. The candidate is expected to be involved in both degree programmes, and as such will be involved in hard-core process design activities (Chemical Engineering) specifically related to the design of green multi-phase reactors and processes involving mainly renewable carbon feeds. Green chemistry and engineering principles are being taught in many engineering curricula around the world. However, the main focus is typically on green chemistry principles and less on the engineering aspects.

## **7. Expected contributions to teaching**

The candidate will at a 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 the following courses:

- Multiphase reactors (MSc CE)
- Product Focused Process Design (MSc CE)
- Chemical process Design and Development (BSc CE)

In particular the candidate is expected to critically assess the current teaching and assessment modes 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 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/cutting edge research in the field. This includes the translation of relevant research activities within sustainable multi-phase reactor and process design elements of the relevant educational programmes, as well as supervision of bachelor and master students in courses with research elements (e.g. design and research projects).

The research group GCRE is already playing a pivotal role in industrial projects within the renewable carbon domain (biomass, CO<sub>2</sub> and recycle conversion). Several industrial partners are already collaborating with the GCRE staff on this topic, which is extremely attractive from an industrial perspective and particularly in the North of the Netherlands. The candidate is expected to reinforce 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. At the level of FSE, the candidate will contribute to the organization of the faculty, for example by participating in working groups and committees in the area of education. The candidate will participate in relevant national and international organizations.