

Faculty of Science and Engineering

Profile report: Sustainable Process Design

Discipline: Process design, circular economy, sustainable process development
Level: Tenure-track assistant professor
Fte: 1,0 fte

1. Scientific discipline

The design of sustainable chemical processes is necessary conditions in the modern chemical industry. It requires and system engineering approach and integration of process design principles and sustainability analyses, supported by new computational tools. Energy usage, the carbon footprint of raw materials and atom efficiency during conversion steps is just a few paradigmatic examples of the many facets of sustainability as associated with chemical processes. These new societal demands will require additional skills of modern chemical engineers. This position will focus on the introduction of this new skillsets for various courses in the Bachelor and Master programmes in Chemical Engineering and Industrial Engineering and Management (particularly the Sustainable Process Engineering track). The research activities of the candidate should preferably support existing research lines in the research unit Green chemical Reaction Engineering within the Engineering and Technology institute Groningen (ENTEG).

2. Vacancy

This position is opened by the Board of the Faculty (PT/gl/21/00100) and will be embedded in 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;
- Dr. G. Jonker, Programme Director Bachelor Industrial Engineering and Management;
- Prof. Dr. P.P. Pescarmona, Professor Sustainable Chemical Products and Catalysis, Programme Director Master Chemical Engineering, ENTEG;
- Prof. dr. M. Tromp, Professor Materials Chemistry, Zernike institute;
- Prof. dr. L. Focarete, University Bologna, Italy;
- Student (tba)

Advisors:

- H. Haagsma, HR advisor, ENTEG
- Dr. K. Voskamp, Scientific coordinator, ENTE
- Dr. R. Bose, assistant professor chemical product engineering, ENTEG

4. Area of expertise

The design of processes in the chemical industry requires a multidisciplinary approach. However, in a changing landscape where linear processing is replaced by circular ones, a strong integration between classical process design and sustainability concepts is required, e.g. by using a system engineering approach. This requires the development of new methodological approaches, not only involving the technology (e.g. using the green chemistry and process principles) but also sustainability analyses and an in-depth analysis of the supply/value chain related to the problem at hand. The integration of all these different fields is necessary for our programmes (MSc and BSc Industrial Engineering and Management and Chemical Engineering) to train and prepare our fresh graduates for the changing industrial landscape.

The candidate is expected to contribute to the strengthening of the sustainable process design in both these programmes. This will particularly involve the development of new ideas/concepts for sustainable process design with a system engineering approach supplemented by sustainability and value/supply chain analyses. These activities should also be supported by the use of computational methods beyond those of classical process design (e.g. Aspen), which is a substantial challenge. Typical examples of courses for which involvement of the candidate is foreseen are Sustainable Process Design, General and Special Process Equipment, and supervision for bachelor research (Chemical Engineering) and design (Industrial Engineering and Management) projects, and master research projects (both Chemical Engineering and Industrial Engineering and Management). Also, the candidate will be involved in the development of sustainable process design learning lines in the relevant educational programmes.

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 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)chemical-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 research activities within the Green Chemical Reaction Engineering (GCRE) group. 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). GCRE currently consists of 2 senior professors and 2 tenure track assistant professors and a

substantial team of PhD-students and postdoctoral fellows. GCRE staff strongly links to the degree programmes Chemical Engineering and Industrial Engineering and Management.

The candidate is expected to contribute to the strengthening of the sustainable process design educational concepts in both these programmes (see above). GCRE will ensure that the candidate has access to all facilities and resources he/she may need for the research.

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 BSc and MSc 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) as well as the broader aspects like life cycle analyses, logistics and value chain analyses. This combination is to the best of our knowledge unique in the Netherlands. Sustainable process design is part of the curriculum (and research activities) of Chemical Engineering programmes most TU's in the Netherlands (e.g. Twente, Eindhoven), with associated research groups with similar names, though these have a strong focus on technology development and less on the business context. In addition, the Chemical Engineering units within ENTEG have a by far stronger chemistry/catalysis flavour than those of the 4TU's and are also able to incorporate the green chemistry and engineering principles in the process activities. Both the business and chemistry/catalysis extension to process design provides a unique opportunity for the development of integrated sustainable process design activities.

7. Expected contributions to teaching

The candidate will at the level of Assistant Professor contribute 60% of his/her time to the degree programmes at the University of Groningen. More specifically, the candidate is expected to take a leading role in innovating the teaching and assessment methods for SPE courses at both the BSc and MSc levels. This might include, although not be limited to, embedding methodological and systems engineering approaches in the definition of sustainable processes and the development of efficient teaching methods for design courses, possibly reflecting common industrial practices. Innovation in the mode of assessment and instruction for BSc and MSc projects along the guidelines of industrial process design (for example by stimulating the necessary multidisciplinary approach) is also highly desirable. In this context, the candidate is expected to contribute to the further development, as specified above, of the learning line Process Design and Sustainability (both in the BSc and MSc Industrial Engineering and Management and Chemical Engineering as it will be particularly evident in the course units "Reactor Engineering" (BSc Industrial Engineering and Management), "Process Design" (BSc Chemical Engineering), "Process Design and Engineering" (BSc Industrial Engineering and Management) and "Product focused process Design" (MSc Chemical Engineering and Industrial Engineering and Management).

The candidate is expected to be involved in the competence development of students and particularly those relevant for sustainable process design like teamwork and computational methods. All activities should provide students with the required mindset, knowledge, competencies and skillsets required in the chemical industry of the future. He/she is also expected to establish good connections with the IEM design group and to contribute to methodological developments within this team.

Finally, it is appreciated if the candidate applies for external funding, in particular for specific teaching grants (e.g. EIT, Erasmus plus, local funds) and contribute to strengthening the international reputation of the degree programmes.

8. Expected contributions to research

The candidate will at the level of Assistant Professor contribute 30% of his/her time to perform research in an existing research line within ENTEG, and particularly to the activities of the GCRE 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 the sustainable 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, CO₂ 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.