FACULTY OF
BIOSCIENCE ENGINEERING

The Chancellor of Ghent University has the honour of inviting you to attend the public defense of the doctoral dissertation of

ir. Marlies Christiaens

Title of the doctoral dissertation:

Technologies for resource recovery from human urine: terrestrial and space applications

The public defense will take place on **December 3, 2018 at 5 pm** in the Aula of Ghent University, Voldersstraat 9, 9000 Gent.

There will be a contiguous reception to which you are heartily invited.
Please confirm your attendance before November 28 to: marlies.christiaens@ugent.be or 0471 66 07 64.

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Abstract of the doctoral research

On earth, mineral fertilizers are extensively produced and inefficiently used. Tremendous losses on the fields result in economic costs and the deterioration of the environment. In long-term space missions, on the other hand, nitrogen is often scarce and therefore valuable. In both cases, nitrogen recycling and valorisation from concentrated waste streams, such as human urine, can tackle these issues.
Urine can be separately collected at the toilet. Prone to microbial growth, urine is highly unstable resulting in NH_3 release, but also loss, odor nuisance, and scaling of source separation infrastructure and downstream valorisation technologies. Therefore, controlled urine hydrolysis and thus stabilisation in a reactor in the toilet was found to resolve these issues. Inoculation with autofermented urine would be sufficient for rapid start-up. In space, direct filtration would be more suitable.
Two novel technologies were developed for nitrogen valorisation. One strategy is to extract ammonium from urine directly *via* electrochemically assisted membrane stripping, resulting in an ammonia liquid, free of urine-derived microorganisms and micropollutants. This can be used as a feed source for the production of microbial biomass, rich in protein. By applying this biomass as a feed additive, the need to grow feed crops on agricultural land with mineral fertilizer reduces.
Another strategy relies on microorganisms converting the nitrogen into nitrate. This can then be used in closed loop systems, *e.g.* in space, as a liquid fertilizer for plant growth on site. Space conditions, however, require a fully known ('gnotobiotic') microbial community. A synthetic consortium was established and proven to nitrify urine in a long-term continuous reactor, producing a sterile nitrate effluent.
The implementation of both technology concepts in (extra)terrestrial applications allows to replace inefficient and costly nitrogen usage with nitrogen recovery.

Brief Curriculum Vitae

Marlies Christiaens (°Lokeren, Belgium, January 24, 1989) obtained her high school degree in Latin-Mathematics at Sint-Gertrudiscollege, Wetteren in 2007. In 2012 she graduated as Master of Science in Bioscience Engineering, Environmental Technology, at Ghent University. After working as a scientific collaborator, she started her PhD at the Center for Microbial Ecology and Technology (CMET) in June 2014. Her research focused on technologies for resource recovery, mainly nitrogen, from human urine. She was engaged as an academic assistant, and worked on the Urine Nitrification ConsortiUM (UNICUM) project of the European Space Agency (ESA). During her final year, she spent four months as a visiting scientist at the Process Engineering Department of Eawag, Dübendorf, Switzerland.

During her PhD research, Marlies Christiaens successfully guided four master students and three bachelor students during their graduation research project. She was responsible for the group work for the course Biotechnological Processes for environmental sanitation, and assisted in computer exercises for the course Microbial Technology for reuse. She was involved in several ESA and industrial consultancy projects. She presented her research on several (inter)national conferences and symposia and won a price for one of her poster presentations. She is (co-)author of six international peer-reviewed publications.