SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Archaeology, Environmental Changes and Geo-Chemistry

has the honor to invite you to the public defence of the PhD thesis of

Besarta Matranxhi

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Utilization of CALUX In Vitro Bioassay (AhR and ERα) for Environmental Toxicity Screening: Insights into Tribology Tests, Wastewater Analysis, and Polluted Soil Assessment

Supervisor:
Prof. dr. ir. Marc Elskens

The defence will take place on

Wednesday, June 11, 2025 at 4 p.m.

VUB Etterbeek campus, Pleinlaan 2, Elsene, auditorium I.2.01

The defence can be followed through a live stream: Teams, Meeting ID: 380 482 251 143 6; Passcode: gx2GJ9HF

Members of the jury

Prof. dr. Yue Gao (VUB, chair)
Prof. dr. Martine Leermakers (VUB, secretary)
Prof. dr. Luc Leyns (VUB)
Dr. Thierry Delplanche (SYENSQO)
Dr. Lucia Pisarova (AC2T Research GmbH, AT)

Curriculum vitae

Besarta Matranxhi obtained her bachelor's degree in Environmental Engineering, in Albania and her master's degree in Water Resources Engineering, in Belgium (KU Luven & VUB). In October 2019, she started her PhD in the AMGC under the supervision of Prof. Dr. Marc Elskens. Her research was focused on investigating persistent organic chemicals in tribotests, wastewaters and soils. Her research was funded by the European Union's Horizon 2020 FET-OPEN programme (Grant No. 829047). During her PhD, she was a co-author of two scientific papers published in international peer-reviewed journals, including one as the first author. She presented her research at three international scientific conferences. and she supervised two master's thesis student.

Abstract of the PhD research

In today's industrialized environment, exposure to chemical mixtures is inevitable. In Europe, over 22,000 substances are registered under the REACH regulation, with a significant focus on persistent organic pollutants (POPs) and endocrine disruptors (EDCs) due to their harmful effects on human and animal health, including reproductive disorders, cardiovascular diseases, and various cancers. Current risk assessments primarily target individual substances, overlooking the complexities of chemical mixtures despite advanced instrumental analyses.

Effect-based methods (EBMs) evaluate the cumulative impacts of chemical exposure on organisms. CALUX *in vitro* bioassays serve as specific EBMs, assessing toxicities induced by contaminants like POPs and EDCs through engineered cell lines that target specific receptors, such as the aryl hydrocarbon receptor (AhR) and estrogen receptor (ERα). This approach enables efficient screening of chemical mixtures while minimizing the need for animal testing.

During the initial phase of research, a tribolysis approach was explored, which involves the degradation of organic macromolecules through mechanical stress, friction, or wear, aimed at developing a safe strategy for managing PCB waste. Both pure PCB compounds and tribotest samples were evaluated using CALUX bioassays (AhR and ERα). Findings indicated a safe and non-toxic degradation of 3,4-dichlorotoluene, with no detectable risk to receptors linked to tribolysis.

Additionally, the removal of persistent pollutants from wastewater at the "Aquafin" treatment plant in Brussels North, utilizing the Capterall® adsorbent developed by Solvay, was assessed through CALUX AhR and ERα bioassays. The treatment effectively eliminated 80-90% of organic micropollutants and 60-80% of inorganic micropollutants, offering a promising solution for improving the ecological status of surface waters and reducing toxicity to aquatic life.

Finally, the potential toxicity of hazardous waste from two metal grinding facilities in Wallonia, Belgium, was examined. *In vitro* CALUX bioassays (AhR and ERα) were conducted to assess receptor-mediated activities, alongside bacterial reverse gene mutation tests using *Salmonella typhimurium* strains for mutagenicity evaluation and zebrafish embryos for *in vivo* toxicity and teratogenicity analysis. Many samples demonstrated significant receptor activation, mutagenicity, and teratogenicity, raising serious environmental concerns.