Best Nano-Related Presentation at Environ 2022

Winner Marina Avena Maia, University of Cambridge

Phosphate capture by atomic layer deposition-based materials

I am a PhD candidate at the University of Cambridge and I am a member of The Catalysis and Process Integration Group led by Dr. Laura Torrente-Murciano. My research is a part of the REWATERGY Consortium, an industrial-academic partnership within the water energy nexus. As such, I am partly developing my project at Delft IMP, a start-up company based in The Netherlands, as part of the Marie Curie Industrial Doctorate training network funded by the European Commission within Horizon 2020.

The relevancy of my research topic is to solve the scarcity of finite primary components in fertilizers, which is foremost represented by phosphate. Currently, this salt is mainly obtained by mining of phosphorous rocks, a compound declared as one of the most 30 critical resources by the European Union (Henckens, 2021). Thus, the development and implementation of phosphate recovery systems for its reuse is urgently needed to guarantee food security worldwide.

Scope: Urine-containing streams from mammals (including human waste) are one of the largest source of phosphate; offering an opportunity for its sustainable recovery aligned to the concept of circular economy (Egle *et al.*, 2015). However, its main challenge is associated to its low concentration in waste streams of approximately 8 mg/L (Wilsenach & van Loosdrecht, 2006). Decentralized wastewater systems (i.e. no-mix toilets) can collect and treat urine as a separate waste stream. This system could offer the opportunity to recover phosphate more

efficiently, since through source separation urine can be collected very low-diluted with a high concentration of phosphate.

Research project highlights: My work is focused in phosphate recovery from no-mix toilets streams through an integrated adsorption and desorption process. The phosphate capture is done by adsorbent materials, which are synthesized through atomic layer deposition (ALD). It is important that the adsorbent possess high affinity and it is selective towards phosphate species due to urine broad composition. After that, phosphate is recover for fertilizer production. Thus, the extraction and recovery of phosphate from waste streams promotes a sustainable closed-loop of nutrients, as shown in Figure 1.

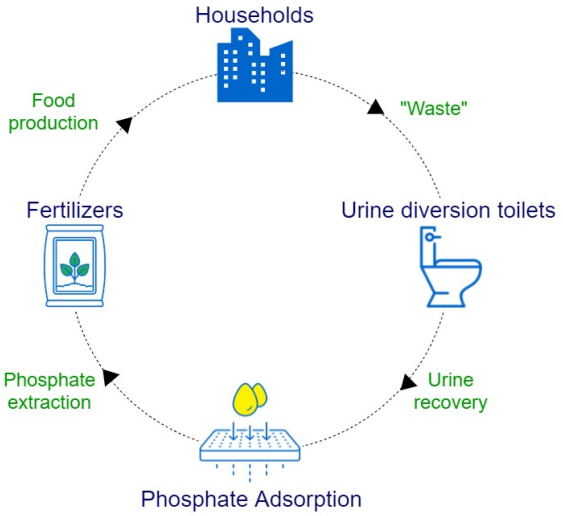

Figure 1: Circular closed-loop of nutrients in human urine for reutilization in agriculture.

References

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