PHOSPHOROUS EXTRACTION FACT SHEET

CINDERELA IN BRIEF

CINDERELA (New Circular Economy Business Model for More Sustainable Urban Construction) is a large-scale demonstration project implemented under the flagship of the Horizon 2020 EU Programme. The objective for the project is to design and demonstrate under real conditions a circular economy business model dedicated to the urban construction sector called CinderCEBM. The model will enable production of construction products using Secondary Raw Materials recovered from different waste types available in urban and semi-urban areas and their application in urban construction services in a technically feasible and economically viable way. Some of these waste streams contain important critical raw materials, such as phosphorus in waste water and sewage sludge, as well as other valuable materials. These materials can be extracted before final utilisation of recycled waste in the construction sector, what is known as cascade extraction.

Phosphorus recovered as struvite
(Source: GENOCOV reserch group, Universitat Autònoma de Barcelona, http://www.genocov.com)

PHOSPHOSOUS FACTS:

- Phosphorous (P) is one of 27 critical raw materials (CRM) in Europe for which supply security is at risk and economic importance is high
- Phosphorous is a vital element for human DNA and RNA and molecules responsible for energy transport in the cells.
- People absorb phosphorous from food
- Phosphorus is used as fertilizer in agriculture
- Phosphorus cannot be manufactured, it is mined
- Phosphorous present in urine is transferred to wastewater.

Phosphorous (P) is one of 27 critical raw materials (CRM) in Europe for which supply security is at risk and economic importance is high. Therefore, its recovery is critical and may create circular business opportunities also in the context of utilising waste streams generated by municipal services, such as wastewater treatment, for SRM-based construction products.
The main principle of the circular economy is to maintain resources at the highest possible value in material flows for as long as possible. CINDERELA will demonstrate how this principle can be applied with the example of Pextraction from wastewater before it ends up in sewage sludge – a waste stream of use for manufacturing SRM-based construction products such as geotechnical composites.
Phosphorus together with other nutrients important for agriculture is recovered directly from source-separated urine in the form of a liquid fertilizer.

EXTRACTION

The complete nutrient recovery (CNR) system consists of stabilization, purification and concentration of the urine. A CNR approach has a number of important advantages when compared to other P recovery approaches like struvite precipitation:

- nitrogen and valuable secondary nutrients (boron, iron, nickel, …) are recovered along with the phosphate;
- the full waste is treated, with full removal of micropollutants, pathogens, and bad odour from urine;

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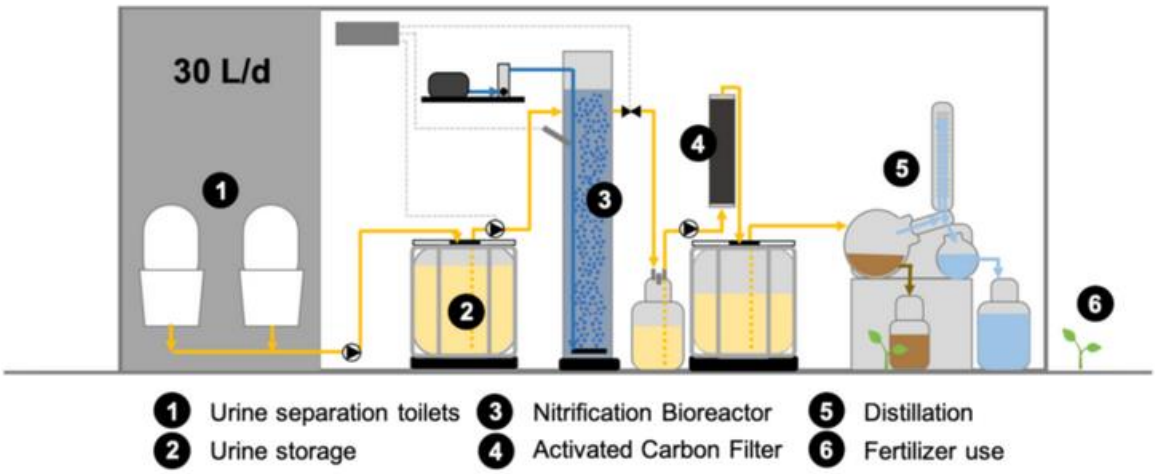
- a liquid high-grade organic fertilizer is produced, which can be directly used for hydroponics/urban farming, and distilled water is obtained as a valuable by-product.



With the source-separation of urine approach, P that would otherwise end up is the sewage sludge, is recovered upstream of the wastewater treatment plant. The P-depleted sludge can then be recycled into an SRM-based construction product, generating value as input material. The modular and mobile unit for extraction of nutrients from urine has been tested in Amsterdam (The Netherlands) and will be trasnsported to Maribor (Slovenia) during a ten-day culture festival 'Lent' in Slovenian Maribor in 2021.

Two special urine separating toilets of the Swiss quality brand Laufen, are part of a container-sized laboratory. The gender-neutral toilets have been developed in such a way that the urine is separated as much as possible from the flushing water, so that it is diluted as little as possible. The urine is collected in a storage vessel and then passed through a 150 liter bioreactor. In this nitrification column, aerobic bacteria ensure that the ammonia from the urine is converted into nitrate. With the stabilization of these nitrogen components, the unpleasant odor also disappears. After the odorless liquid is pumped through an activated carbon filter to remove the last impurities, in the final step the liquid is concentrated in a rotary evaporator. Valuable nutrients are extracted from the urine, in particular phosphorus in the form of phosphate and nitrogen in the form of nitrate, but also other micronutrients, such as potassium and traces of calcium, magnesium and zinc, among others.

Visitors can clearly see what is happening in the laboratory.

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