

## Specialized in Sustainability

# The circular economy of the future

**The research project RUN (Rural Urban Nutrient Partnership) explores how waste might be used more efficiently as a resource. In this project, Veronika Fendel investigates how recyclable materials from biowaste and domestic wastewater can be fed back into the material cycle in the best possible way.**

When one hears the word "waste", it is often in connection with an environmental problem. However, waste that is not integrated in the material cycle is not just an environmental issue, it is also an economic loss. The RUN (Rural Urban Nutrient Partnership) research project explores the question of how waste might be more efficiently used as a resource. A number of project partners have come together to develop a joint concept for regional closed-loop recycling of recyclable materials from biowaste and domestic wastewater and to test this in a practical setting as part a pilot project. The aim is to close nutrient and carbon cycles from secondary resources between rural and urban regions.

In her work, research associate Veronika Fendel from the Institute for Sanitary Engineering, Water Quality and Solid Waste Management concentrates on the resources blackwater (from vacuum toilets) and kitchen and green waste. The products obtained are: design fertilizer, vegetable coal and biopolymers. All of this can be reused in local agriculture and the products produced can in turn be sold to the residents in the city - thus closing the material cycle.

Veronika Fendel is an agricultural scientist and studied "Biobased Products and Bioenergy" at the University of Hohenheim. She is now part of the research group led by Prof. Martin Kranert at ISWA, who is also project leader of the RUN project. Fendel is currently conducting her doctoral research in the field of material flows. She initially observed these in a laboratory setting and calculated initial estimates. "After that, I compared this concept with two others; one that uses biogas and an additional concept that implements agriculture as a waste recycler."

## Kitchen waste and toilet contents become fertilizer and plastic

Together with her colleague Benjamin Schäffner, Fendel has produced a "design waste". The basic question was: What does the average kitchen waste in Germany look like? "All of the project partners use this completely analyzed designed waste so that the project findings are comparable." To this end, a garbage disposal unit was also used to make the waste more accessible for biological transformation. In the future, garbage disposal units could be installed in homes directly in the sink to prepare kitchen waste for the material cycle.

A further element is blackwater from vacuum toilets. Our conventional wastewater treatment system allows blackwater to enter a water treatment facility via the sewer system, together with stormwater, industrial and commercial water. RUN is based on the idea of directly utilizing the nutrients that are found in high concentrations in blackwater.

According to Fendel's research, the process of mixing the two types of waste shows great potential. This process is known as co-utilization and it seems to be particularly effective, because it not only utilizes the carbons from the kitchen waste, but also the nutrients from blackwater. These contain valuable resources, primarily phosphorus, nitrogen and potassium. A further aspect of the project focuses on finding out the optimal mixing ratio of blackwater and kitchen waste.

According to Veronika Fendel, agriculture can derive great benefit from the two organic resources: "On the one hand, MAP fertiliser, which is free-flowing and solid, is produced from them. According to a survey within the RUN project, a large proportion of farmers would prefer granulated, i.e. solid, fertiliser over liquid". In addition, biopolymers can also be obtained from it, which can be used as plastic films in the fields. "Up to now, plastic residues have often remained on the fields. If these were made entirely of biopolymers, the advantage would be that petroleum would no longer be used as a resource, but secondary household resources," says Fendel.

The next step in Fendel's research is to "check how the concept could work in India." To this end, she is planning a research trip to India in October 2021, where she will be able to join projects of this kind that are already taking place locally.

## Why India?

"India is a very populous country and there are still not enough sanitary facilities for everyone. In addition, the soils are severely degraded due to years of chemical fertilizer use. This problem has been recognized, and policymakers in India are striving to integrate as many recycling concepts as possible."

Veronika Fendel expects the research trip to provide new insights into co-processing in India and its impact on closed-loop recycling. To what extent the results can then be transferred to other countries remains open. "Basically, I see the closing of the loop as being of such global importance that every country can only benefit from the experience of others. For the implementation of the research results, however, regional adjustments would certainly have to be made. The young researcher remains confident, however: "From a sustainability perspective, the future definitely belongs to the circular economy. Politicians will not be able to close their minds to this either."

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### Press release

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Source: University of Stuttgart

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### Further information

- ▶ [University of Stuttgart](#)
- ▶ [Institute for Sanitary Engineering, Water Quality and Solid Waste Management](#)
- ▶ [Research Project RUN](#)
- ▶ [Video on "RUN – Rural Urban Nutrient Partnership"](#)