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EDITORIAL
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Editorial: Resource Recovery From Wastewater Treatment

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Editorial on the Research Topic

Resource Recovery from Wastewater Treatment

The transition to a circular economy is becoming a topic on the forefront of policymaking in recent years, given its advantages in environmental protection, resource management, and industrial efficiency (Stahel, 2016). One of the steps to foster this transition is the minimization of waste, by considering all excess productions as resources with potential for upcycling and valorization. In this Research Topic, we welcomed contributions on the recovery of resources from liquid waste, that is, wastewater, by specific processes, improvements, or new technologies for treatment.

Anaerobic digestion (AD) has been a common process applied to wastewater treatment for resource recovery for decades (Appels et al., 2008). Biogas is a product of anaerobic metabolism of carbonaceous organic matter. It is a renewable source of energy which can be used for combustion in combined heat and power units. Its energy potential depends on the rate of methane generation, as this component of biogas has the highest calorific value (Weiland, 2010). AD is used with great success for the treatment of wastewater flows with high organic loads, such as wastewaters from animal farming, food and dairy processing, and secondary sludge (Holm-Nielsen et al., 2009).

Domingues et al. have studied for the first time the co-digestion of swine slurry, the most common liquid waste flow of swine farms, with swine hydrolyzate, a small volume also produced at these facilities from the hydrolysis of swine carcasses. They found that the use of a small proportion of hydrolyzate, between 9 and 27%, improved the process by providing higher concentrations of nutrients P and S, leading to the generation of larger biogas volumes with higher methane content than previously reported values from anaerobic digestion of swine slurry.

Another article focused on the recovery of the nutrients themselves from the swine slurry, rather than the carbonaceous material. Palominos et al. successfully used a combination of bischofite and zeolite for the precipitation of struvite, an important mineral for fertilization which is rich in both N and P. The studied process did not inhibit the anaerobic digestion process, even providing a small advantage in the production of methane, due to the elimination of the ammonia interference. The bischofite source was a byproduct of lithium production, so the proposed process has several environmental benefits.

Finally, Neugebauer et al. submitted an important contribution highlighting the recent exploration of the thermal energy potential of wastewaters, which goes beyond the electric energy potential provided by anaerobic digestion of high organic loads. This is especially relevant in the area selected for analysis, Central Europe, where wastewater temperatures often exceed ambient temperatures by several degrees. The authors provide calculations that show

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tremendous untapped potential for heat recovery from wastewater to be used in local settlements for district heating, where much of the energy demand is currently met by natural gas supply. The use of renewable energies in the current global context is becoming an urgent need, so the conclusions of this study become more relevant by the day.

This collection offers a small sample of the potential for research and innovation that can be done in resource recovery from wastewaters: improving or devising new methodologies for extracting their material and energy assets in the form of biogas, nutrients, and heat. We hope the published studies inspire other researchers to dedicate themselves to the complex but worthwhile task of maximizing the valorization of wastewaters as a resource rather than a waste.

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All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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