New anaerobic wastewater treatment technologies applied to agri-food industry

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Abstract:

Agri-food industry produces large amounts of wastewater and are distinguished from municipal and other industrial wastewaters as they are biodegradable and do not contain toxic chemicals. The concept of recovering energy and resources from wastewater has gained growing interest in line with circular economy objectives. In such processes, organic matter can be utilized as substrates by microorganisms to generate energy (in the forms of methane, hydrogen, or electricity) or produce valuable chemicals (e.g., volatile organic acids and alcohols). Agri-food wastewaters are especially attractive for such bioconversion processes due to their high organic contents (typical COD values in the range of 5 to 10 g/L), nutrients and high biodegradability.

Although widely applied, aerobic activated sludge process requires the use of chemicals and involves high capital, operational, and maintenance costs. Energy costs for aeration are significant and depend directly on the organic load to be removed. Industrial wastewater treatment systems, that rely on the anaerobic digestion process for the removal of organic pollutants, offer important advantages over conventionally applied aerobic processes. In anaerobic digestion, the organic wastes are converted into biogas in the absence of oxygen, and is in principle, an energy-generating process through the production of methane-rich biogas, and produces only one-fifth to one-tenth of biomass per unit of organic substrate converted as compared to aerobic processes. Wastewater treatment based on the circular economy principles aims at resource recovery and water reuse, reducing energy requirements and chemical consumption as well as at decreasing the environmental impacts.

Thus, the development of novel strategies for accelerated methane production from agri-food industry by microbial communities will contribute significantly to tackling major environmental challenges related to methane emissions in nature (from soils, sediments, and groundwater), and to recover valuable renewable energy from contaminated effluents and wastes.

The present work will present and discuss new approaches to optimize the anaerobic digestion process either by accelerating methane production or by improving the resilience and application of anaerobic processes to more recalcitrant compounds.