Role of Waste Biorefineries in Future Energy and Green Products

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Abstract

A waste-driven factory is intended to valorize waste sources as renewable feedstock to recover value-added chemicals, materials, alternative fuels, and energy. This concept aims to integrate waste treatment, resource recovery, alternative fuels, and energy generation to shift from fossil-based linear economies to circular economies. Although the traditional linear economies have resulted in rapid economic growth, but at the cost of increasing energy demands, environmental pollution, and climate change. Recently, the Paris COP21 summit has set out a roadmap to reduce greenhouse gases (GHGs) emissions to keep global warming to 'well below 2°C'. Like global warming, the tremendous waste generation and its unsustainable disposal have emerged as a potential threat to our civilization. It is estimated that the current waste generation rate would escalate by three times by 2025. Traditional waste remediation methods are concerned with waste removal from collection points and their disposal in designated dumping sites where waste valorization to generate energy and other value-added products are rarely performed. These sites have become a major source of GHGs emissions contributing to climate change. As a result, nations are now focusing on treating or refining wastes instead of disposing, striving to recover energy and value-added products from waste to achieve a circular economy. In better words, using closed-loop waste bioprocessing units, the inherent net positive energy contained in solid, liquid, and gaseous wastes is harnessed and utilized as energy carriers. Despite their promising features, these individual processing technologies are incapable of handling the huge volume of waste at a single platform to achieve zero waste concept. They suffer from limited efficiencies and high capital and maintenance costs. Therefore, if these waste processing or waste-to-energy technologies could be integrated through the under-one-roof concept of a waste-driven factory, a significant part of wastes can be treated by various specialized techniques, while their outputs (heat, power, and fuel) could suffice the operating requirements of each other. An array of products including heat, power, fuel, and value-added chemicals, enzymes, and materials would be available, not only to run the waste-driven factory by itself but to support the national electric grids, vehicular gas stations, combined heat and power (CHP) units, and domestic heating and industrial furnaces. However, such waste-driven factories' overall sustainability should be assessed through various tools, including life cycle assessment (LCA), life cycle impact assessment (LCIA), and exergy.

Keywords: Waste-driven factories; Waste to energy; Alternative fuels; Sustainability