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# Advances in Mixed Plastics Chemical Recycling

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## Abstract

Plastics represent a serious waste-handling problem, with only 10–15% of the plastic waste (PW) generated worldwide being recycled. The remainder follows a linear economy model, involving disposal or incineration. Chemical recycling is considered an attractive technological pathway to reduce plastics waste, as well as promote a circular economy. Plastic recycling via the gasification route is picking up momentum slowly owing to its availability to handle large scale of waste. Another important reason is that gasification is considered to have a positive impact on net carbon emissions, and further processing of waste plastics can enable the final products of the gasification process to fall under the sustainability tag. Thus, the chemical recycling of plastics via gasification route plays an important role in the circular economy.

This report discusses advanced chemical recycling of plastics via the gasification route. The objective of this report is to evaluate the process economics of associated technologies. PEP presents a comprehensive description on the technological aspects, current industry trends across globe, and major factors related to technological implementation. The following cases are covered in this report:

1. Case I—Ebara Ube PTIFG process for chemical recycling of waste plastics
2. Case II—Enerkem carbon recycling process for waste plastics
3. Case III—Eastman carbon renewal technology for recycling waste polyesters

PEP has used Aspen Plus, Thermoflow, and IHS Markit's internal tools to work out a process design and its economics. The particular characteristics of waste plastics, especially low-thermal conductivity, sticky behavior, high-volatile content, and tar formation, impact their complete (stand-alone) treatment in conventional gasification technologies and involve a challenge for the process implementation. But the gasification flexibility is increased when the waste plastics are co-fed with other feedstocks (especially biomass and coal). An increase in the plastic content in the net gasifier feed improves the $H_2$ content and gas product-heating value, resulting in a reduction in the utility consumption of downstream product synthesis.

The main challenges associated with the economics of the chemical recycling of plastics via gasification lie with the selection of proper feedstock, plant capacity, downstream high value-added monomer selection, and tipping fee. The chemical recycling of plastics via gasification to monomer confers economic advantages with its promotion in assigning its value to environmental benefits, e.g., $CO_2$ savings, increased share of biogenic carbon in plastic products, increasing recycling quotas, and/or the potential of the process to compensate for the intermittency of renewable power.

 

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