ENVIRONMENTAL SUSTAINABILITY OF MUNICIPAL WASTE THERMOCHEMICAL CONVERSION TECHNOLOGIES

Lidia Lombardi, Niccolò Cusano University, Italy
lidia.lombardi@unicusano.it
Susan Thorneloe, U.S. Environmental Protection Agency, USA

Key Words: municipal waste, waste-to-energy, thermochemical conversion, gasification, pyrolysis

Both in USA and EU waste management is evolving towards sustainable materials management, intended as a systemic approach to using and reusing materials more productively over their entire life cycles. A similar Waste Management Hierarchy prioritizes and ranks the various management strategies from most to least environmentally preferred. The hierarchy places emphasis on reducing, reusing, and recycling as key to sustainable materials management. However, for non-recyclable materials, waste-to-energy represents the most preferred option, to save important resources (such as landfill volumes and non-renewable energy), to reduce the contribution to global warming, and to provide an essential contribution to fulfil the goals of a really sustainable waste management.

According to EU strategy, the waste disposal to landfills must be considered as the last possibility and limited to pre-treated wastes (not biologically active or not containing easily leachable hazardous substances), confirming that thermochemical treatments of non-recyclable or potentially hazardous solid waste are still necessary.
Thus, recent data (Cewep, 2019) showed that in Europe, by 2035, 142 million ton of residual waste treatment capacity will be required to comply with the targets imposed by the EU on municipal waste, even if the recycling targets will be achieved for commercial and industrial waste. Current Waste-to-Energy capacity in Europe is 90 million ton and the capacity for co-incineration is around 11 million ton. So still 41 million ton have to find appropriate thermochemical treatments aimed at energy recovery.

A conventional waste-to-energy (WtE) facility accepts unprocessed municipal waste which is burned in a large combustion unit to generate electricity or utilized in a combined heat and power system. Other thermochemical waste conversion technologies, such as gasification and pyrolysis, are less established and differ from conventional WtE in that they do not directly combust municipal waste. Instead they convert municipal waste feedstock via partial-oxygen or oxygen-absent thermochemical process. The resulting gases can be combusted to produce electricity or further processed into a liquid fuel or chemical commodity product.
In assessing conversion technologies, it is important to understand which municipal waste feedstock(s) can be managed by the technology, what pre-sorting or processing is required, whether minimum quantities of municipal waste must be provided, net energy balance, emissions data, environmental permit requirements, and the types and quantities of solid and hazardous residuals requiring management or disposal.
With this in mind, the aim of this work is to understand the environmental and economic sustainability of some thermochemical conversion technologies applied to municipal waste – eventually after appropriate pre-treatments – in comparison with conventional WtE.

While for conventional WtE facilities decades of environmental and economic performance data are available, less experience is available for gasification and pyrolysis technologies applied to waste and in particular to municipal waste/ municipal derived waste. For this reason, after a review of the available plants in EU and USA based on thermochemical conversion technologies different from conventional WtE, a comparison will be performed by environmental point of view, using Life Cycle Assessment, and economic point of view.

Cewep, 2019. Achieved Circular Economy Targets Will Leave 40 Million Tonnes Residual Waste Gap in 2035. Available at http://www.cewep.eu/cewep-capacity-calculations/