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Experimental and Numerical Investigation of Plastic Waste Thermochemical Recycling in the Vortex Reactor

Aim

Obtaining a bigger picture about plastic waste (PW) pyrolysis and gasification in a vortex reactor (VR) from an experimental and numerical point of view.

Justification

Over the recent decades, the annual amount of municipal solid wastes, including PW has increased. There are a few possible options to handle these PW, one of which is thermochemical recycling [2]. This method includes pyrolysis and gasification, in which the long-chain polymers are cracked and converted to fuels, energy, and syngas (**Fout! Verwijzingsbron niet gevonden.**).

Due to the ever-increasing environmental problems of PW, their recycling is one of the important targets of process intensification, which has received a lot of attention in the past decades. A possible reactor technology for process intensification is the VR [3], which has been studied and developed at the Laboratory for Chemical Technology (LCT) in the last decade. In this type of fluidized bed reactor, a controllable centrifugal force (instead of the gravity force) acts against the drag force. Therefore, higher gas velocities are possible compared to conventional gravitational fluidized bed operation. This results in a higher slip velocity between the two phases, and consequently, an increased heat and mass transfer rate.

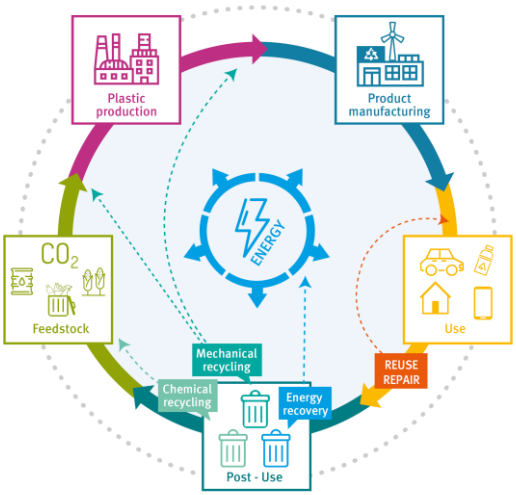

Fig. 1 Circular economy in the case of plastic waste recycling (adopted from [1])

To understand the full potential of VR technology for thermochemical conversion of PW, it is essential to investigate it thoroughly. Hence, the available reactive vortex setup at the LCT will be used to assess the pyrolysis and gasification of PW. Moreover, the developed 0D/1D model of VR will be improved to be validated against experimental results. A reliable 0D/1D model of VR specifically for plastics is a cost effective way to predict the products which could help us on design of the experiments, as well as the setup modifications. Moreover, the available 2D CFD frameworks should be further adapted for this process.

Program

1. Literature study on thermochemical recycling of plastic waste.
2. Performing the PW pyrolysis and gasification experiments in the VR setup
3. Modifying/Improving the available 0D/1D model to be validated against the experimental data
4. Modifying the available 2D CFD models to be used for PW pyrolysis and gasification processes

[1] PlasticsEurope, Plastics – the Facts 2018, An analysis of European plastics production, demand and waste data, PlasticsEurope, Association of Plastics Manufacturers, Belgium, 2018.

[2] K. Ragaert, L. Delva, K. Van Geem, Mechanical and chemical recycling of solid plastic waste, Waste Manage. (Oxford, U. K.), 69 (2017) 24-58.

[3] J. De Wilde, Gas-solid fluidized beds in vortex chambers, Chem. Eng. Process., 85 (2014) 256-290.

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