Plasbreaker: a novel pyrolysis technology for mixed plastic waste recycling

Stefano Redaelli[a], Edoardo Vitto[b] & Flavio Manenti [a]

[a] Department of Chemistry, Materials and Chemical Engineering "Giulio Natta", Politecnico di Milano, P.zza Leonardo da Vinci 32, 20133 Milan, Italy
[b] a2a S. p. A., Corso di Porta Vittoria 4, 20122 Milan, Italy

E-mail: *flavio.manenti@polimi.it*

In the path of post-consumer plastic waste, after sorting, there is generation of a flow made of mixed plastics (defined as "Plasmix" in Italy), which cannot be easily recycled by a conventional mechanical recycling process. This plastic waste stream is usually composed by polyolefins mainly (polyethylene, PE, and polypropylene, PP, in particular) from the packaging of consumer goods, followed by polyethylene terephthalate (PET), polystyrene (PS), polyvinyl chloride (PVC) and traces of other plastics and non-plastic contaminants. At present, this stream is sent to energy recovery mainly. However, research and industry are implementing new strategies to allow its material recovery. Due to the wide composition spectrum of this stream and to the presence of contaminants, many alternatives rely on thermal processes, namely gasification or pyrolysis, as a way to develop robust processes capable of convert effectively this stream. In this research work, it is presented a novel process design for thermal pyrolysis of mixed plastic waste which is being realized as a pilot plant in an industrial facility located in northern Italy. In this process, plastics, after being extruded, are diluted with a thermal oil, which is expected to assist pyrolysis at the same time through increase of the thermal conductivity and through coke reduction due to the control of homogeneous and heterogeneous nucleation sites, since mixed plastics and their products would be dispersed in the oil medium. Dilution with thermal oil is maintained throughout the entire process, including a dehalogenation reactor, where release of hydrogen chloride is promoted at 300 °C, and a pyrolysis reactor. The pyrolysis reactor is designed as a long tube externally heated, which imitates the configuration of a visbreaker, a unit operation in the field of petrochemical industry where viscosity of a high boiling point hydrocarbon mixture is reduced by a mild thermal pyrolysis. After the reaction section, pyrolysis oil and diathermic oil are separated through distillation. While pyrolysis oil is collected as product, diathermic oil is recycled back before dehalogenation.

Keywords: mixed *plastic waste, pyrolysis, process design*