Compositional analysis of LDPE collected from household waste - Part 1: Non-sorted household waste plastic -

[Background] Plastics recycling is a pressing concern, but the quality of recycled plastics greatly affects their performance. Therefore, recycling plastics requires a sophisticated sorting process, and the quality of collected and separated waste plastics will determine the recycling mode: material, chemical, or thermal. Thermal desorption (TD)-GC/MS and pyrolysis (Py)-GC/MS are effective methods to identify the polymer matrix, additives, and contaminants of collected waste plastics. In this technical note, the composition of low-density polyethylene (LDPE) household waste was analyzed, focusing on components other than LDPE, by TD-GC/MS and Py-GC/MS.

[Experimental] The collected LDPE household wastes were cryo-milled, and the resulting powder was used as a sample for TD-GC/MS and Py-GC/MS analysis.

[Results] The TD chromatogram (Fig. 1) shows not only peaks associated with polymers (in bold), but also various low molecular weight compounds such as fatty acids and saturated hydrocarbons which are ascribed to additives and contaminants. In the pyrogram (Fig. 2), peaks derived from various polymers were observed in addition to PE. These results indicate that various polymers and additives are present in the collected LDPE household waste, and that the quality of LDPE recovered from the household waste is not so high.

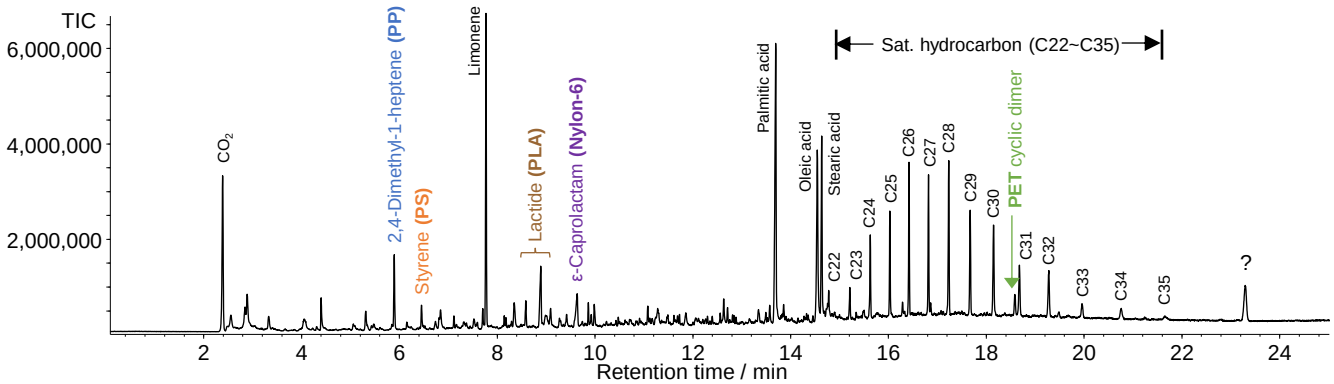

Fig. 1 TD chromatogram of waste LDPE collected from households.

Furnace temp.: 100 - 400 ºC (40 ºC/min, 1 min hold), ITF temp.: 300 ºC, GC Inj. temp.: 300 ºC, separation column: UA⁺-5 (5 % diphenyl-95 % dimethylpolysiloxane; *L*=30 m, i.d.=0.25 mm, df=0.25 µm), GC oven temp.: 40 (2 min hold) - 20 ºC/min - 320 ºC (14 min hold), split ratio: 1/5, column flow rate: 1 mL/min, GC/MS ITF temp.: 300 ºC, MS scan range: *m/z* 29 - 600, MS scan speed: 4 scan/s, Sample amount: 1,000 µg

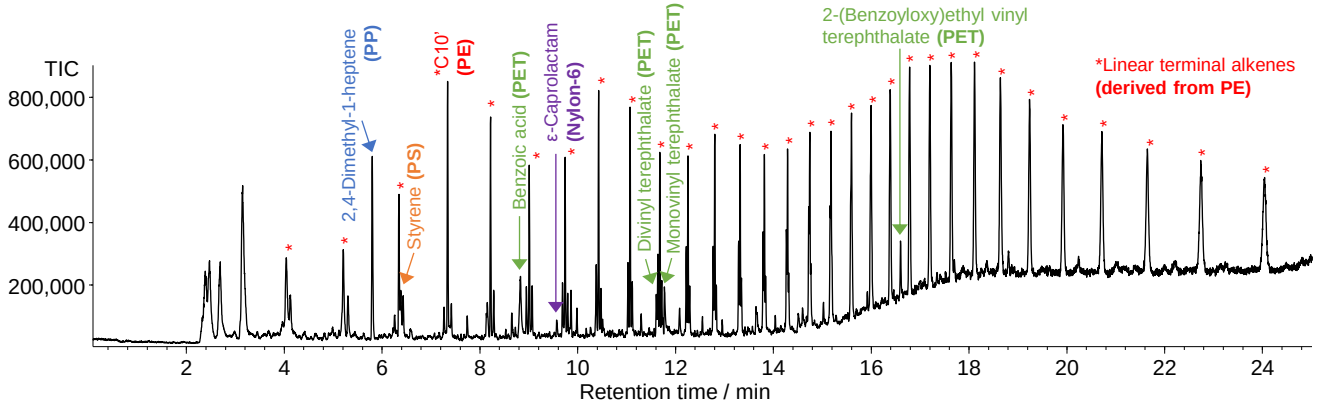

Fig. 2 Pyrogram of waste LDPE collected from households.

Furnace temp.: 600 ºC, ITF temp.: 300 ºC, GC Inj. temp.: 300 ºC, Separation column: UA⁺-5 (5 % diphenyl-95 % dimethylpolysiloxane; *L*=30 m, i.d.=0.25 mm, df=0.25 µm), GC oven temp.: 40 (2 min hold) - 20 ºC/min - 320 ºC (14 min hold), Split ratio: 1/100, Column flow rate: 1 mL/min, GC/MS ITF temp.: 300 ºC, MS scan range: *m/z* 29 - 600, MS scan speed: 4 scan/s, Sample amount: 100 µg.

Sample provided by Dr. Frank Malz, The Fraunhofer Society, Germany.

Keywords : Low-density polyethylene (LDPE), Sorting of waste plastics, Recycled plastics, TD-GC/MS, Py-GC/MS

Products used : Multi-Shot Pyrolyzer, Auto-Shot sampler, MicroJet Cryo-Trap, UA⁺-5, Eco-cup LF, Vent-free GC/MS adapter, F-Search, Cryogenic Mill (IQ MILL-2070)

Applications : Environmental analysis, Material recycling, General polymer analysis

Related technical notes : PYA1-169E (Part 2)

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