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► **To cite this version:**

Ludovic Hermabessiere, Charlotte Himber, Guillaume Duflos, Alexandre Dehaut. Pyrolysis-GC/MS: a powerful tool for microplastics identification. ECsafeSEAFOOD Conference, Jan 2017, Bruxelles, Belgium. anses-03889445

HAL Id: anses-03889445

<https://anses.hal.science/anses-03889445>

Submitted on 8 Dec 2022

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Pyrolysis-GC/MS: a powerful tool for microplastics identification

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Background

Plastic pollution has gained a large interest in the scientific community because plastic particles are found in marine environments. Moreover, ingestion of microplastics (MP) particles (<5 mm) by numerous seafood products (bivalves and fishes) has been demonstrated. Consequently MPs can represent an emerging risk for human consumption of seafood products. However, only few studies performed the identification of plastic polymer from inorganic debris with reliable methods such as Fourier Transform infrared, Raman spectrometry or Pyrolysis-GC/MS (Py-GC/MS).

Py-GC/MS has been recently used for microplastics identification and it has the advantage to be relevant to specifically identify plastics polymers and their additives.

Aims

The purpose of this work was 1) to develop a method using Py-GC/MS to identify multiple plastic polymers and 2) to apply this method on MP found in the environment.

Pyrolysis-GC/MS principle

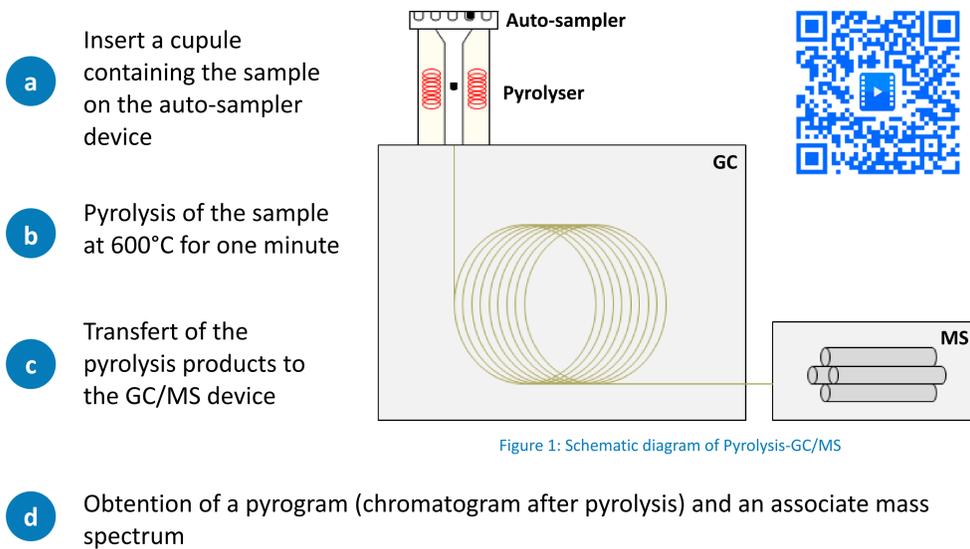


Figure 1: Schematic diagram of Pyrolysis-GC/MS

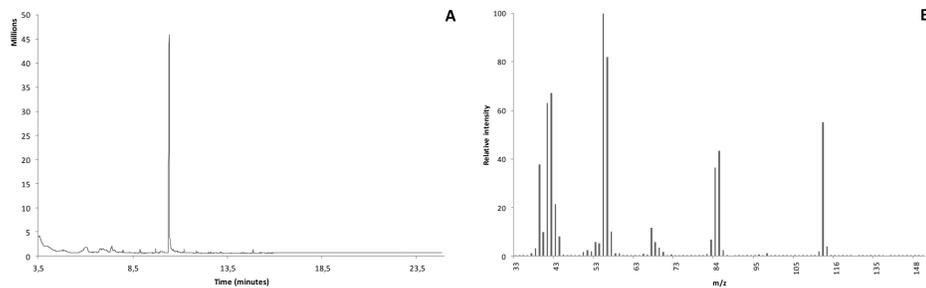


Figure 2: Typical pyrogram obtain after the pyrolysis of PA-6 sample (A) and the associate average mass spectrum (B)

Materials and methods

1. Pyrolysis of fifteen reference material

High and low density polyethylene (HDPE & LDPE), polypropylene (PP), expanded polystyrene (ePS), crosslinked polystyrene (PSXL), polystyrene (PS), poly(methyl-methacrylate) (PMMA), poly(laurylactam) (PA-12), polycaprolactam (PA-6), polyethylene terephthalate (PET), polyurethane (PUR), polytetrafluoroethylene (PTFE), unplasticized polyvinyl chloride (uPVC), polycarbonate (PC) and cellulose acetate (CA)

- Verification of the Py-GC/MS method
- Creation of a database



2. Pyrolysis of microplastics sampled on a local beach (France)

Application of the developed method and use of the database to identified field samples

Results

1. Polymer identification of plastic reference

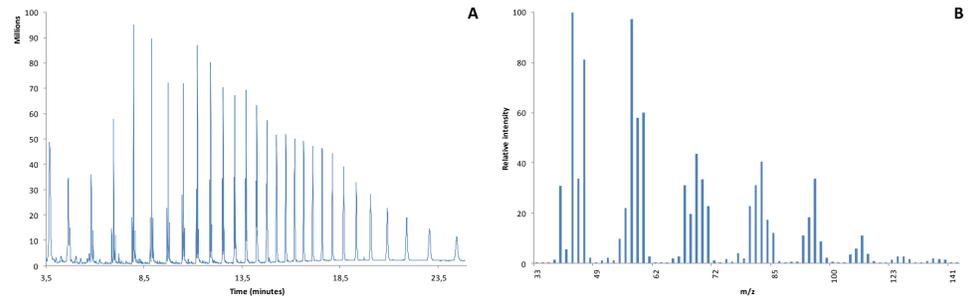


Figure 3: Typical pyrogram obtain after the pyrolysis of HDPE sample (A) and the associate average mass spectrum (B)

