



Non-target analysis of microplastics in indoor dust using liquid chromatography high-resolution mass spectrometry

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INTRODUCTION

- Microplastics have become pervasive in the environment, including dust. These particles pose potential health risks due to their ability to be inhaled and accumulate in humans.
- Although microplastics are commonly analyzed using pyrolysis-gas chromatography-mass spectrometry, liquid chromatography-mass spectrometry (LC-MS) provides sensitive detection of a wide range of analytes, including thermolabile plastic additives and plasticizers.
- Indoor dust samples were collected in residential and industrial settings and analyzed using high-resolution LC-mass spectrometry following depolymerization treatment.
- Non-target analysis with MS/MS library matching using the NIST 2023 library and Kendrick Mass Defect analysis was applied to identify polymer homologous series.

SAMPLE COLLECTION AND PREPARATION

Sampling of indoor dust at residential and industrial settings

- Dust samples were collected using a vacuum cleaner from three bedrooms.
- Laundry lint was collected directly from the laundry dryer.
- Dust samples were collected using a Kimwipe from the floors of two laboratory rooms.

Pretreatment

- All the samples were sieved through 1 mm sieve.
- Hydrogen peroxide was applied to remove organic substances from the surface of microplastics.
- The samples were dried in the oven.

Depolymerization

- 100 mg of samples were heated in 10 mL of LCMS grade methanol with 200 mg of potassium hydroxide.

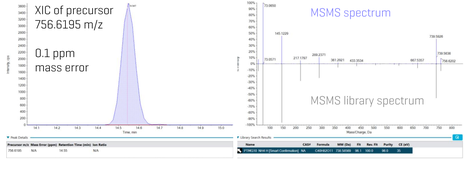
Filtration and Dilution

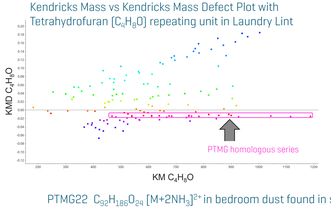
- The extracts were filtered with 0.45 µm PTFE syringe filters and then diluted 1:100 in acetonitrile.

UNKNOWN SCREENING OF POLYMERS IN DUST SAMPLES

- A series of **PTMG** (Poly[tetramethylene ether] glycol) was found in residential samples through MSMS library matching.
- Curated targeted suspect screening of PTMGs revealed the detection of polymers from PTMG 3 up to PTMG 26.
- PTMG is used in flexible materials such as spandex and shoe soles.

PTMG10 $C_{46}H_{82}O_{11}$ $[M+NH_4]^+$ in bedroom dust found in non-target analysis



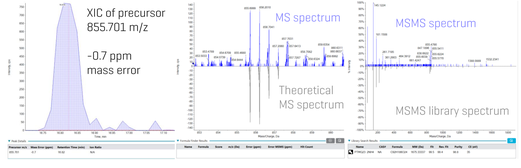


PTMG suspect screening

PTMG 3 to PTMG 26 confirmed by

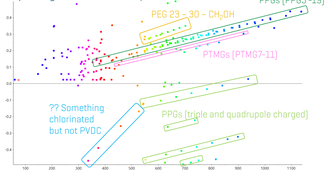
- Precursor mass error
- Isotope pattern
- MSMS library matching

PTMG22 $C_{92}H_{186}O_{24}$ $[M+2NH_4]^{2+}$ in bedroom dust found in suspect screening

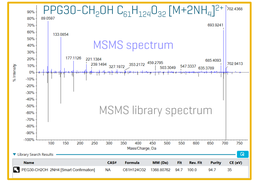


- PEGs, PPGs, and PTMGs dominated the dust sample collected in a non-residential setting.
- A KM vs KMD plot captured an overview of the polymers in the samples.

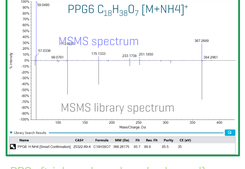
Kendricks Mass vs Kendricks Mass Defect Plot with CH_2 repeating unit in Laboratory dust



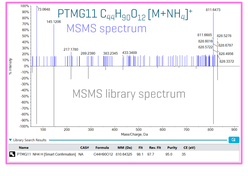
PEG 23 – 30 – CH_2OH



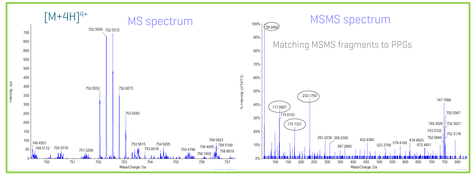
PPGs (PPG5 -19)



PTMGs (PTMG7-11)



PPGs (triple and quadrupole charged)

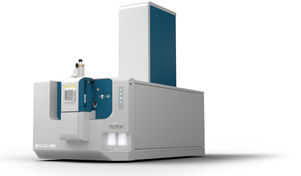


ANALYSIS DETAILS

Chromatography: Chromatographic separation was performed using an Exion AE system with a Phenomenex's Luna Omega Polar C18 (2 x 150 mm, 3 µm) column, using 0.1% formic acid and 5 mM ammonium formate in ultra-pure water as mobile phase A and 0.1% formic acid and 5 mM ammonium formate in methanol as mobile phase B. The column temperature was maintained at 40°C, and the injection volume was 5 µL.

Mass Spectrometry: Extracted samples were analyzed using the ZenoTOF 7600 system with a Turbo V ion source with Twin Sprayer ESI probe. Analysis was conducted in data-dependent acquisition mode. The instrument parameters are in the following tables.

MS source and gas parameters	
Ionspray Voltage (IS)	5500 V
Heater Temperature (TEM)	550 ° C
Gas 1	50 psi
Gas 2	40 psi
Curtain gas	35
CAD gas	10



TOF parameters	MS	MS/MS
TOF start – stop mass	50 – 3000 m/z	50 – 3000 m/z
TOF accumulation time	0.1 s	0.05 s
Declustering potential	60 psi	60 psi
Collision Energy	10 V	35 ± 15 V

Data Analysis: Non-targeted and suspect screening analyses were conducted using SCIEX OS version 3.4.5 with NIST 2023 MSMS library. Kendrick Mass and Kendrick Mass Defect were calculated as follows;

Kendricks Mass [KM] = precursor mass ×[nominal mass of repeating unit /mono isotopic mass of repeating unit]
Kendrick mass defect [KMD] = Nominal KM- exact KM