Impact of polymer recycling at lab-scale on nano-microparticles emissions in atmosphere

Rana Zeeshan Habib[1], José-Marie Lopez-Cuesta[1], Jérémie Pourchez[2], Lara Leclerc [2], Sebastien Moussard [3], Carine Chivas-Joly[4], Claire Longuet[1]

[1] *Polymers Composites and Hybrids (PCH), IMT Mines Ales, 6 Avenue de Clavières, 30319 Alès Cedex*

[2] *Mines Saint-Etienne, Univ Lyon, Univ Jean Monnet, INSERM, U 1059 Sainbiose, CIS, F - 42023 Saint-Etienne*

[3] *Polyvia, 1 Boulevard Edmond Michelet, 69008 Lyon*

[4] *LNE – National Metrology Institut, CARMEN Platform, 29, Avenue Roger Hennequin 78197 Trappes*

E-mail speakers: carine.chivas-joly@lne.fr and leclerc@emse.fr

Many industrial sectors and applications benefit from polymer recycling, which is currently a significant challenge in efforts to reduce the use of petroleum-based materials. However, polymer recycling can have adverse environmental impacts in some cases, depending on the recycling process used (such as solvents employed, particle production, etc.). The primary method for polymer recycling is mechanical recycling, which involves grinding polymers. One associated issue is the potential impact of emitted particles or micro- and nanoparticles released into water.

In this context, the aim of the MIPLAS project is to provide new insights into the emission of micro- and/or nanoplastics that may become aerosolized during the treatment and regeneration of plastic waste.

In this study, polyolefins bottles sourced from waste plants and from the purchase of consumer goods (polyethylene (PEHD) and polypropylene (PP) samples) were analyzed to evaluate their airborne particle generation rates, air suspension potential, and the physicochemical properties of airborne particles produced during grinding in a pilot-scale polymer grinder.

The chemical composition of airborne particles was determined using Raman microscopy, while morphology and elemental composition were analyzed with Energy Dispersive Spectroscopy (EDS) and scanning electron microscopy (SEM).

The exposure risk of inhalable and respirable fractions of airborne particles during grinding was measured by collecting the mass concentration of airborne particles at different airflow rates. An initial analysis of the potential toxicity of samples was also performed, focusing on two main parameters: cytotoxicity and pro-inflammation. For this purpose, Fetal Calf Serum and two types of Bovine Serum Albumin were used as particle dispersants, and a final protocol was validated for evaluating biological activity.

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