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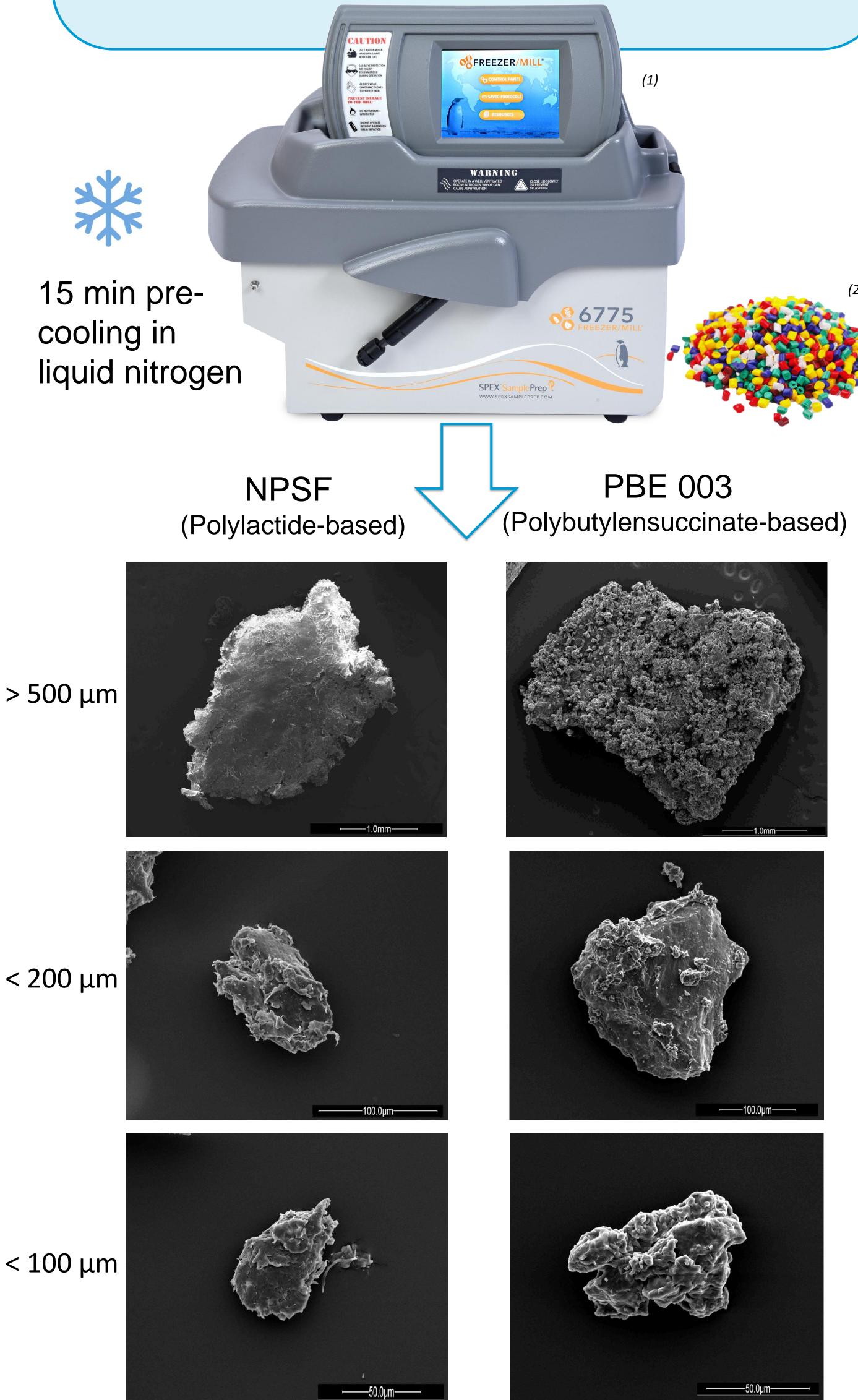
Preparation of Microparticles for Microplastic Research by Cryo-Milling

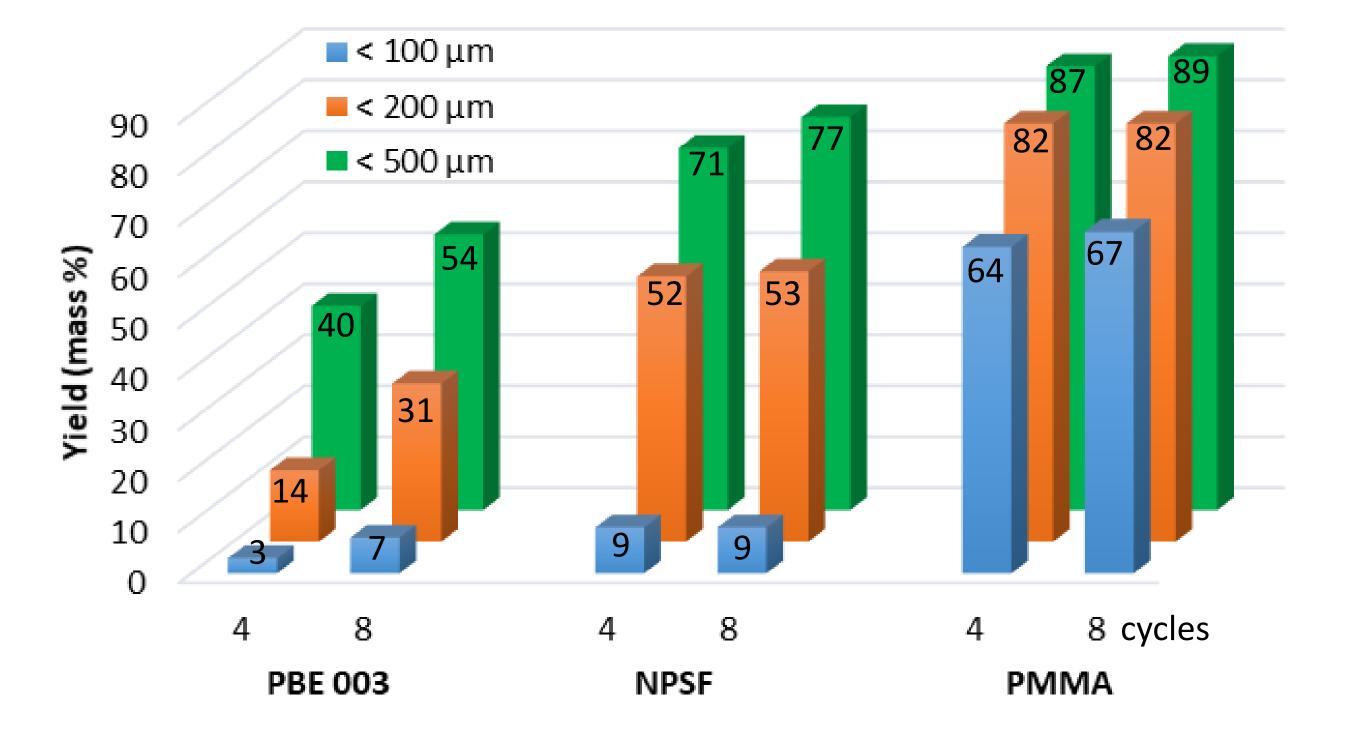
Introduction

Microplastic research is fundamental for assessing the potential impacts of microplastic particles on environment and human health. However, laboratory and field experiments on microplastics demand smallest particles, which are often hard to produce. Especially the fragmentation of bio-based plastics is challenging, as most plastic brands are tough and resilient against mechanical impact. Here we present a method to grind different plastics in a cryogenic mill and describe the resulting products as well as advantages and disadvantages of the method.

Materials & Methods

- 1g of plastic pellets were cooled and mechanically ground in a cryogenic mill (6775 Freezer/Mill, Spex SamplePrep).
- Particles were sieved for fractions $< 500 \mu m$, < 200 μ m, and < 100 μ m and inspected by scanning electron microscopy.





Yield of size fractions of bio-based and conventional plastics after cryogenic milling.

4 cycles: 2 min run, 2 min cooling 8 cycles: 1 min run, 1 min cooling



Results

- PBE 003 yielded lowest amounts of fractions < 500 μ m, < 200 μ m, and < 100 μ m
- Short grinding intervals (8 cycles) doubled the yield of the PBE fraction $< 200 \,\mu m$ and $< 100 \,\mu m$
- NPSF gave higher yields of fractions $< 500 \mu m$ and $< 200 \ \mu m$ but scarcely $< 100 \ \mu m$
- PMMA yielded highest amounts of all size fractions, accounting in total for about 90 % of the applied material
- Long grinding intervals (4 cyles) caused larger aggregations of platelet-like particles (left graphic, upper row)



Scanning electron micrographs of cryo-milled bio-based plastics.

Conclusion

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- Cryogenic milling is suitable to grind conventional as well as bio-based plastics to microparticle size.
- The effectiveness strongly depends on the plastic material and the grinding/cooling intervals.
- Every plastic needs its own optimized methods and running parameters for best performance

Image Sources ALFRED-WEGENER-INSTITU Presented at HELMHOLTZ (1) Taken from https://www.spexsampleprep.com/6775freezermill-for-cryogenic-grinding, 19.08.2020 10:47 HELMHOLTZ-ZENTRUM FÜR POLA (2) Taken from https://www.uihere.com/free-cliparts/ullmann-s-polymers-and-plastics-products-and-processes-ullmann-s-encyclopedia-of-industrial-chemistry-This project has received funding pelletizing-granules-2146828 19.08.2020 15:14 CYMARE from the European Union's Horizon REMERHAVE ernational Conference fo 2020 research and innovation Am Handelshafen YOUNG Marine Researchers 27570 Bremerhaver programme under grant agreement Telefon 0471 4831-0 No. 860407 www.awi.de 26 – 27 August 2020