**MASTER THESIS**

**Title**: In-Depth Study of the Foam Cell Nucleation Process in Physical Foaming – Paving the way towards the reduction of polymer consumption on industrial scale

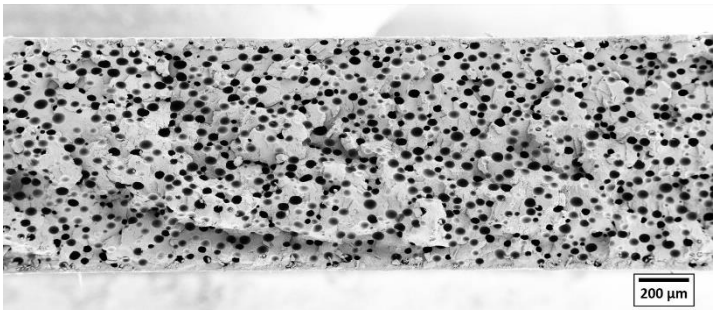


**Figure 1: Overall cross section SEM image of PET foam sheet, cell size below 50 µm**

**Summary**: Foaming of polymeric materials is the method of choice to reduce raw material and energy consumption in industrial extrusion processes. Among others, the mechanical and thermal properties of thus produced foams strongly depend on foam density and cell structure. In turn, the cell structure can be tuned for example by using tailored active nucleation additives based on an acid-base chemistry.
In this project, we aim at studying the role of active nucleation additive in the physical foaming process. Through rapid implementation of laboratory findings at pilot scale (and vice versa), we expect to reach unprecedented results of foam quality.

**Description**: Polymeric foams are used in a wide variety of applications and surround us in our daily life. For example, they are used in the building sector (insulation boards, cables, window profiles), in packaging (food trays, pouches), in the automotive sector and in many consumer products. Besides that, they are used in industrial applications ranging from rotor blades in wind turbines to flowerpots and ebb-flow trays for greenhouses. Foams are used for their excellent thermal and sound insulation properties, their lightness, but also their high weight-specific stiffness. It is noteworthy that the final part properties strongly depend not only on the foam density but even more on the microscopic cell structure. Since the cell structure is the result of cell nucleation, growth, and stabilization, it is of utmost importance to master these process steps. State of the art processes for continuous production of polymeric foams typically allow to reach cell sizes in the range of 40-100 µm while it has been proven in batch processes that foams with cell size well below 1 µm can be synthesized. The superordinated goal of the present project will be to close this gap through focussing on the cell nucleation and stabilization process.

**Approach / Organisational Matters**: The exploration and optimization of the role and mechanism of active nucleation additives, in particular regarding their chemistry and physical impact, will be done partly in the laboratory at ETH Zurich (70%) including but not limited to ex-situ reaction trials, XRD analysis, thermal analysis (TGA, DSC), and SEM (+EDX) imaging while the foaming trials will be carried out on a pilot extruder at Promix Solutions in Winterthur (30%). Earliest start date: August 2023.

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