PREPARATORY INDUSTRIAL PROJECT

Advanced characterization of new cellulose-based materials for melt processing in the packaging industry

THE INDUSTRIAL CHALLENGE

As a partner in a previous Vinnova-funded center of innovation (BiMaC), Tetra Pak helped to identify a novel cellulose-based material that ultimately can be a replacement candidate to petroleum-based plastics. This material can be melt processed in conventional equipment, though with more difficulty than conventional thermoplastics. Understanding the nanostructure features in the material can enable scale-up of the melt processing of a new generation of cellulose-based materials in disposable packaging, replacing petroleum-based polymers. The physical properties and rheological behavior of the modified cellulose when processed is important to understand.

WHY USING A LARGE-SCALE FACILITY?

Synchrotron X-ray scattering techniques will yield important information on how morphology depends on how this cellulosic material was produced, how it was melt processed and the effect of changes in the processes. Further, use of synchrotrons minimize test duration and could possibly also enable in-situ testing. The goal in this study was to identify any existing infrastructure for these types of measurements, or if non-existing, design an experimental set-up.

THE RESULTS AND EXPECTED IMPACT

Initial lab-based tests showed that X-ray scattering techniques as SAXS/WAXS were able to capture changes in the material. The result indicates that the scattering tests could be done in a synchrotron in the future. There are existing large-scale synchrotrons available using SAXS/WAXS technique that can be used for evaluating the changes in morphology in cellulosic materials.

In Europe this could be possible at e.g.:

- cSAXS beamline at SLS, (Swiss Light Source, Villigen, Switzerland), where scanning SAXS/WAXS possibilities are excellent.
- P03 at PETRA III at the DESY facility in Hamburg also has good possibilities.

For the future, the ForMAX beamline at MAX IV is dedicated to the length scale relevant for materials from the forest. Possibilities for in-situ experiments could be explored there. Another beamline at MAX IV that could be relevant is CoSAXS.

The fact that relevant differences in this material were captured will bring increased industrial interest in scattering tests for cellulosic materials as well as the more practical possibility to improve the design of the materials to give them suitable functions needed in the material.

Tetra Pack Packaging Solutions AB have cooperated with KTH and Chalmers in this study. Tetra Pak Packaging Solutions AB brought the needs from the industry while KTH and Chalmers provided in-depth knowledge of the material and the process. The good results mean a possibility for further collaboration in this area. A possible addition to the group could be a producer of the material.

"Synchrotrons will be an excellent tool in understanding material properties and will help in designing new materials with good functions"/Magnus Östlund and Katarina Jonasson, Tetra Pak Packaging Solutions AB

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