ANDREAS KRYPCZYK
TITK - Thüringisches Institut für Textil- und Kunststoff-Forschung e. V.
DE- Rudolstadt

CAREMELT ®– DEVELOPMENT OF A BIO-BASED AND BIO-DEGRADABLE HOT MELT ADHESIVE SYSTEM

Conventional hot melt adhesives offer fast, solvent-free processing and are well established in many industrial sectors. However, with increasing focus on environmental protection and resource efficiency, bio-based and biodegradable alternatives are gaining importance – and will become an indispensable component of sustainable production processes in the long term.

With that in mind, the Thuringian Institute for Textile and Plastics Research (TITK) has developed a fully bio-based and biodegradable hot melt adhesive system called Caremelt. The goal was to formulate a functional adhesive system based on renewable raw materials that is characterized by industrial processability, thermal stability, and good adhesive properties. The bio-based polyesters polylactide (PLA) and polybutylene succinate (PBS) were selected as base polymers because they are both thermoplastically processable and certified biodegradable. However, the main challenges were their limited flexibility, high melt viscosity, lower thermal stability, and limited compatibility with conventional resins.

The addition of citric acid esters as plasticizers led to notable changes in the flexibility and rheological behavior of PLA. To increase hydrolytic stability under thermal stress, polymeric carbodiimides were incorporated as additives. These counteract the depolymerization-induced viscosity decrease without impairing biodegradability under real environmental conditions. Measurements show that the viscosity of the stabilized system remains over 80% stable even after one hour of exposure at 160°C – a value comparable to conventional EVA-based systems. Another crucial development step was the choice of extrusion as the processing method instead of traditional reactor mixing. The extrusion process enables significant protection of the biopolymers thanks to short residence times and moderate processing temperatures. At the TITK, a throughput of up to 15 kg/h is currently being achieved using a twin-screw extruder; scaling up to production scale (80 kg/h) is in preparation. The selection of suitable natural resin-based tackifiers (e.g., rosin and terpene resins) proved to be critical, as many commercially available resins are not compatible with biopolymers.

However, through cooperation with resin manufacturers, suitable types were identified and adapted. A project funded by the „Fachagentur Nachwachsende Rohstoffe“ (FNR) is currently transferring the developed system to edgeband applications for the furniture industry. Initial results show promising performance in terms of adhesive strength and processability. Furthermore, Caremelt has been successfully used at ROSENGARTEN animal burials since 2024 to seal biodegradable urns.

Conclusion: The development of Caremelt has led to a bio-based, biodegradable hot melt adhesive system capable of matching the application properties of conventional solutions. Caremelt thus makes a substantial contribution to reducing plastic emissions and replacing petrochemical adhesive components.