Latex Adhesives from Plant Oils for Multisubstrate Applications

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High functionality of new adhesives based on vinyl monomers from plant oils (POBMs) can be controlled by physico-chemical properties of latexes synthesized from POBMs. This research aims to improve the performance and sustainability of POBM-based latex adhesives. Elaborating on this concept, camelina (CMM) and high oleic soybean oil-based (HOSBM) monomers were incorporated into latex copolymers to evaluate adhesives performance on multiple substrates. Life Cycle Assessment (LCA) method was used as a tool to evaluate the environmental performance of the synthesized biobased latex adhesives.

Latex adhesives were synthesized from combination of methyl methacrylate (MMA), butyl acrylate (BA) and POBMs at various monomer ratios. The MMA content in monomer mixture was kept at 55 wt%, while BA (within remaining 45 wt% of the feed) has been gradually replaced by POBM in monomer feed, yielding feasible latex adhesive formulations.

Latex adhesives performance was evaluated using peel testing (ASTM D 1876-08) on the multiple substrates. Presence of HOSBM and CMM fragments in latex copolymers improves adhesives peel strength on most substrates. It was found that performance of POBM-based adhesives can be improved by varying adhesive consumption. It was shown that the incorporation of POBMs into latex copolymers enhances hardness of the latex films upon formation of latex networks.

LCA results demonstrated a positive environmental impact when BA was replaced with POBM leading to a lower toxicity for latex adhesives overall. To address the hotspots pinpointed by conducting the initial LCA several strategies were implemented. The environmental performance of the biobased adhesive was improved by synthesizing POBM using 2-Methyl-tetrahydrofuran – an environmentally friendly alternative of widely used solvent tetrahydrofuran. Additionally, monomer washing step was improved by replacing dichloromethane with hexane, a solvent with a relatively lower environmental impact. Finally, comparison of the several monomers used for synthesis of the adhesive showed that POBM had the lowest negative impact on the environment as well as human health in various categories.

In summary, the obtained experimental data demonstrate plant-oil based latexes environmental benefits and potential as adhesives as well as their utility for usage on multiple substrates.

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