Cottonseed Protein as Wood Adhesives: Use of Promoters to Enhance Adhesive Properties

H. N. Cheng*, Zhongqi He, Michael K. Dowd, and K. Thomas Klasson

Southern Regional Research Center, USDA Agricultural Research Service,
1100 Robert E. Lee Blvd., New Orleans, LA 70124, USA

Because of current interest in reducing the toxicity of formaldehyde resins and increasing the use of agro-based renewable materials, plant proteins are being studied as eco-friendly wood adhesives. Commercial wood adhesives based on soy proteins are now available. In our laboratories, we are using cottonseed protein as an alternative to soy protein in wood adhesive application. In this presentation, a review (and update) will be given on our cottonseed protein adhesives work. Thus, cottonseed protein isolate (CPI) was shown to exhibit equivalent (or better) dry adhesive strength and superior hot water resistance relative to soy protein isolate (SPI). In addition, we evaluated a large number of additives to further improve the protein's adhesive performance. Low-molecular-weight carboxylic acids were shown to be adhesion promoters that enhanced the dry adhesive strength of CPI. Another group of promoters consisted of phosphorus-containing acids that improved both the dry adhesive strength and the hot water resistance of CPI. A third group of promoters comprised selected anionic polysaccharides that enhanced both the dry and hot water adhesive performance of CPI. These promoters worked well with CPI but showed only negligible effects on SPI. Cottonseed protein is known to contain more arginine (11–12%) than does soy protein (7–8%). As arginine carries a net cationic charge at most pH values (up to 12.0), the preferred enhancement of the promoters on CPI (relative to SPI) may be due to the interactions of protein's cationic charges with the anionic charges on the promoters. The enhanced adhesive performance of the CPI-promoter combinations should make cottonseed protein an attractive ingredient in adhesive formulations.