

## **Development of Safe Paper Glue Sticks Using Whey Protein as a Major Ingredient**

Lihua Zhou and Mingruo Guo

Paper glue stick products in the market may contain toxic volatile organic compounds (VOCs). The production of whey, a by-product of cheese making, is continuing to increase. It is urgent to find new applications for whey products such as whey proteins. In this study, safe glue sticks containing whey proteins were developed. A five- factor, three-level orthogonal experiment was designed to optimize the formulation with the amount of binders including whey protein isolate (WPI), polyvinyl alcohol (PVA) and polyvinylacetate (PVAC), the hardener sodium stearate and the moisturizer propylene glycol (PG) as variables. As the major index for evaluating glue stick products, bonding strength of different glue samples were measured. Results showed that WPI, PVA, PVAC and sodium stearate all had significant effects on bonding strength ( $p<0.05$ ). The bonding strength was the highest (59.25 N) for the formulation with 300 g WPI (10%, w/w) solution, 400 g PVA solution (20%, w/w), 300 g PVAC, 70 g sodium stearate and PG each. Different procedures also had significant impact on bonding strength ( $p<0.05$ ). The bonding strength of the paper bonded by the prototype prepared using the high speed blending technique was significantly higher than that of the commercial glue stick ( $p<0.05$ ). Experiments were also conducted to investigate the effects of nano calcium carbonate on bonding strength, however, the effect was not significant ( $p>0.05$ ).