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Study of application of straw fermented residues in urea-formaldehyde resin

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About 700 million tons of straw are produced annually in China. The utilization of agricultural residues as raw material to prepare fuel ethanol has become an important aspect for the second generation biomass energy. In bio-refining process, a large number of straw fermented residues are produced. The main components of fermented residues are cellulose, hemicellulose, lignin, and ash. As the most abundant renewable phenolic compounds in nature, lignin can prepare lignin-based wood adhesives, but it did not achieve real commercial success due to complicated composition, dark color, complex extraction process, and lack of chemical reactivity. Lignin-based adhesives normally require excessively long curing times and higher curing temperatures during composite board production. So far, less than 20% of lignin has been utilized. Large quantities of bio-refinery lignin have been used as fuel for energy recovery. In order to cut down production cost and use lignocellulose more efficiently, the straw fermented residue should be developed and utilized. The use of the residues can reduce the pollution on environment, increase the economic benefit and promote the positive social benefit. The straw fermented residues, without pre-treatment by extraction and purification, were modified by sulfomethylation to increase the reactivity of lignin. Then they were used as additives of urea-formaldehyde resin. The experimental results showed that when the amount of additive is 5%-20%, the adhesive performance is improved significantly. The modified UF has a good application prospect because of its simple preparation process and lower free formaldehyde content.

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Synthesis and characterization of novel biobased thermoplastic polyester elastomers

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Thermoplastic polyester elastomer (TPEE) is a new type of thermoplastic elastomer, which not only combines the characteristics of plastics and rubber, but also has the advantages of easy design and synthesis. Although the commercial growth of TPEE has continuously increased in the past few decades, most of TPEE were chosen PBT as the hard segment, seldom TPEE product concerned about bio-based poly(butylene furandicarboxylate) (PBF) polyester. In our work, a series of novel 2,5-furandicarboxylic acid based copolyesters, poly(butylene furandicarboxylate)-b-poly(tetramethylene glycol) (PBF-PTMG), containing different contents of PTMG were synthesized through a direct esterification melt polycondensation method. We selected the crystallized PBF as hard segment and amorphous PBF and PTMG as soft segments. The copolymers were characterized by 1HNMR, GPC, DSC, POM, XRD, TGA and tensile strength measurements. As the content of PTMG segments increased, the glass transition temperature (T_g), the melting temperature (T_m), the crystallization temperature (T_c) and the crystallization ability of these copolymers decreased gradually, while their crystal structure changed little. For mechanical properties, the copolymers exhibited the characteristics of elastomers, showing good stress at break (16–26 MPa) and outstanding elongation at break (381–832%). The copolymers had greatly enhanced elasticity and flexibility properties as the content of PTMG segments increased, and the thermal annealing enhanced their tensile properties due to the more crystallinity and better regularity of PBF segments. Moreover, the TGA results revealed that PBF-PTMG copolymers had excellent thermal stability. Therefore, as novel bio-based copolymers, they might find applications in thermoplastics as well as elastomers.

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