The Performance of Waterborne Polyurethane Leather Finishing Agent Modified by MMT and OMMT

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Abstract: As an environmental friendly product, waterborne polyurethane (WPU) exhibits the same performance as that of conventional solvent-borne system, but reduces the release of volatile organic compounds (VOC) to atmospheres. Therefore, it has been extensively investigated and used in leather industry. On the other hand, the exploitation and the application of nanocomposites have recently attracted much attention in both research and practical fields since it has excellent mechanical properties, thermal resistance and dimensional stability. As a nanometer layered silicate, montmorillonite can be dispersed in polymer as nanometer size, which significantly improves the physical and mechanical performance, such as superior heat distortion temperature, enhanced flame resistance, increased modulus, reduced thermal expansion coefficient, improved electronic and optical properties, and increased biodegradability rate for biodegradable polymers. In this study, the montmorillonite and organic montmorillonite are used to modify WPU to improve its mechanical properties, wear resistance, heat-resistant stability and flame retardancy of the films.

The organic montmorillonite (OMMT) used in the experiment was prepared through ion-exchange reaction of MMT and cetyltrimethylammonium chloride (CTAC) at 70 °C for 4 hours. A commercial PU leather finishing agent was then modified by emulsion blending with MMT and OMMT at different dosages respectively. The composites were casted into polytetrafluoroethylene （PTFE） molds and dried at 40℃ until constant weight to form WPU/MMT and WPU/OMMT films for the subsequent analyses.

Fourier transform infrared spectrum (FT-IR), X-ray diffraction (XRD) and thermo gravimetric (TG) measurements indicate that the intercalation reaction occurs between MMT and CTAC, so that the d-spacing of MMT increases and the thermal weigh loss of OMMT is larger than that of MMT. When the contents of MMT and OMMT in WPU matrix are below 6.25%, XRD studies show that they are completely exfoliated resulted from the intercalation of PU chains. TG measurements indicate that the thermal decomposition temperatures of WPU/MMT and WPU/OMMT films are increased by 16.3 °C and 15.8 °C, respectively, when the dosages of MMT and OMMT are 6.25%. The mechanical properties tests show that the tensile strength (TS) of the films increases first then decreases with the contents of MMT and OMMT. And when the doses of MMT and OMMT are 10% and 6.25%, TS values reach the maximum, i.e. 275.6% and 448.4%, respectively. Water absorption rate (WAR) and static contact angle (SCA) measurements show that the modified WPU films are more hydrophobic in compare with the pristine WPU. The water vapor permeability (WVP) of the films first increases then decreases as MMT and OMMT increase. The WVP values increase to 150.2% and 282.1%, respectively, when 6.25% of MMT and OMMT were used.

In conclusion, the present studies indicate that OMMT can be prepared by intercalation of CTAC into MMT. Both of MMT and OMMT with appropriate contents improve the thermal resistant stability, mechanical property, water-resistance ability and hygienic properties of WPU films, and OMMT is more effective in comparison with MMT.

Key words: montmorillonite; polyurethane; intercalation; modification; leather finishing agent