Development of Powder-lacquering Procedures for Indoor and Outdoor Wood Surfaces

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Objective

It was the goal of the research project to develop an application procedure for the manufacture of decorative surfaces on wood for use indoors/outdoors by applying powder lacquers of low melting and curing temperatures. Products made of wood are often subjected to a lacquering process, frequently involving solvent-containing lacquers applied in several layers. Therefore, and for meeting statutory environmental requirements, the application of electrostatic powder lacquering as a method of environmentally friendly surface coating is a promising alternative. In the past, no suitable lacquers were available for the powder lacquering of wood and, even less so, for outdoor use. Investigations were carried out into the powder lacquering of solid wood, thermowood, veneered panels and weather-resistant wood-based materials by applying advanced lacquer raw materials and newly developed acrylate/polyester-based formulations.

Investigations

Tests on the further development of the powder-lacquering technology for wood-surface coating were performed on the laboratory coating unit at the IHD and under industrial conditions at a transfer partner's facility. These tests were carried out on wood species suggesting themselves for both indoor and outdoor use. Thereby, the influence of technological and material-relevant parameters on the feasibility of powder lacquering under several technological conditions (pre-treatment, application quantity, melting temperatures, UV parameters) and depending on the wood species used and wood moisture. Pigmented and transparent NT and UV powder lacquers were applied to untreated and primed wood samples. The melting temperatures ranged between 70 °C and 120 °C. The powder lacquer was applied by Corona or Tribo sprayers (Fig. 1), subsequently melted under performance-modified IR radiators and then cured either thermally or by UV radiation, depending on the recipe (Fig. 2).

Fig. 1: Use of a Tribo spray gun for applying powder to veneered samples

Fig. 2: Ceramic-coated IR radiators at IHD's technical laboratory melting the powder lacquer applied to veneer

After coating, selected surface properties were characterised. They included a visual check for faults following a defined evaluation scheme, resistance to chemicals, scratch resistance and adhesive strength. Also, selected samples were subjected to a 3,000-hour weathering test in a Xenon test device. The results obtained were compared to similar requirements for high-pressure laminates (HPL) for outdoor application acc. to EN 438-6.

Results

Correlations could be shown between the electrical properties of the substrates, the behaviour of the powder lacquer during application and the quality of the powder-lacquered surface. The results of the measurements of wood moisture and of selected electrical properties (surface resistance) revealed the correlation between both parameters and their impact on the electrostatic lacquerability of the wood samples with powder lacquers. For some wood species, (thermowood, beech, also maple and beech veneers), it was possible to determine settings in laboratory tests in which surface qualities could be achieved that passed "good" visually. The coating results from the laboratory proved the principal feasibility, but also optimisation potential was detected regarding the reduction of gas emissions during the melting and curing of the lacquer.

Tests on primed, moisture-resistant wood-based materials (plywood, fibreboards) were also promising. The application of temperature-resistant priming resulted in the closing of the surface of the substrate. This prevented gas emissions. At OEM Nu Tech, Australia, sample panels of various materials for outdoor use could be powder-lacquered flawlessly under industrial conditions. The IHD laboratory succeeded in doing so by using thermowood. These variants were used for comparing them regarding their resistance to weathering to the long-term tests of liquid lacquers for outdoor use in Australia. After 3,000 hours of exposure to weather, no differences or better properties occurred on several powder-lacquered, primed wood-based materials and thermowood variants as compared to the liquid lacquers. Regarding weather-resistant HPL, the requirements of the best HPL quality class could be met for the primed and powder-lacquered wood-based materials as well as white tones under investigation after 3,000 hours of artificial weather exposure. Thus it was shown that surfaces of sound weather resistance could be achieved by applying powder lacquer to thermowood and moisture-resistant wood-based materials (plywood, fibreboards). Interesting new applications for wood or wood-based materials for outdoor use, e.g., façades, claddings or fencing, might thus become feasible.