Polyester powder coating of wood and wood composites with atmospheric pressure plasma jet (AAPJ)

Robert Köhler[1], Philipp Sauerbier[2], Lars ten Bosch[1], Holger Militz[2] and **Wolfgang Viöl[1,3]**
[1]HAWK University of Applied Sciences and Arts, Germany
[2]University of Gottingen, Germany
[3]Fraunhofer Institute for Surface Engineering and Thin Films, Germany

Introduction: Powder coating processes represent an alternative to conventional coating methods. Especially, the possibility of total omission of all kinds of additives comprising volatile organic compounds or organic solvents renders this process environmentally friendly. Furthermore, it omits the need for special substrate properties such as electrical conductivity. The electrical conductivity is particularly important for standard powder coating processes, as the powder adheres to the substrate due to different electric potential, is applied to the powder-substrate-system. To charge a powder, commonly a corona discharge is used and the powder is sprayed onto the grounded substrate. In case of wood and wood composites, the limited electrical conductivity constitutes a disadvantage. To coat a non-conductive and porous substrate like the beforehand mentioned ones a pre-heating or priming process using an electrically conductive wet lacquer is usually necessary.

Materials & Methods: In this study, an APPJ has used to applicate a polyester powder (Interpon 610 MZ013GF; D50 ≈ 50 µm) (Akzo Nobel Powder Coatings GmbH, Arnsberg, Germany) to wooden and wood-like substrates. The powder material is based on iso- and terephthalic acid and was deposited using the effluent plasma zone of the source in use. The coating substrates are European beech wood (Fagus sylvatica L.), Grand fir (Abies grandis lindl) and medium density fiberboard (MDF). After the plasma treatment, the coating was annealed in an oven at 180°C for 10 min. The coated samples were examined via X-ray photoelectron spectroscopy (XPS) and Fourier-transform infrared spectroscopy (FTIR) to determine possible chemical decomposition of the applied polyester during the plasma coating process. In addition, the resulting layer thicknesses of the samples were determined using laser scanning microscopy (LSM). Adhesive strength investigations were carried out using dolly test based on ASTM D 4541-02 and DIN EN ISO 4624:2016-08

Results: The applied powder material exhibited no chemical changes due to plasma process and the adhesive strength of the layers met practical requirements of >1 MPa. The presented atmospheric pressure plasma coating process for wood and wood-based materials could represent an interesting alternative to existing wood coating methods.

Biography

Robert Köhler is pursuing his PhD at University in Göttingen. His thesis is concerned with "The weathering resistance and the catalytic degradation of VOC`s of plasma particle-modified wood and wood materials". Currently, he is a research scientist at the project "PLaNaWood2- functionalization of wood and wood materials" with financial support from the German Federal Ministry of education and research. He has published one poster presentation and one patent.

robert.koehler@hawk-hhg.de

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