Nanotechnology in the Service of Wood Protection

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Wood is a reemerging construction material with the advantage of being fully degradable. Although being the most contrasting property towards other materials being, it is also the reason why wood is protected from these natural decaying processes.

One of the newest wood preservatives contains its biocidal compound as a solid in contrary to previously solubilized agents. In view of the complex material wood and its microstructural dimensions, it is unclear what ideal properties are required for particle size and surface property to enable nanoparticle as effective wood preservative. Ideally, a wood preservative enters wood deeply and displays low leaching to ensure prolonged protection.

To explore these ideal properties, model nanoparticles in various sizes and surface functionalization were synthesized and tested in impregnation studies on pine and beech wood. Silica nanoparticles were selected as model particle, which were produced in defined sizes with narrow size distributions and various surface-functionalities. These particles were used to investigate the relationship between impregnation depth and particle properties.

In a second part, the connection between particle size and leaching behavior was assessed in leaching experiments on wood samples. In order to quantify the amount of silica nanoparticles released, a new non-toxic method to digest the particles was developed, which allowed quantification per ICP-OES. Additionally, the applicability of the method was verified by digesting real, silica containing food products. The presented results show that nanoparticles can certainly be used as wood preservatives, but impregnation and leaching are strongly dependent on particle size and surface functionalization.

Jury:
Prof. Dr. Alke Fink (thesis supervisor)
Prof. Dr. Marco Lattuada (internal co-examiner)
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Prof. Dr. Michael Mayer (president of the jury)