Gone with the wind

Waterproofing agents that contain copper salts protect wood against rot and wood-destroying fungi. They have been used all over the world for more than a century. Compounds with copper nanoparticles have been on the market in the USA since 2006 and thousands of tons of these sprays are used every year. But what happens when this timber is recycled or does eventually rot?

Children's playgrounds, walkways, fences, poles and wooden pylons along the roadside all need to be protected against wood-destroying fungi. There is only one substance that combats soft rotting fungi from the soil: copper. Back in the early days, toxic solutions such as copper vitriol, chromated copper arsenate and copper chrome boron were used. Meanwhile, wood is waterproofed with copper carbonate or copper citrate (the copper salt of citric acid), which inhibits the metabolism of fungi but is harmless for mammals. Various wood preservatives containing copper carbonate particles that measure between one nanometer and 25 micrometers have been on the market in the USA since 2006. According to the manufacturers, the particles soak deeper into the wood during waterproofing than conventional liquid copper salt solutions, which is why the protection they offer lasts longer. The manufacturers would now like to expand their business on the European market, where refractory types of wood, such as Norway spruce (Picea abies) or Swiss pine (Abies alba), are primarily processed.

The problem: there are also wood-destroying fungi that are copper-resistant. These fungi from the pore sponge family (such as the Antrodia, Postia and Serpula species) store the copper in their cells and shut it away, which begs a question: can the fungi also store copper nanoparticles, multiply and eventually scatter the nanoparticles in the environment in their spores? After all, humans breathe in between 20,000 and 30,000 fungal spores every single day. Empa researcher Chiara Civardi set about investigating this hypothesis with support from Peter Wick, a specialist in nanoparticles, and Francis Schwarze, an expert in wood fungi.

Their first move was to treat spruce and fir wood with the novel waterproofing agents and incubate it with fungi. The researchers then examined questions such as: does the fungus absorb the smallest particles, which are one nanometer in size? Or only the larger microparticles? Do the particles actually penetrate the wood more effectively and, if so, does this increase the wood's durability? The team's next move was to follow the "fate" of the copper particles absorbed by the fungus. How quickly do the particles dissolve in the fungal cells? Do they get into the spores? Do they leave the waterproofed wood and enter the air, soil or even the food chain? //

Wooden telephone poles are still a common sight, especially in the US. As they are meant to last for decades, they are waterproofed with copper nanoparticles, which are supposed to keep rot fungi from the soil at bay. But where do these nanoparticles end up when the wood does eventually rot?