Spotting weaknesses in solid wood

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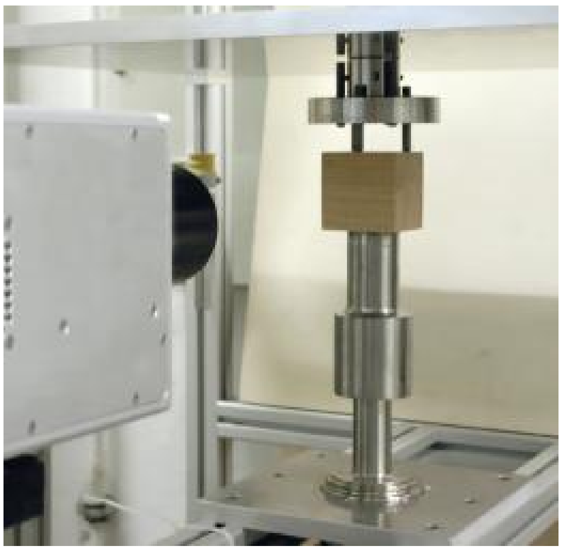

The ultrasound agitator causes the wood to vibrate, which generates frictional heat wherever there are cracks. A thermal imaging camera shows these defects up. (© Fraunhofer WKI)

Is there a hairline crack in the oak table? Was the window frame glued badly? Ultrasound thermography can reliably identify material defects during the production of wooden items. This allows rejects to be caught quickly and eliminated, and faulty goods to be repaired in good time.

People who buy an expensive solid wooden table or wardrobe want to be certain that their new piece of furniture is absolutely faultless. Pianos – whether upright or grand – can only produce an opulent tone if their soundboard, bridge and keyboard are made of high-quality materials.

And wood that is free of imperfections is also essential in house building and window construction: load-bearing wooden beams need to be of the highest quality, as even the smallest crack can cause them to fail.

Research scientists from the Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut, WKI in Braunschweig are able to pinpoint defects in wood that cannot be seen with the naked eye. Using high-power ultrasound thermography they can detect longitudinal and transverse cracks, gluing errors, delaminations and black knots. To do this they vibrate the wooden item using a sonotrode, or ultrasound agitator, at a frequency of 20 kHz – in other words, 20,000 times a second. Where there are defects, the different parts of the material rub against each other and produce heat. This heat at the defect's extremities is picked up by a thermal imaging camera connected to a monitor; in the case of hairline cracks, frictional heat can be seen along the length of the crack as well. High-power ultrasound thermography even allows the researchers to probe beneath the surface to uncover dowels that have not been glued and defects hidden under coatings – something that today's much less reliable testing methods, such as mechanical materials testing or electrical measuring, are simply not able to do.

"We can spot the imperfections in raw timber. That is crucial for rejecting defective wood before time and money have been invested in processing it," says physicist Peter Meinlschmidt at the WKI. Whether the wood in question is oak, walnut or beech is not important, and neither is the condition of the wood ; defects in damp parts show up on the thermal imaging camera too. The depth to which the wood can be analyzed depends on its thermal conductivity, but up to 20 millimeters are possible. "Our process is especially suited for finding defects in high-quality solid wooden parts and window frame squares and to detect badly glued joints. It's a non-destructive testing method. Applying the ultrasound agitator does leave small pressure marks though – but these aren't an issue when you're dealing with raw timber," explains

Meinlschmidt. The researchers have even managed to use high-energy ultrasound thermography to detect cracks in ceramics and glass. In laboratory tests, they were able to pinpoint defects in ceramic floor tiles and in glass mouthwash bottles. “In ceramics and glass we can spot defects that are up to 30 centimeters away from the sonotrode,” says the research scientist. A demonstrator of the ultrasound generator with thermal imaging camera has already been built.

Provided by Fraunhofer-Gesellschaft

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