

# Ultrasonic propagation properties of red oak

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## Abstract

This work was motivated by the need to identify ultrasonic parameters that exhibit the greatest sensitivity to wood degradation as the result of bacterial infection; the so-called “wetwood” condition. Wetwood infection creates microscopic changes to the wood structure, which then surface as checks and shake following drying. Slower drying schedules can often mitigate the appearance of these drying flaws, however, so there is value in being able to identify problem boards prior to the drying stage.

In order to generate baseline ultrasonic property data on red oak, a series of drying experiments was conducted to develop populations of “normal” and “bacterial damaged” wood. For these studies, a total of 30 red oak samples was taken from boards harvested from two different U.S. geographical regions (Wisconsin and Virginia). We describe the ultrasonic analysis of red

oak over the frequency range from 100 to 500 kHz. Although numerous ultrasonic studies have been conducted using p-waves (longitudinal), very few experiments have been reported that combine both p-wave and s-wave (shear) measurements. To separate the different ultrasonic modes, all ultrasonic data was acquired using highly damped transducers.

By making repeat measurements at several stages during the drying cycle, we were able to quantify the relationships among various ultrasonic parameters and other wood properties such as moisture content, wood macrostructure, geographical origin, and bacterial damage. Our measurement matrix included ultrasonic velocities, attenuation, and frequency dependent attenuation for all ultrasonic modes. While none of the velocity modes showed any sensitivity to bacterial damage, several attenuation modes exhibited a substantial increase that was attributed to bacterial damage. This presentation described the test methods, showed data for all ultrasonic modes, and discussed the potential for using attenuation as a nondestructive method to determine the extent of bacterial infection in oak.

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