Shrinkage processes in standard-size Norway spruce wood specimens with different vulnerability to cavitation.

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Abstract: The aim of this study was to observe the radial shrinkage of Norway spruce [Picea abies (L. Karst.)] trunkwood specimens with different hydraulic vulnerability to cavitation from the fully saturated state until the overall shrinkage reaches a stable value, and to relate wood shrinkage and recovery from shrinkage to cavitations of the water column inside the tracheids. Radial shrinkage processes in standard-size sapwood specimens (6 mm x 6 mm x 100 mm; radial, tangential and longitudinal) obtained at different positions within the trunk, representing different ages of the cambium, were compared. Cavitation events were assessed by acoustic emission (AE) testing, hydraulic vulnerability by the AE feature analysis and shrinkage was calculated from the changes in contact pressure between the 150 kHz AE transducer and the wood specimen. Two shrinkage processes were observed in both juvenile (annual rings 1 and 2) and mature wood (annual rings 17-19), the first one termed tension shrinkage and the second one cell wall shrinkage process, which started when most of the tracheids reached relative water contents below fiber saturation. Maximum tension shrinkage coincided with high-energy AEs, and the periods of shrinkage recovery could be traced to tension release due to cavitation. Juvenile wood, which was less sensitive to cavitation, had lower earlywood tracheid diameters and was less prone to deformation due to tensile strain than mature wood, showed a lower cell wall shrinkage, and thus total shrinkage. Earlywood lumen diameters and maximum tension shrinkage were strongly positively related to each other, meaning that bigger tracheids are more prone to deformation at the same water tension than the smaller tracheids.

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