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Broadband elastic scattering by fiberglass spherical shells and plates measured in a water tank: acoustic inversion and wave analysis

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Spherical shells and plane plates made of different types of fiberglass (either random or textured) were measured in the backscatter direction, suspended in a water tank in a broadband frequency range between 30 and 350 kHz. The range of ka for the spheres was approximately 8 to 90, with the fd range for the plates approximately 0.15 to 1.75 MHz*m. The aim of the study was to investigate the effects of the fiber type on the object signature, as the frequency and the type of fiber layers vary. Inversion of the material parameters was conducted on the basis of the object's temporal echo. In particular, the estimate of material loss is crucial to determine at what frequency elasticity becomes irrelevant to the object's global response. The spherical shells were measured either void or filled with different materials (liquid and solid) in order to evaluate the contribution of the shell-borne elastic waves with respect to sound scattered from the interior of the object. Elastic wave analysis and analytical modeling tools were used to support the physical interpretation of the measured responses from the different objects.