

Acoustic wave incidence on a multilayer medium containing a bubbly fluid layer

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Abstract

© 2017, Pleiades Publishing, Ltd. The problem of acoustic wave reflection and transmission through a multilayer medium containing a bubbly fluid layer is considered. For the water-water with air bubbles-water model the wave reflection and transmission coefficients are calculated and compared with the experimental data. The problem parameters, at which these coefficients take extremum values, are determined. The influence of vapor within the bubbles on the acoustic wave transmission through a layer of a fluid with the vapor-gas bubbles is shown.

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Keywords

acoustic waves, bubbly fluid, multilayer media, reflection and transmission coefficients

References

- [1] V.Sh. Shagapov and V.V. Sarapulova, "Distinctive Features of Sound Refraction and Reflection on the Boundary of a Bubbly Fluid," *Akust. Zh.* 61, 40 (2015).
- [2] V.A. Gusev and O.V. Rudenko, "Nonlinear Sound in a Layer of Gas-Saturated Sediments," *Akust. Zh.* 61, 169 (2015).
- [3] V.A. Grigor'ev, A.A. Lun'kov, and V.G. Petnikov, "Sound Decay in Shallow-Water Aquatoria with Gas-Saturated Bottom," *Akust. Zh.* 61, 90 (2015).
- [4] V. Leroy, A. Strybulevych, M. Lanoy, F. Lemoult, A. Tourin, and J.H. Page, "Superabsorption of Acoustic Waves with Bubble Metascreens," *Phys. Rev. B* 91, 020301 (2015).
- [5] O.B. Zel'manskii, S.N. Petrov, and A.A. Kazeka, "Air-Bubble Panel to Prevent the Information Leakage by Technical Channels," *Reports Byelorussian State Univ. Informatics Radioelectronics* 78 (8), 30 (2013).
- [6] A. Baranowska, "Theoretical Studies of Nonlinear Generation Efficiency in a Bubble Layer," *Arch. Acoustics* 37, 287 (2012).
- [7] V. Leroy, A. Strybulevych, M.G. Scanlon, and J.H. Page, "Transmission of Ultrasound through a Single Layer of Bubbles," *J. Eur. Phys. E* 29, 123 (2009).
- [8] V. Leroy, A. Strybulevych, J.H. Page, and M.G. Scanlon, "Sound Velocity and Attenuation in Bubbly Gels Measured by Transmission Experiments," *J. Acoust. Soc. Amer.* 123, 1931 (2008).
- [9] V.Sh. Shagapov, I.K. Gimaltdinov, N.S. Khabeev, and S.S. Bailey, "Acoustic Waves in a Liquid with a Bubble Screen," *ShockWaves* 13, 49 (2003).
- [10] K. Lee, B.K. Choi, and S.W. Yoon, "Acoustic Pressure Reflection Coefficients of a Subsurface Bubble Layer in Water," *J. Korean Phys. Soc.* 40, 256 (2002).
- [11] T.M. Tien, "Sound Propagation through a Bubble Screen of Finite Gas-Volume Fraction," Master Thesis, Tainan, Taiwan, National Cheng Kung Univ. (2001).
- [12] O.A. Druzhinin, L.A. Ostrovsky, and A. Prosperetti, "Low-Frequency Acoustic Wave Generation in a Resonant Bubble Layer," *J. Acoust. Soc. Amer.* 100, 3570 (1996).

- [13] R.I. Nigmatulin, D.A. Gubaidullin, and A.A. Nikiforov, "Dynamics of Pulsed Waves in Bubbly Fluids. Comparison of Theory with Experiment," *Dokl. Ross. Akad. Nauk* 456, 662 (2014).
- [14] R.I. Nigmatulin, *Dynamics of Multiphase Media. Part 1* [in Russian], Nauka, Moscow (1987).
- [15] V.E. Nakoryakov, B.G. Pokusaev, and I.R. Shreiber, *Wave Dynamics of Gas-and Vapor-Liquid Media* [in Russian], Energoatomizdat, Moscow (1990).
- [16] A.Yu. Varaksin, "Hydrogasdynamics and Thermophysics of Two-Phase Flows: Problems and Advances," *Teplofiz. Vys. Temp.* 51, 421 (2013).
- [17] L.M. Brekhovskikh and O.A. Godin, *Acoustics of Layered Media* [in Russian], Nauka, Moscow (1989).
- [18] D.A. Gubaidullin and Yu.V. Fedorov, "SoundWaves in a Liquid with Polydisperse Vapor-Gas Bubbles," *Acoustical Physics* 62, 179 (2016).
- [19] A.G. Petrov, *Analytical Fluid Dynamics* [in Russian], Fizmatlit, Moscow (2010).
- [20] S.N. Gurbatova and O.V. Rudenko, *Acoustics in Problems* [in Russian], Fizmatlit, Moscow (1996).
- [21] D.A. Gubaidullin and Yu.V. Fedorov, "Sound Waves in Liquids with Polydisperse Vapor-Gas and Gas Bubbles," *Fluid Dynamics* 50 (1), 61 (2015).
- [22] D. Fuster and F. Montel, "Mass Transfer Effects on LinearWave Propagation in Diluted Bubbly Liquids," *J. Fluid Mech.* 779, 598 (2015).
- [23] A. Prosperetti, "The Speed of Sound in a Gas-Vapor Bubbly Liquid," *Interface Focus* 5, 20140024 (2015).