applied sciences

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Editorial

Acoustic Properties of Absorbing Materials

Edoardo Alessio Piana [1,*], Paolo Bonfiglio [2] and Monika Rychtarikova [3]

1 Applied Acoustics Laboratory, University of Brescia, 25123 Brescia, Italy
2 Materiacustica Srl, Spin-Off of the University of Ferrara, 44121 Ferrara, Italy; paolo.bonfiglio@materiacustica.it
3 Faculty of Architecture, Katholieke Universiteit Leuven, 3000 Leuven, Belgium; monika.rychtarikova@kuleuven.be
* Correspondence: edoardo.piana@unibs.it

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Citation: Piana, E.A.; Bonfiglio, P.; Rychtarikova, M. Acoustic Properties of Absorbing Materials. *Appl. Sci.* **2022**, *12*, 4446. https://doi.org/10.3390/app12094446

Received: 11 March 2022
Accepted: 26 April 2022
Published: 28 April 2022

Overview of the Articles in This Special Issue

Thanks to the progress made in materials research and to the introduction of innovative manufacturing technologies, a wide range of sound-absorbing elements are currently available to adjust the acoustic features of an environment. Nowadays, performance is only one of the required specifications, together with environmental compatibility, longevity, and affordable cost. The Special Issue, "Acoustic Properties of Sound-Absorbing Materials", collected the most recent advances in the broad-spectrum characterization of sound-absorbing materials used in civil, industrial, and tertiary applications, by means of experimental, numerical, or theoretical studies. Among many submissions, 11 articles were accepted and published.

The first published paper is an investigation by Dengke Li et al. [1] about the improvement of the sound absorption characteristics of a porous material coupled with a spherical structure. The aim was to improve the sound absorption of a specimen at relatively low frequencies, without increasing its thickness and keeping a good mid- to high-frequency sound absorption. Such behavior was obtained introducing a hollow perforated spherical structure, featuring extended tubes in a foam. The overall thickness of the specimen was less than 1/28 of the wavelength. Good agreements were observed between the simulated and the experimental results. The second paper, by Yaw-Shyan Tsay et al. [2], concerns the development of a resonant membrane panel absorber. The study focused on the improvement in acoustic quality parameters for auditoria, and showed how it is possible to manufacture a prototype, which proved to be particularly effective below 800 Hz. The tests were carried out during an experimental campaign, carried out in the Ge-Chi Hall of the National Cheng Kung University. The third paper, authored by Hasina Begum and Kirill Horoshenkov [3], studied the acoustical properties of fiberglass blankets impregnated with silica aerogel. The use of aerogel with fibrous blankets allows one to improve both acoustic absorption and thermal insulation performances. Since the mechanism influencing the acoustic performance of aerogel-impregnated blankets is still unclear and there is a lack of studies attempting to explain the measured absorption properties with a valid mathematical model, this paper contributed to this knowledge gap through a simulation that predicts the measured complex acoustic reflection coefficient of aerogel blankets with different filling ratios. The fourth contribution to the Special Issue, by Shtrepi et al. [4], is an experimental characterization of the sound absorption performances of "normal weight" and "lightweight" porous concrete aggregates. For each concrete type, three panel thicknesses were tested. Moreover, different mounting conditions were investigated, considering the combination of single panels in multiple layers, adding an air gap between the panel and the backing structure, and inserting a layer of rock wool in the air gap. The results show weighted absorption coefficients in the range of 0.30 to 0.75, depending on the thickness and mounting conditions. In the context of recycling materials that reached their end of life, but can still be used for other applications, Neri et al. [5] studied the sound absorption characteristics of low-cost insulating elements made of non-conventional materials. Given that household materials at their end of life (EoLHM) are free of costs and available also to the more disadvantaged population, they can be used to build acoustic panels for such contexts. The acoustic properties of EoLHM, such as cardboard, egg cartons, clothes, metal elements and combinations of them, are investigated by means of a four-microphones impedance tube. The measured sound absorption coefficient and transmission loss showed that EoLHM can be used for manufacturing acoustic panels. However, since none of the analyzed materials show good absorbing and insulating properties at the same time, EoLHM must be wisely selected. The sixth article is authored by Zihao Li et al. [6] and proposes the application of a technique based on semi-active structure of a shunted loudspeaker and a fully exhaustive backtracking algorithm, in order to obtain an optimized sound absorption in a specific frequency range. In the seventh article, Levi et al. [7] investigated the acoustic and non-acoustic properties of steelwork by-products. The inverse method adopted in the paper is founded on the Johnson–Champoux–Allard (JCA) model and uses a standard minimization procedure, based on the difference between the experimentally obtained sound absorption coefficients and the absorption coefficients predicted by the JCA model. The eighth paper, by Bettarello et al. [8], investigates the sound insulation properties of timber floors. Such structures must be properly designed in order to meet the requirements of indoor comfort and comply with current building regulations. This work presents the results obtained by in-field measurements developed using different sound sources on Cross-Laminated Timber floors (tapping machine, impact rubber ball, and airborne dodecahedral speaker), changing different sound insulation layering conditions (suspended ceiling and floating floors). The results clearly show that there is no available analytical model able to correctly predict the acoustic performances of Cross-Laminated Timber floors. In the ninth paper, Xin Li et al. [9] studied the low-frequency sound absorption of a Perforated Plate with Stepwise Apertures. Such panels can match the acoustic resistance of air and moderately increase the acoustic mass, especially at low frequencies. Some prototypes made by 3D printing technology were tested in an impedance tube. The measured results agree well with the predictions. The tenth paper, by Urban et al. [10], focuses on the determination of the acoustic properties (sound absorption and transmission coefficients) of membrane types of specimens. The characterization was made by means of a combination of incident plane wave sound pressure and membrane surface displacement information, measuring the sound pressure with a microphone and the membrane displacement by means of a laser Doppler vibrometer. The proposed method was compared with the conventional methods for sound transmission loss and absorption measurements in an impedance tube, both numerically and experimentally. Subsequently, the proposed method was tested in a laboratory environment. The last paper in the Special Issue is authored by Lamberto Tronchin et al. [11], and compares different methodologies that can be applied for the evaluation of the sound diffusion inside a room. This article considers the surface-scattering effects and the diffusion phenomena related to some types of MDF and plywood panels, tested by disposing the wells horizontally and vertically. The test results, undertaken inside a semi-reverberant room and inside a large reverberant room, were compared to highlight the success and the failure of the different measuring methodologies adopted.

Author Contributions: Conceptualization, E.A.P., P.B. and M.R.; writing—original draft preparation, E.A.P., P.B. and M.R.; writing—review and editing, E.A.P., P.B. and M.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: We gratefully thank all authors, who made this Special Issue a success.

Conflicts of Interest: The authors declare no conflict of interest.

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