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HABILITATION THESIS

- ABSTRACT -

**Development of new materials and structures with sound-
absorbing/sound-insulating properties in the context of the
circular economy**

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The present habilitation thesis, titled *"Development of New Materials and Structures with Sound-Absorbing/Sound-Insulating Properties in the Context of the Circular Economy"*, synthesizes my scientific, professional, and pedagogical activity carried out after obtaining the doctoral degree in 2012.

The work reflects a constant evolution in the field of *Environmental Engineering*, emphasizing the transformation of waste into technological resources and the development of innovative solutions for the acoustic, thermal, and ecological protection of the built environment.

The habilitation thesis is structured into three main parts, designed to provide an integrated image of my professional trajectory, scientific achievements, and future research directions.

Part I – Professional and Academic Achievements documents my teaching activity, the courses taught, my involvement in the ethical and professional training of students and doctoral candidates, as well as the development of teaching and applied research laboratory infrastructure. This section highlights how pedagogical and managerial experience correlates with progress in the field of Environmental Engineering.

My professional evolution took place at the Technical University of Cluj-Napoca, where I progressed through all academic ranks to the position of Associate Professor. My scientific activity is reflected in the volume and quality of my academic output, international recognition of the results, and active involvement in the scientific community. The research conducted led to the publication of 72 articles in specialized journals, of which 27 are ISI-indexed, accumulating over 900 citations in ISI and BDI indexed journals. The portfolio also includes 4 books, 4 patents, and over 55 awards and distinctions obtained at national and international invention exhibitions, reflecting the applied value of the research.

Involvement in national projects, both as a director and as a member of research teams, allowed for the extension of the initial themes, the integration of results into concrete applications (prototypes, publications, patents), and the development of experimental infrastructure within the Department of Environmental Engineering and Sustainable Development Entrepreneurship.

An essential dimension of my academic maturity is the active involvement in training new generations of researchers. I am a member of the doctoral guidance committees in the field of Environmental Engineering, as well as in other fields, at the National University of Science and Technology POLITEHNICA Bucharest and the University of Agricultural Sciences and Veterinary Medicine (USAMV) Cluj-Napoca. Furthermore, I have served as a specialist reviewer in committees for the analysis and public defense of doctoral theses, an experience that provided me with a critical perspective on the standards of excellence in research.

Academic activity also included contributions to strategic university processes, such as collecting and reporting data for international rankings (Times Higher Education – World University Rankings) and for the National Council for Higher Education Financing (CNFIS). I participated in organizing scientific events, workshops, communication sessions, and educational workshops dedicated to environmental protection and recycling, contributing to the dissemination of knowledge to students and pupils.

Through this integrated activity—research, dissemination, scientific evaluation, and institutional contribution—a mature academic profile has been consolidated, recognized nationally and internationally, with an impact on the scientific, educational, and strategic levels.

Part II – Scientific Achievements details original research in the development of sound-absorbing and sound-insulating materials and structures, with an emphasis on the high-value recovery of by-products, as well as the design, manufacturing, and performance evaluation of acoustic panels. This section is organized into three chapters, which highlight the applied methodologies, the results obtained, and interdisciplinary contributions.

The chapter *Research on the development of new sound-absorbing materials through the high-value recovery of by-products* presents the study of materials obtained from sawdust, polyurethane foam waste, spent coffee grounds, sheep wool, and textile waste, emphasizing processing methods and the characterization of acoustic properties. The research demonstrates a sustainable and innovative approach, validating the potential of secondary resources for producing high-performance sound-absorbing composite materials and contributing to the promotion of circular economy principles.

The chapter *Research on the development of sound-absorbing/sound-insulated structures* focuses on the design, manufacturing, and evaluation of acoustic panels, including the determination of the sound reduction index. This section illustrates the transfer of research from materials to concrete technological applications, demonstrating practical relevance and the capacity to create acoustic panels.

The chapter *Related directions and interdisciplinary contributions* extend the research into related fields, such as the acoustics of special spaces, complex waste management, and the integration of innovative solutions in multidisciplinary contexts. This section highlights the interdisciplinary nature of the activity, showing how Environmental Engineering intersects with materials engineering, applied biology, acoustics, and civil engineering to generate sustainable solutions with social and industrial impact.

The addressed themes support national and international strategies for the circular economy, pollution reduction, and the sustainable development of the built environment, aligning with European directives on waste management, noise pollution, and innovation in eco-friendly materials.

Part III – Career Evolution and Development Plans outline future research perspectives and professional objectives, including the modeling of sound-absorbing properties, the development of acoustic and "green" panels, the design of noise barriers, IoT integration, and the use of nanofibers. This section emphasizes the importance of developing the research school in Environmental Engineering, consolidating commitment to innovation and sustainable development at national and international levels.

At the end of the work, the final conclusions and original contributions are presented, synthesizing the contributions of the thesis and their scientific and applied relevance, as well as the bibliographic list, which documents the sources used and the scientific framework of the research presented.

By continuing and developing the research directions addressed, this thesis opens perspectives for deepening and applying innovative solutions based on the recovery of secondary resources, consolidating the contribution to the development of sustainable materials and structures and to the progress of Environmental Engineering in the context of current challenges.