MINISTRY OF EDUCATION AND RESEARCH

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# HABILITATION THESIS
## – ABSTRACT –

## Sustainable methods for remediation of contaminated soils

**Assoc. Prof. Eng. Ioana Monica SUR, PhD**
**Faculty of Materials and Environmental Engineering**
**Technical University of Cluj-Napoca**

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str. Memorandumului nr. 28, 400114 Cluj-Napoca, România
tel. +40-264-401200, fax +40-264-592055, secretariat tel. +40-264-202209, fax +40-264-202280
www.utcluj.ro

# Contents

The habilitation thesis presents the author's professional career concisely, highlighting the evolution and development of her academic, scientific, and professional career. The interdisciplinary nature of the topic allowed the integration of the results obtained over the years into the thesis, offering a broad perspective on the research carried out and their inclusion in the field of environmental engineering.

This habilitation thesis highlights the author's contributions in the field of contaminated soil remediation, through a series of studies and research focused on innovative and sustainable methods. The habilitation thesis "Sustainable methods for remediation of contaminated soils" is structured in 3 main parts.

*The first part,* entitled Professional and Academic Achievements, provides a synthesis of academic and professional achievements, highlighting experiences in university teaching, the development of study programs, and involvement in the training of new generations of specialists, as well as through the activities of promoting study programs, academic counseling and coordination of master's programs, while also contributing to the organization of admission and competitions for students in the field of Environmental Protection (SIMTECH).

The author has demonstrated a constant commitment to research and science, significantly contributing to the field of environmental engineering, through rich scientific activity. The impact of her work is reflected in her publications: 1 book, 97 articles published in internationally indexed journals, of which 36 in ISI journals and a patent, respectively through participation in national and international conferences and through medals obtained at invention salons in Romania and abroad (Croatia, Saudi Arabia, Japan). Her work has accumulated approximately 200 ISI and BDI citations. In addition to publications, the author has been a project director and member of national and international research teams. She has played an active role in mentoring future researchers and participating in the advisory committee for doctoral students in the field of environmental engineering. She has also been involved in organizing scientific events and has contributed as a reviewer for international journals and conferences.

Her teaching career combines harmoniously with research activity and involvement in institutional processes, such as the Human Resources for Research (HRS4R) assessment and CNFIS reporting at the level of the Department of Environmental Engineering and Sustainable Development Entrepreneurship.

*The second part*, entitled "Scientific Achievements", highlights the themes of interest and research directions pursued throughout his career, organized into four chapters and focuses on two major directions: the decontamination of soils contaminated with metals and the decontamination of soils affected by hydrocarbons, addressing and developing several innovative and sustainable methods for the decontamination and remediation of affected soils.

The identification and application of effective solutions for the remediation of contaminated soils is a priority both at a national and international level, requiring an interdisciplinary approach based on advanced scientific research.

*Chapter 1* explores *soil decontamination through bioleaching.* Bioleaching is a biological process used to mobilize and remove heavy metals from soil, based on the activity of microorganisms. This technique promises an ecological alternative to conventional chemical methods and is analyzed through a series of experiments to highlight the optimal parameters and obtain the highest possible remediation yields.

*Chapter 2* is dedicated to the *extraction of metals from soil by washing*, a physico-chemical method used to remove contaminants by using appropriate washing agents. Research conducted in this field aims to optimize the process parameters to maximize the efficiency of decontamination and reduce the impact on soil properties.

*Chapter 3* presents the *phytoremediation of metal-contaminated soils.* The work analyzes the potential of some plant species, capable of accumulating, stabilizing, or degrading metal contaminants. Phytoremediation is an environmentally friendly technique, and the studies presented highlight the selection of suitable species, the mechanisms involved, and the factors influencing the efficiency of the process.

*Chapter 4* focuses on *ex-situ bioremediation of soils affected by petroleum hydrocarbon pollution*. Ex-situ bioremediation is a method based on the use of microorganisms to degrade polluting organic compounds. The paper presents strategies for optimizing the ex-situ bioremediation process both at the laboratory and pilot scale levels.

*The third part* presents the academic career development plan, highlighting future research directions, teaching objectives, expected contributions to the advancement of knowledge in soil remediation and environmental protection, and the consolidation of the scientific path. The bibliography is presented at the end of the paper.

Future research activity will continue in the directions already explored, consolidating the results obtained so far and expanding the area of investigation toward new scientific perspectives. This will involve deepening studies on soil decontamination processes, optimizing existing technologies, developing innovative ecological remediation methods, integrating advanced materials into soil treatment solutions, and applying circular economy principles in resource management.

The author will also aim to expand interdisciplinary collaborations, both at national and international levels, to facilitate the exchange of best practices and access to advanced research infrastructures. Through these efforts, the main objective is to significantly contribute to scientific progress and the application of innovative solutions in environmental engineering.