



Universitatea  
Transilvania  
din Braşov

# HABILITATION THESIS

## SUMMARY

Title: *Research on energy management and conversion in mechanical and thermo-chemical systems*

Domain: Mechanical Engineering

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University: Transilvania of Braşov

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## (A) Summary

The habilitation thesis entitled *Research on energy management and conversion in mechanical and thermo-chemical systems* presents the scientific achievements conducted by author after obtaining of the scientific title of *doctor (PhD)*, in the field of the *Mechanical engineering (May, 1999)* and as Associate Professor at the Faculty of Mechanical Engineering, Transilvania University of Braşov.

In the **(B-i)** part, the habilitation thesis approaches a research theme in the mechanical engineering field, which refers to the modeling, simulation of the complex thermal plants regarding their dynamical behavior as well as the components of these plants. Mainly the plant configuration are modeled, simulated for energy conversion for cooling production with mechanical compression, with Stirling engine as prime mover, with thermo-chemical adsorption and absorption using real thermodynamic properties for fluids or solids used as working refrigerant (were published 9 scientific articles, 3 papers in ISI proceedings, 1 paper in SCOPUS, 2 papers in BDI and 3 presented at international scientific events).

In addition to the topic of doctoral thesis, the author performed experimental research in investigation of energy density of plastic materials, on heat of combustion of municipally waste materials using oxygen bomb calorimetry (published in 2 ISI articles, 2 SCOPUS), on influence of reprocessing by melt mixing and thermo-formation of polyolefins and determination of morphological features of recycled polypropylene using differential scanning calorimetry (published in 1 ISI article), on experimental thermal characterization of timber frame exterior wall using reed straws as heat insulation materials (published in 1 ISI article), and on simulation of energy management of a greenhouse for crops (published in 2 SCOPUS articles).

The scientific achievements that are the subject of the habilitation thesis and were published in the 7 ISI articles (2 in Q1), 5 articles in SCOPUS, and 10 scientific papers that are presented at national and international events.

In Chapter 1 entitled *Theoretical research on energy conversion for cooling production*, the author presents theoretical background of modeling regarding cooling production plants with mechanical compression using ecological refrigerants, or with Stirling engine like prime mover. Also, the cooling production of plants with no-moving parts using thermo-chemical

absorption and adsorption is presented and modeled. For these plants models for real thermodynamic properties of fluids as working refrigerant are used. The mathematical models of above-mentioned plant configurations are implemented and simulated into software code like: Pascal, EES software (Engineering Equation Solver) and Matlab-Simulink programming platform.

The research results presented in Chapter 1 were disseminated in 9 scientific articles ( 3 papers in ISI proceedings, 1 paper in SCOPUS, 2 papers in BDI and 3 presented at international scientific events) as well as in the progress reports on the projects as member author: CNSCU nr.1154/1996, CNCSU nr.256/1997, CNCSU nr.223/1998, CNCSIS nr.285/1999, CNCSIS nr.287/1999, CNCSIS nr.863/2000. More information on the dissemination of results is presented at the end of Chapter 1.

The chapter 2, *Determination of the energy density of waste materials*, is dedicated to experimental investigations on the on heat of combustion of municipally plastic waste materials using oxygen bomb calorimetry. The next step regarding energy conversion is dedicated to experimental investigation of the influence of reprocessing by melt mixing and thermo-formation of polyolefins and determination of morphological features of recycled polypropylene using differential scanning calorimetry.

Other aspect investigated is related to experimental investigations on the on heat of combustion of wood species materials using oxygen bomb calorimetry and on thermal characterization of timber frame exterior wall using reed straws as heat insulation materials. The research results presented in Chapter 2 were disseminated in 6 scientific articles ( 4 ISI papers, 2 of them in Q1, 1 paper in SCOPUS and 1 BDI presented at international scientific event), as well as in the progress reports on the projects as member in the team: International Grant FP 7, "*Magnetic Sorting and Ultrasound Sensor Technologies of High Purity Secondary Polyolefins from Waste*", W2Plastics, Nr 212782, PC7 project 152EU/2012, CNCSIS nr.945/2007, and 2 books as co-author: „*Combustia ecologica a biomasei lemnoase*”, Transilvania University Press, ISBN:978-973-598-194-5, 2007 and „*Ecological combustion of wooden biomass*” , Transilvania University Press, ISBN:978-973-598-384-0, 2008. Detailed information on the dissemination of results is presented at the end of Chapter 2.

The chapter 3, *Simulations regarding the energy conversion in thermal plants*, is dedicated to the crop-greenhouse energy management, pressure wave energy conversion as supercharging method in engines and numerical results for constructive optimization of

velocity and thermal field in a vending machine (a machine that dispenses small articles such as food, drinks) undertaken with the UTBv nr.8771/12.07.2018 research project.

The research results presented in Chapter 3 were disseminated in 3 scientific articles (1 ISI paper, 2 papers in SCOPUS) as well as in the report on the project as director: „Refrigerating system optimization calculus“ for TATA Technologies, research project UTBv nr.8771/12.07.2018.

The (B-ii) part presents the evolution and achievements on a professional level (academic, teaching and scientific), and the professional academic development plan.