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HABILITATION THESIS

- ABSTRACT -

Possibilities and limits of the use of biodiesel-diesel-ethanol ternary blends as fuels for compression-ignition engines

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This habilitation thesis is based on the didactic and research activities undertaken between 2003 and 2019 and is structured into *Introduction, Scientific, Professional and Academic Achievements and Career Evolution and Development Plans*.

The Introduction presents the professional career of the author, the main didactic and research interests, the activities as a member of commissions for the guidance of doctoral students respectively in commissions for analysis and public defence of doctoral theses. The activities carried out within research projects as a director or member in research teams and the main current and prospective research directions are also briefly stated.

The second part, entitled *Scientific, professional and academic achievements*, is based on the results obtained in the research project carried out within the IDEA program (the National Research, Development and Innovation Plan - PN II, Exploratory research projects), with the title "*Research on partial substitution of diesel fuel for compression-ignition engines by biodiesel-diesel-bioethanol blends*" and the main publications that resulted from it. This part is structured in six chapters, in which are presented the main challenges of using biofuels: the opportunity of using biofuels in the conditions of re-orienting the automotive industry towards hybrid and pure electric propulsion; evaluating the main properties of biofuels in relation to the classic ones; modelling two essential properties of the biodiesel-diesel-ethanol blends: the density and viscosity, the experimental study of the injection process and the testing of ternary blends on an compression-ignition engine.

Chapter 1 entitled *Current trends in the automotive industry* presents the major changes in the automotive industry at a global, European and national level, identifying the place and role of biofuels in the near future and medium-term.

In the second chapter *Experimental determination of the main properties of the constituents and their blends* are presented the fuels used in this research, the composition

and the method of preparation of the biodiesel-diesel-ethanol blends, the apparatuses used for measuring of the main physico-chemical properties of constituents and their blends, as well as the obtained results.

Chapter 3 entitled *Modelling the density and the viscosity of biodiesel-diesel-ethanol ternary blends* presents the principle of modelling of the blends properties, reviews the main models used to estimate the density and viscosity of fuel blends, proposes new high precision models for estimating the temperature and composition dependent density and viscosity of the blends.

The quality of fuel spraying is determined, in addition to the constructive and functional parameters of the engine, by the physical and chemical properties of the fuel. In Chapter 4 – *Experimental study of the injection process* is presented a comparative study regarding the formation and evolution of the fuel jet in the cases of three types of biodiesel-diesel-ethanol blends and diesel fuel.

The biodiesel-diesel-ethanol blends have also been tested on a stand equipped with a compression-ignition engine. Chapter 5 – *Experimental research on the use of BME blends to fuel a CIE* shows the obtained comparative results. Using three types of biodiesel-diesel-ethanol blends, the load dependent performances of the engine (brake specific fuel consumption and brake thermal efficiency) and its emission parameters (carbon monoxide, carbon dioxide, nitrogen oxides, hydrocarbons and smoke emissions) have been determined and have been evaluated in comparison to those obtained in the case of diesel fuel.

The main conclusions concerning the possibilities and limits of the use of BME blends as a fuel for CIE are presented synthetically in Chapter 6.

The third part of the thesis, *CAREER EVOLUTION AND DEVELOPMENT PLANS*, presents the proposal to develop the university career of the candidate from a didactic point of view, identifying the targeted objectives in this regard. The planned research objectives and research themes are presented in detail as well.