Anexa nr.6

ACADEMIA ROMÂNĂ
SCOSAAR

REZUMATUL TEZEI DE ABILITARE

TITLE: **Explosivity of the gaseous flammable mixtures in deflagration regime**
Domeniul de abilitare: *Chimie*.

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2. English

The habilitation thesis entitled "Explosivity of the gaseous flammable mixtures in deflagration regime" presents an overview of the most important scientific, fundamental, and applicative research activities that I carried out between 2009 and 2024, after obtaining the Ph.D. title in the field of Chemistry from University of Bucharest, in 2008.

The habilitation thesis was structured in two main parts: Chapter 1 – Scientific, academic, and professional achievements, Chapter II – Academic, Professional and Research Career Development Plans, followed by References section. The most important original contributions described in chapter I are supported by the most 10 representative ISI articles published between 2009 and 2024, as main author, as well as based on the main academic and professional achievements presented in Chapter II. The scientific research is focused on the characterization of the fuel-oxidant, fuel-oxidant-inert and multiple fuel-oxidant combustion in deflagration regime in various initial conditions.

Chapter I describes the main scientific research directions addressed, being divided into four subchapters:

❖ Quenching distances, minimum ignition energies and related properties for fuel-air and fuel-air-inert gas mixtures (subchapter I.2.);

❖ Ignition by low voltage electric discharges of fuel-air and fuel-air-inert gas mixtures (subchapter I.3);

❖ Propagation of fuel-air and fuel-air-inert flames in closed vessels (subchapter I.4);

❖ Confined explosions characteristics in multifuel-air mixtures. (subchapter I.5);

The first direction of the scientific research represents an extension of the research activity

started during the doctoral period and involved the indirect determination of minimum ignition energy using quenching distances for fuel-air and fuel-air-inert gaseous mixtures. The high degree of novelty of the addressed field consists in the easy way to obtain the minimum ignition energy of explosive mixtures using experimental measurements of quenching distances, which are less time and resources consuming.

The second sub-chapter presents the ignition of fuel-air and fuel-air-inert gaseous mixtures using break sparks in order to evaluate the minimum ignition currents and maximum experimental safe gaps for flammable mixtures in the presence or absence of various additives. Using these parameters, the flammable gasses can be classified in the flammability groups. This classification of gases is important for choosing the type of tests which have to be performed in test explosive mixtures using laboratory closed vessels for the electrical/non-electrical equipment, “Ex”-labeled, explosion protected. The test fuels chosen to verify the ignition/nonignition of explosive atmospheres depend on the selected group: for the first group, methane-air mixture is used, for IIA group, propane – air mixture, for IIB group, ethylene –air mixture and for the IIC group, hydrogen – air mixture.

The third direction of research represents experimental and theoretical work performed in order to obtain information about the unsteady propagation of flames under confined conditions. The characteristic parameters (indices) of explosions propagating as deflagrations (sub-sonic propagation velocities) in enclosures with various shapes and dimensions are basic parameters for risk assessment in plants and equipment where flammable mixtures are present and form the necessary input in formulating safe working conditions. At the same time, the deflagration indices are necessary for design of vents, meant to reduce the damaging effect of closed vessels explosions. Such studies are considered meaningful for characterization of explosions propagating in chemical reactors and/or components of chemical plants which are elongated cylinders, isolated or inter-connected. Under such conditions, the flame can be extinguished as a result of large heat losses or it can be accelerated until the deflagration transforms into a detonation. Adequate safety recommendations can be formulated only on basis of such systematic and comprehensive studies concerning characteristic indices of deflagrations taking place in enclosures.

Part of the results were obtained within the project PN-II-RU-PD-2012-3-0035, implemented in the period 2013-2015, entitled " Study of explosion propagation in elongated closed vessels", financed by the National Authority for Scientific Research, CNCS – UEFISCDI, coordinated by the author of this habilitation thesis.

The fourth research direction represents mainly the response to the energy problems, the lack of resources and the intensification of environmental pollution. These problems have led to the need to discover and explore green, alternative fuels instead of traditional fossil fuels or in combination with them. The clean and efficient alternative fuels were the issue of studies in the last years. Less information on characteristic properties of hydrogen-blended fuel-air explosions in confined conditions are available and they make the subject of this research direction. The propagation properties (the peak explosion pressure, the maximum rates of pressure rise, the severity factor, the time to peak explosion pressure) are important for safety conditions regarding the storage, manipulation, transport and work with such mixtures. Part of the results were obtained within the project PN-III-P4-PCE-2021-0369, implemented in the period 2022-2024, entitled "The influence of hydrogen addition on the explosiveness of LPG-air gas mixtures", financed by the National Authority for Scientific Research, CNCS – UEFISCDI, coordinated by the author of this habilitation thesis.

Chapter II presents the main professional, academic and scientific achievements after obtaining the PhD title in Chemistry. The research activity resulted in the publication of 45 articles published in ISI journals (16 as main author), 1 book chapter and 2 national patents proposals. I was the director of 4 research projects and a collaborator in 8 research projects. The second part of Chapter II presents career development plans. The previously described scientific directions of research with significant results will be considered for the future, along with the development of new ones.

The last part of the habilitation thesis is represented by the bibliographic references.