Abstract of the Habilitation Thesis

ass.prof.dr.eng. Petre Ivona Camelia

The paper, presented as a habilitation thesis in the fundamental field of Engineering, Mechanical Mechatronics and Robotics Engineering presents the main scientific, professional and didactic research activities carried out after obtaining the title of "doctor of engineering" in 2000.

The habilitation thesis is structured in accordance with the legislation in force and with the Regulation on obtaining the habilitation certificate in the “Valahia” University of Târgoviște (approved by Senate Decision no. 32 of 02/06/2015).

The habilitation thesis continues the research directions started by the author in the doctoral thesis. Thus, it is channeled on the fundamental and experimental research from the tribological point of view of the pair of polymer / metal materials, used for the friction couplings with sliding movement. The relevance and originality of the paper consists in the interdisciplinary combination of research conducted in the field of surface engineering, in order to increase the durability of mechanical systems with sliding motion.

In the present summary of the habilitation thesis "Contributions regarding modeling, testing and evaluation of the tribological behavior of polymeric materials used in sliding friction couplings” will be briefly presented the activity and research results related to the public period of the doctoral thesis.

First part of the paper presents the main achievements regarding education and training, as well as the professional experience gained throughout the activity.

After graduating from the Faculty of Machine Construction Technology, Polytechnic University of Bucharest, specializing in Machine Tools in 1986, I was employed at SARO Târgoviște Lathe Enterprise and after at the Scientific Research Institute for Machine Tools Bucharest, Târgoviște branch, where I actively worked, researched and designed in the field of machine tools.

During 1995-1999 I attended the doctoral courses at the Polytechnic University of Bucharest, Faculty of Mechanical Engineering, with the thesis "Research on the wear of machine tool guides with an influence on machining accuracy".

From 1993 until now, I have worked at the University of Valahia, Targoviste. During this period I carried out didactic activities of course, seminar, project and laboratory in the field of “Machine organs and tribology”, “Technical drawing and infographics”, “Mechanical engineering” etc., both at the bachelor and master cycle. For all these disciplines we developed different educational paperworks necessary to our students.

Part II contains the main research and results that the author developed after completing her doctoral studies. Thus, scientific concerns have been oriented towards fundamental tribological research

related to the behavior of surfaces in a frictional coupling with sliding motion. The research undertaken was channeled mostly on the elaboration of theoretical models and a verification of them in experimental conditions as close as possible to those of the operation of the coupling in operation.

The theoretical research undertaken allows the preparation (execution) of the "friction maps" for materials used in the sliding torques of mechanical systems, used in the machine building industry. The creation of these "maps" and their use in the design of various tribological systems are necessary working tools in order to optimize the functioning of these mechanical systems. The estimation of the increase of the durability of the friction couple is made in correlation with the working conditions, with the state of surface processing and with the physical-mechanical characteristics of the chosen materials.

The research undertaken aimed at:

1. Arguing the need to know the tribological behavior of polymeric materials. This first part has an interdisciplinary character. Knowledge of the changes that occur in the surfaces of the friction couple, lead to the need to test polymeric materials in conditions as close as possible to those of industrial applications. Research on the tribological behavior of polymeric materials began with the thermoplastic materials Relamid and Turcit, materials that covered the guides of machine tools (between 1990-2000). After the post-doctoral period, research continued with other materials frequently used in sliding couplings, such as PTFE, PP and PA6, and the list may continue with other types of materials. The research mainly focused on a comparative study of the tribological behavior of the materials under analysis.

2. The development of models for calculating the intensity of friction by abrasion, adhesion, surface fatigue, thermal fatigue and oxidation which are considered the main types of wear that cause damage to mechanical tribosystems. For each model, an analysis of the positive and negative aspects presented in the literature was made and novelty elements were brought to the proposed models.Thus, "friction maps" are established by means of which the load capacity of a sliding friction coupling can be estimated for each type of wear considered to be predominant.

3. The elaboration of models for calculating the friction coefficient. Two models have been proposed, one that estimates the evolution of the coefficient of friction as a function of surface processing and the other that highlights the evolution of static and kinetic coefficient of friction as a function of surface processing and lubrication conditions in intermittent motion (phenomenon of stick-slip). Research on this topic highlights the evolution of the coefficient of friction with working parameters (loading, speed, surface processing, material properties).

4. Study on the deformation state of the polymeric material. The model analyzes the behavior of the polymer surface material considered flat under the action of a penetrator (made of metal material) of conical shape. The penetration method corresponds to the deformation produced by roughness in practice.

In the proposed study it is considered that the deformation mode of the material depends mainly on the angle of inclination of the penetrator.

5. Experimental evaluation of the wear of polymeric materials depending on the working parameters. Due to the complexity of the tribological phenomena, it was not possible to elaborate mathematical relations regarding the intensity of wear and the coefficient of friction that would include all the mechanisms of wear. In this context, in order to establish the evolution of the wear of the materials with the exploitation parameters, experimental determinations are needed.

In order to make an accurate assessment of the tribological behavior of polymeric materials and to validate the theoretical research done, experimental analyzes are proposed on:

- establishing the amount of wear of the polymeric material under the action of the operating parameters (pressure, speed);

- establishing the wear of the polymeric material depending on the processing mode of the counterpart surface (metallic);

- study on the deformation state of the polymeric material;

- studies on the evolution of the coefficient of friction depending on the working parameters.

6. Realization of tribological test stands. In order to establish the tribological characteristics of the materials, two test stands were made in their own conception.

The stands allowed a separate or simultaneous study of the influence of different factors that influence friction (load, speed, lubrication, etc.) and measuring its effects (friction, wear).

Regarding the research done on this topic, I consider that an important step has been taken regarding the analysis of the frictional and wear behavior of different material couplings, but many things remain to be analyzed in order to find an optimal pair of materials from the point of view of increasing the durability of the coupling.

All this research has been published in over 90 ISI / BDI scientific papers or journals.

Part III presents the professional, scientific and academic career development plans. My future concerns will be new theoretical and experimental studies in the field of friction and wear of materials and their extension to other material couplings. In my professional activity I will follow the development of teaching skills and techniques within the current areas of competence.

The thesis ends with a selective bibliographic list with both references from their own writings and references from the literature.