REVIEW OF 20 YEARS OF INDUSTRIAL APPLICATIONS OF ION BEAM AND RADIATION TECHNIQUES

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The present work summarizes the applicative researches performed during 1980s and1990s in Romania using Ion beam based technologies, radiation based technologies and many other measurement techniques to characterize various technological objects as engines, gear boxes, pumps, tools and materials as shown in Fig.1. Tribology studies were performed together with material studies, and assembly performances using a large variety of measurement methods and devices. In order to improve speed and accuracy of tribology thin and Ultra-Thin Layer Activation (UTLA) method have been used producing a radioactive layer on a selected surface of a technological part, measured for quality assurance with auto-radiography and spectroscopy. The part was mounted in the installation and its radioactivity decrease faster than the natural decay was considered to be due to material loss by wear, corrosion or abrasion.

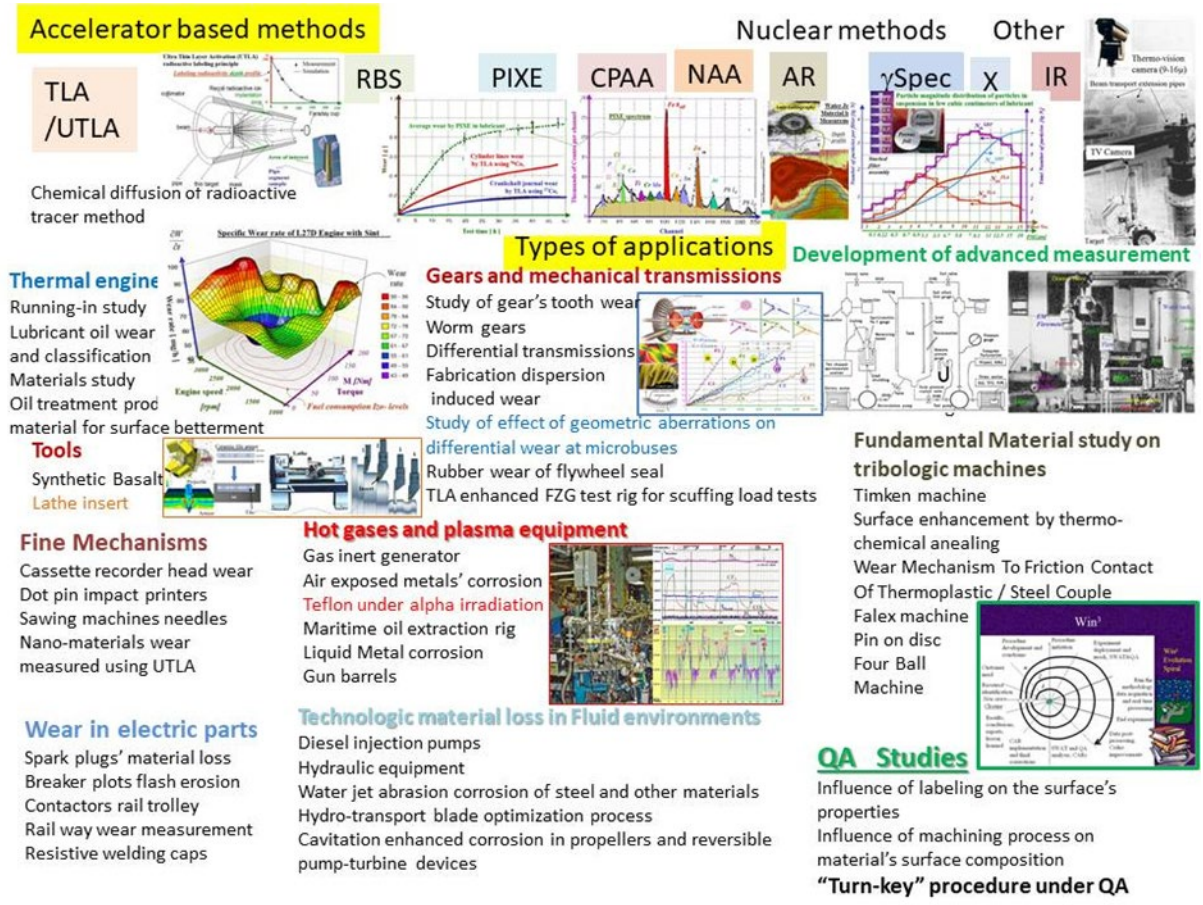

Fig. 1 – Accelerator and nuclear methods application range

Complex stationary or mobile test benches have been built to integrate the nuclear methods with classical measurement technologies and other novel methods of operation and data processing. The results were indicated the material loss rate, duration of good operation, surface distribution of material loss, driving to profile optimization, material transfer rate inside tribology assembly, filter properties and behaviour, lubricants properties, granular aspects of material loss, material structure, as functions of operating conditions as temperature, pressure, stress, relative movement speed distribution, etc.

Measurements have been done in machine building industry, on subassemblies as automotive engines of various sizes, transmission gears, lubricants and oil filters, injection systems, etc. TLA method was successfully used in hydraulic and gas environments, measuring the parts wear in real time. Fundamental tribology studies have been performed using the method to increase the detail of the results.

From the very beginning the TLA or UTLA based methods were more expensive and complicated than the classical methods of measurement, but the advantage was that this method is giving more complex results of the studied element, in real time, that may be correlated with various operating regimes and other elements that are influencing the material behaviour. Using the method gave companies a leap in time of several years, because in inly few months, there was possible to obtain all the information obtained in few years using usual methods, only, but with an order of magnitude in detail, helping the designer and prototype manufacturer to optimize all necessary parameters in order to drastically improve the product in a time shorter by an order of magnitude, and when compared with the quantity of information obtained it becomes by at least an order of magnitude cheaper.

The measuring method did not excluded the usual measurement techniques, but used them associatively, improving the reliability of data, because the same values have to be obtained by all the measurement methods used, checking one-another, and having the differences clearly explained, and understood, in a more detailed manner. Measuring in real time all operational parameters opens the possibility of determining the inter-correlations among them, and improves the quality of information obtain in the testing process.

During this period several hundred experiments have been performed, and the method have been gradually developed following the quality assurance principles, and transformed into a turn-key procedure, with clear steps, stages and control means and methods, integration as many as needed nuclear and non-nuclear technologies. Methods as XRF, PIXE, RBS, UTLA, NAA, Gama Spectrometry, were integrated with optical, acoustical, mechanical and electrical methods using automated data acquisition, computer processing and results interpretation, benchmarking the computer simulation and using lessons learned for further improvements, following a spiral of evolution. The results were outstanding, assuring the industrial customer with the capability to shorten the time from design to market, cheaper and more accurate than with usual methods which were integrated in the measurement process, together with Quality assurance tests, increasing the market competitiveness.

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