

Obituary

Professor Doctor Jan Szargut—Obituary

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Received: 26 November 2017; Accepted: 30 November 2017; Published: 2 December 2017



Professor Szargut speaking during the Contemporary Problems of Thermal Engineering Conference, CPOTE 2012, in Gliwice, Poland—September 2012

It is with deepest sadness that we announce that professor Jan Szargut passed away on 22 November 2017.

Jan Szargut was born on 9 September 1923 in Lwow, then Poland, and obtained his Master Degree in 1948 and his Ph.D. in 1955, both at the Technical University of Silesia, in Gliwice, Poland, where in 1957 he was appointed to the Chair of Thermal Engineering. In the last 70 years Szargut, an inspired thermodynamicist, explored both engineering and theoretical thermodynamics topics with zest, incredible dedication, and unsurpassed innovation. He was one of the first scientists to combine rigorous thermodynamic analysis with economics, and is rightly regarded as one of the founders of Thermo-Economics (Exergo-Oekonomie in the German literature), a branch of Engineering that has led to innumerable and constructive advances in theoretical and applied thermodynamics. In 1956, he published the first structured treatment of the calculation of the specific exergy of materials, which included his well-known Table of the Reference state, used since by all exergy practitioners.

He combined an incredible level of sharpness with an immense dedication to his studies, to education, and to the dissemination of results. Due to the historical developments in the region of Poland, he started publishing in German (his first papers were in Polish) and, after 1980, in English.

Jan will be sorely missed, and his legacy will remain forever, as will his very personal way of continuously questioning his students, his colleagues, and even policymakers to “enlighten” them by forcing them to reflect of their basic assumptions, on their methods of investigation, and on the validity and consequences of the numerical results they obtained. In 1987, he published a seminal paper, “Analysis of Cumulative Exergy Consumption”, elaborating on a quantity he had previously introduced, the CExC, Cumulative Exergy Consumption, and demonstrating how this physical quantity (measured in J/unit) can be used as an indicator of the “sustainability” of a process. In later years, Professor Szargut took yet another step forward in the science of Thermo-Economics, by including in his rigorous thermodynamic treatment the concept of the ‘cost’ of the environmental externalities. In his 2005 book, *Exergy Method: Technical and Ecological Applications*, he systematized some previous work of his by defining an index for the effects of environmental pollution in the cost of technological processes (see the Exergoecological portal on the web [<http://www.exergoecology.com/>] for more details).

At *Energies*, we want to remember him and his legacy by this humble tribute to his greatness: as a scientist, I had the privilege of working with him and to engage in some incredibly rewarding discussions about the methods of exergy analysis of complex systems. He taught me a lot, as he did to entire generations of students and colleagues. Thanks Jan!

Enrico Sciubba, Academic Editor

Attached is a brief compendium of professor Szargut’s academic career and achievements.

Professor Jan Szargut

Professor Jan Szargut was born on 9 September 1923 in Lwow (that time Poland, currently Ukraine). There he spent his young years attending primary and secondary school, and in 1941 he passed his GCSE. In 1942, he became a student in the Faculty of Mechanical Engineering at the Technical University of Lwow, which during the German occupation was named Technische Fachkurse. After the War, in 1946 he moved to Gliwice, as did the whole Lwow Technical University, and he continued his studies at the Technical University of Silesia. He graduated in 1948 and in the same year he was employed as a senior assistant. Between 1951 and 1954, Jan Szargut participated in Ph.D. studies under the supervision of Professor Stanisław Ochęduszek (who was a former Ph.D. student of Wilhelm Nusselt), and in 1955 he got his Ph.D. degree on the basis of the dissertation on “*Balance Equations Resulting from the First and Second Thermodynamic Principles*”. In 1957, he became the manager of the Chair of Thermal Engineering. Between 1960 and 1962, Professor Szargut was the Dean of the Faculty of Mechanical and Energy Engineering, Technical University of Silesia. Starting from 1971, Professor Jan Szargut was the director of the Institute of Thermal Technology. He held this position until he retired in 1993. In the year 1976, he was elected a member of the Polish Academy of Sciences. That prestigious position in Polish science has been the crown of his outstanding scientific achievements.

The scientific activities of Prof. Szargut began at the turn of 1940s and 1950s. At that time he began, as one of the first scientists in the world, the investigations in the area of exergy analysis of thermal processes. In 1956, he published (in Polish) the work “*Potential Balance of Physical Processes Resulting from the Second Law of Thermodynamics*”. This paper closed the early stage of his exergetic adventure that initiated his great contribution to the development of this modern and important branch of thermodynamics—exergy analysis. Within his further works devoted to exergy analysis, Professor Szargut proposed a reference environment for calculating chemical exergy of elements in the Earth. This approach has been one of the most commonly used methods until now and is of great importance from the point of view of the calculation of chemical exergy and is essential for the development of such modern branches of exergy as thermoecology and thermoeconomics. The research works of

Professor Szargut have focused on different applications of exergy for investigations of thermal and metallurgical processes. Additionally, he proposed ecological and economic applications of exergy. The next contribution by Szargut to the exergy community was the concept of cumulative exergy consumption (CExC). This concept was the basis for contemporary branches of advanced exergy analysis—thermoecconomics and thermoecology. The latter, also originally developed by Szargut, is applied to the investigation of the influence of human activities of human on the depletion of natural resources. Noticeably, this application of exergy perfectly supported the idea of the necessity of sustainable development. The great achievements of Szargut's in the field of exergy bore fruits in four monographs: 1. Szargut J., Petela R. *Exergy*. PWN Warszawa 1965 (in Polish) and Eksergija, Moscow 1968 (in Russian); 2. Szargut J., Morris D. R., Steward F. R., *Exergy Analysis of Thermal, Chemical and Metallurgical Processes*, Hempshire, New York 1988 (in English); 3. J. Szargut, *Exergy—Technical and Ecological Applications*. WIT Press 2005 (in English); and 4. Szargut, J., *Exergy—Handbook of Calculations and Application*, SUT Press 2007 (in Polish).

The area of Prof. Szargut's scientific activities is not limited to exergy analyses. The early years of his scientific career were simultaneously devoted to the theory of energy balances of chemical processes and the theory of the reference states of chemical enthalpy and exergy. In 1956, he introduced the concept of the enthalpy of devaluation which was a generalization of lower heating value.

In the 1950s Professor Szargut also began to work on the application of the least squares adjustment method in reconciliations of substance and energy balances in chemical processes. In 1984, he published the monograph "*Least Squares Adjustment Method in Thermal Engineering*" (in Polish).

During his scientific carrier, Professor Szargut has also published books on the fundamentals of technical thermodynamics, e.g., *Thermodynamics* (1971 and later editions), *Theory of Thermal Processes* (1973), *Applied Thermodynamics* (1991 and later editions) and *Exercises in Applied Thermodynamics* (1979 and later editions, as a co-author), *Thermodynamic and Economic Analysis in Industrial Thermal Engineering* (1983), and *Fundamentals of Thermal Engineering* (1998 and later editions, as a co-author). For many years, these books have been—and still are—an invaluable source of knowledge for students learning thermodynamics and thermal engineering at the Silesian University of Technology. For these scientific and didactic activities, Szargut is considered to be the creator of the Polish school of thermal engineering and one of the creators of the Silesian school of thermodynamics.

Other important areas of Szargut's scientific interests include mathematical modelling and experimental investigations on heat transfer in metallurgical processes. He worked for example on the mathematical modelling of radiative heat transfer in industrial furnace chambers and heat transfer in recuperators and regenerators. Two books summarized Szargut's investigation in the field of numerical heat transfer: *Numerical Methods in Thermal Calculations of Industrial Furnaces* (1974, in Polish) and *Numerical Modelling of Temperature Fields* (1995, in Polish; co-authored).

In 1993, Professor Szargut officially retired, but he surely did not abandon his scientific activities. After 1993 he was the author, co-author or editor of several books: *Industrial Waste Energy* (1993, in Polish), *Rationalization of the Consumption of Energy in Industrial Plants* (1994, in Polish), *Fundamentals of Energy Management* (1995, in Polish), *Fundamentals of Thermal Engineering* (1998, in Polish), *Exergy—Technical and Ecological Applications* (2005), *Co-Generated Heat and Electricity Production—Cogeneration Plants* (2007, in Polish), and *Exergy—Handbook of Calculation and Application* (2007, in Polish).

All in all, Professor Szargut has published 327 articles, 24 books, and 12 handbooks. He also presented over 130 papers at national and international conferences. Under his guidance, 28 Ph.D. theses were prepared; 15 of his PhD students are now professors.

