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Editorial

Waste energy recovery is the topic of the first five papers of this issue of the International Journal of Thermal Sciences. They represent results of an interdisciplinary research project [1] on "Waste Energy Utilization Strategies" of the Berlin-Brandenburg Academy of Sciences and Humanities, the ancient Prussian Academy of Sciences. Basic idea of the project was the fact that according to the law of energy conservation, all energy transferred into a stationary system has again to be emitted. As a consequence, all energy consumed in our human societies will eventually be transferred into the environment. The state of the energy emitted is however of lower quality than that of the energy transferred into the system. This decrease of quality, characterised by an entropy increase, is on the other hand the source of driving forces for energetic processes.

As is well known, almost half of the energy consumption is emitted as waste heat. It is unused, warms up the atmosphere, and most often pollutes it with harmful waste gases. As a matter of fact, all energy conversion processes lead to heat and mass transfer with the environment. They represent quantitatively the most important interaction between human society and its environment, not only with regard to removal of waste material, but also with regard to pollution of the environment, particularly by emission of carbondioxid and heat.

In view of a rapidly growing world population and hence an increasing energy demand — estimates of the US Department of Energy predict that until the year 2005 an additional 1 Terawatt of power station capacity is needed — it becomes imperative to make the best use of all human energy resources. Such a demand is not new and at present intensively discussed in public. Most often, however, in these discussions scientific aspects are not considered in an adequate manner. Usually the energy consumption for a given process and, according to the energy carrier, also the substances required are quantified; thus, variants and alternatives can be studied, and as an optimising goal the expenditures can be minimised. As useful as this way of looking at a given situation is, it is nevertheless insufficient because it makes only use of the conservation laws of matter and energy.

Starting point of the project was the explicit incorporation of the statements of the second law of thermodynamics, which enables first of all a more precise comprehension of the meaning of the term "waste energy". This term is not only linked to waste heat, although this is quantitatively most important, but it includes also a part connected to material; this comes from the fact that the state of mass or material export is different from the state of the environment. The energy and mass transfer to the environment, with parameters different from those of the environment, cause via transfer processes external irreversibilities, which for the system itself represent an entropy export. This statement made it necessary to include the realms of waste material economy into the considerations.

On the other hand, integration of the environment with its state properties into the studies of waste energy recovery may be regarded as a contribution to the discussions to the subject of sustainable development. This is underlined by itself by the fact that energy carriers represent the largest mass transfer between human society and its environment.

In the first of the five papers the main principles of this specific view are discussed. The following papers discuss different aspects of waste energy recovery, such as energy and material conversion by means of regeneration and transformation, by means of thermal and material conversion, by cogeneration and heat pump technology and by utilisation of wood as a biochemical energy carrier. They are mainly devoted to technical aspects of energy recovery.

[1] Fratzscher W., Stephan K., Strategien zur Abfallenergievewertung. Ein Beitrag zur Entropiewirtschaft, Vieweg-Verlag, Braunschweig, Wiesbaden, ISBN 3-528-02563-8, 2000, 465 pages. A compilation in English is available entitled "Strategy of Waste Energy Usage and the Conception of Entropy Economics", Report of Berlin-Brandenburg Academy of Sciences and Humanities, 2000, `http://www.bbaw.de/iag/ag_saev/index.html`.

It is nevertheless noteworthy that waste energy is the carrier of the entropy export of a complex system. This export is in a certain measure necessary to create and maintain a state of order within the system to satisfy the needs and requirements of human society. Strategies to deal with a reduction of waste energy and material can therefore not only be based on "engineering thinking". Social, economical and political considerations come into play. They are not discussed in the five papers here, but were studied in the more comprehensive publication[1] which insofar also serves as a basis for public discussions of strategies for a better use of waste energy. Such discussions seem to be imperative in order to achieve a general acceptance of new strategies; otherwise engineering concepts risk to fall into oblivion or will simply be ignored.

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Editor-in-Chief