ADVANCED EXERGY-BASED METHODS

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EXTENDED ABSTRACT

An exergetic analysis identifies the location, magnitude, and sources of thermodynamic inefficiencies in an energy conversion system. This information is used for improving the thermodynamic performance and for comparing various systems [1]. In addition, an exergetic analysis forms the basis for the exergoeconomic [1] and exergoenvironmental [2] analyses. These two analyses (including an exergetic analysis) are called exergy-based methods.

A so-called *conventional* exergetic analysis does not consider the interactions among the components of a system and the real potential for improving the system. These effects can be estimated and the quality of the conclusions obtained from an exergetic evaluation is improved, when for each important system component the value of the exergy destruction is split into endogenous/exogenous [3] and avoidable/unavoidable [4] parts. We call the analyses employing such a splitting *advanced exergetic analysis*.

Endogenous exergy destruction is the part of exergy destruction within a component obtained when all other components operate ideally and only the component being considered operates with the same efficiency as in the real system.
The *exogenous* part of the exergy destruction is the difference between the value of total exergy destruction within the component in the real system and the endogenous part.

The *unavoidable* exergy destruction cannot be further reduced in the foreseeable future due to technological limitations such as availability and cost of materials and manufacturing methods. The difference between total and unavoidable exergy destruction for a component is the *avoidable* exergy destruction. Improvement efforts should be focus only on *avoidable* exergy destructions, costs, and environmental impacts.

In analogy to the advanced exergetic analysis, an exergoeconomic and an exergoenvironmental analysis can be conducted by considering separately the endogenous / exogenous and the avoidable / unavoidable costs and environmental impacts. In this way we obtain a consistent evaluation of a system from the viewpoints of thermodynamics, economics, and environmental protection. All evaluations are conducted using consistent definitions for *exergy of fuel* [5], *cost of fuel*, *environmental impact associated with the fuel, exergy of product* [5], *cost of product*, and *environmental impact associated with the product.*

The presentation will demonstrate how advanced analyses, including exergetic, exergoeconomic, and exergoenvironmental analyses, provide the user with information on the formation processes and the sources of thermodynamic inefficiencies, costs, and environmental impacts [6], and how they can enhance the creativity of engineers to develop ways for their minimization.

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