Exergy

“In thermodynamics, the **exergy** of a system is the maximum useful work possible during a process that brings the system into equilibrium with a heat reservoir. When the surroundings are the reservoir, exergy is the potential of a system to cause a change as it achieves equilibrium with its environment. Exergy is the energy that is available to be used. After the system and surroundings reach equilibrium, the exergy is zero. Determining exergy was also the first goal of thermodynamics. The term "exergy" was coined in 1956 by Zoran Rant (1904–1972) by using the Greek ex and ergon meaning "from work", but the concept was developed by J. Willard Gibbs in 1873.

Energy is never destroyed during a process; it changes from one form to another (see First Law of Thermodynamics). In contrast, exergy accounts for the irreversibility of a process due to increase in entropy (see Second Law of Thermodynamics). Exergy is always destroyed when a process involves a temperature change. This destruction is proportional to the entropy increase of the system together with its surroundings. The destroyed exergy has been called **anergy**. For an isothermal process, exergy and energy are interchangeable terms, and there is no anergy.

Exergy analysis is performed in the field of industrial ecology to use energy more efficiently. Engineers use exergy analysis to optimize applications with physical restrictions, such as choosing the best use of roof space for solar energy technologies. Ecologists and design engineers often choose a reference state for the reservoir that may be different from the actual surroundings of the system.

Exergy is a combination property of a system and its environment because it depends on the state of both the system and environment. The exergy of a system in equilibrium with the environment is zero. Exergy is neither a thermodynamic property of matter nor a thermodynamic potential of a system. Exergy and energy both have units of joules. The Internal Energy of a system is always measured from a fixed reference state and is therefore always a state function. Some authors define the exergy of the system to be changed when the environment changes, in which case it is not a state function. Other writers prefer a slightly alternate definition of the available energy or exergy of a system where the environment is firmly defined, as an unchangeable absolute reference state, and in this alternate definition exergy becomes a property of the state of the system alone.

However, from a theoretical point of view, exergy may be defined without reference to any environment. If the intensive properties of

different finitely extended elements of a system differ, there is always the possibility to extract mechanical work from the system. Also, it is possible to formulate the exergetic content of a single body in thermodynamical disequilibrium (with intensive properties varying with location, such as having a temperature gradient).

The term exergy is also used, by analogy with its physical definition, in information theory related to reversible computing. Exergy is also synonymous with: availability, available energy, exergic energy, essergy (considered archaic), utilizable energy, available useful work, maximum (or minimum) work, maximum (or minimum) work content, reversible work, and ideal work.

The exergy destruction of a cycle is the sum of the exergy destruction of the processes that compose that cycle. The exergy destruction of a cycle can also be determined without tracing the individual processed by considering the entire cycle as a single process and using one of the exergy destruction equations. ---Information found in thermodynamics by Yunus A. Cengel"

Wikipedia. *Exergy.* [online] Available at: <http://en.wikipedia.org/wiki/Exergy> [Accessed 15 September 2014].