Exergy Analysis within Process Simulation Software to Enhance Process Energy Management

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Introduction

Context
Industrial sectors account for one third of global energy consumption. A common feature of industrial processes is reliance on fossil fuels as the primary source of energy and a large part of the energy consumption is spent on production of utilities (electricity, steam at various pressure levels, hot/cold water, hot flue gas,...). As this reliance on fossil fuels has huge negative impacts on the environment, the scientific world makes a significant effort to find alternative sources of energy. However, even by the most optimistic assessments, these alternatives are long-term solutions and many projections show that in the near future, fossil fuels will remain as primary sources of energy.

Definition of Exergy
Exergy is defined as the maximum theoretical useful work obtained if a system S is brought into thermodynamic equilibrium with the environment by means of (reversible) processes in which the system S interacts only with this environment. (Sciubba and Wall, 2007)

The COOPER (CCombiner Optimisation des Procédés, Récupération énergétique et analyse Exergetique pour une meilleure efficacité énergétique des sites industriels – Combine process optimisation, energy recovery and exergetic analysis for a better industrial energetic efficiency) project, focusing on the development of a software platform for simulation and energetic optimisation of industrial processes, has been selected by the ANR (French National Research Agency, ANR-11-SEED-0012).

The project brings together 4 partners from the academic world (AgroParisTech and INP Toulouse) and the industry (Veolia and ProSim).

Exergy of Material Streams

*The amount of work obtainable when a material stream is brought to a state of thermodynamic equilibrium with the common components of the natural surroundings by means of reversible processes, involving interaction only with the abovementioned components of nature*. (Szargut et al., 1988).

Exergy Analysis within a Simulation and Optimization Software: ProSimPlus

Grassman diagrams

Irreversibilities

Internal & External Exergy losses table

Relative Exergy loss

Exergy streams table

References


E. Sciubba, G. Wall, A brief commented history of exergy from the beginnings to 2004, Int. J. of Thermodynamics, 10 (1), 2007

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