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Application of exergy balances for the optimization of non-adiabatic small turbomachines operation

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ABSTRACT

In the current context of global warming due to CO_2 (carbon dioxide) emissions, mainly produced by power plants and road transportation, it is imperative to optimize the operation of thermal engines in general and of gas turbines in particular. This requires accurate knowledge of their performance. In the case of turbomachines, performance is usually estimated by assuming an adiabatic flow. This assumption is inappropriate, however, for small-scale machines such as turbochargers and micro gas turbines. This study presents the influence of heat transfer on their performance. The concept of entropic temperature is developed and a general exergy analysis conducted in order to quantify accurately the available energy dissipation. Both a turbocharger and a gas turbine with internal heat transfer are investigated. Under the adiabatic assumption, the model results are overestimated. New gas turbine maps have therefore been generated and new operating points defined. The trends of the modeling results thus obtained are compared with the performance measured on a micro gas turbine with and without insulation. Fuel consumption is higher with internal heat transfer.

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