

# Preface

The aim of this book is to enable the reader to perform the necessary calculations for an exergetic analysis (thermodynamics) and a thermoeconomic analysis (process costs) of any industrial process.

Using the presented methodology, a deeper understanding and analysis of an example process will be obtained throughout the book. This process is an innovative working cycle that uses the exhaust gases from the gas turbine coupled with the compressor of a natural gas compression station. This kind of station is used in natural gas pipelines to recover the pressure needed by the gas to flow.

The chosen cycle is an ammonia–water cycle. Throughout this book, all the concepts and calculations needed are broken down using the thermodynamic data obtained from an Aspen Plus<sup>®</sup> simulation. The use of a simulation is greatly beneficial because it makes available the thermodynamic data needed for the calculation of the exergy of the process streams.

Hand-made calculations for obtaining thermodynamic data are also explained, although the procedure can be difficult, since the following data are needed for each matter stream:

- composition
- mass flow
- pressure
- temperature
- enthalpy increment between two states
- entropy increment between two states
- chemical exergy of the substances, or their free energy of formation
- kinetic and potential energy if their variation is important in the process

Also, the work values are needed, as well as the heat flows' value and the temperature at which they are produced.

All the calculations of the example used are done in a spreadsheet. Matrix algebra is continuously used to release calculations from the size and complexity of any facility. Valuable and additional material is available on a web page hosted by Springer <http://www.springer.com/978-1-4471-4621-6>. This material is

referenced in the text to avoid including an excessive number of tables and numbers in the text.

When there is a clear added value for a better understanding of the analysis done and/or the process improvement possibilities, results are displayed in two ways; numerically (in tables) and graphically.

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The authors wish to express their gratitude to their families and friends for their support, as well as the unselfish work of those who have contributed to the fulfillment of this book.

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The following information is available in the website:

### **Documents**

Doc1001: Aspen Plus<sup>®</sup> flowsheet of the example process used in the book (Figs. 1.2 and 1.3).

Asp1002: Aspen Plus<sup>®</sup> v.7 simulation files of the book example process.

Doc1003: RPI classification of the example process.

Doc1099: list of errors.

Doc2001: Aspen Plus<sup>®</sup> flowsheet of a combined cycle.

Asp2002: Aspen Plus<sup>®</sup> v.7 simulation files of a combined cycle.

Doc2002: Brief description of the combined cycle.

Doc2003: RPI classification of the combined cycle.

### **Workbooks**

WB1001: Workbook with the data obtained from the simulator in three sheets: m for matter streams, W for Work streams, and Q for Heat streams.

WB1011: Workbook with the calculations done for the case studied in the book.

The structure of the book is as follows:

Sheet	Name	Content
1	m	Data obtained from the simulator (Matter streams)
2	W	Data obtained from the simulator (Work streams)
3	Q	Data obtained from the simulator (Heat streams)
4	BCorrM	Data selected from the matter streams simulator data (BCorrM) and calculation of the physical and chemical exergy of the matter streams
5	MHBT	Selected data for the matter streams as well as the Matter, Energy and Exergy vectors. Also vectors, calculations and results are present for: Exergy Cost, Unit exergetic cost, Thermoeconomic cost, unit exergoeconomical cost.
6	A	Incidence and costs matrixes
7	Eq	Results for the pieces of equipment
8	R	Resource Matrix
9	P	Products Matrix
10	I	Losses Matrix
11	Report	Report with a summary of all the results obtained

WB2001: Example 2 workbook with the data obtained from the simulator in three sheets: m for matter streams, W for work streams, and Q for heat streams.

WB2004: Example 2 workbook with the fixed cost data (Z) of each equipment unit.

The text inside a grey textbox like this refers to additional information available in the book website in Springer.

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