

Preface

The made by the arm of man production of cooling and heating is amongst the energy processes of vital importance today in all domains of human activity, technology, food, health, social, research, etc. Also, the global population increase, the limited energy resources, and the accelerated global warming process, has forced people involved in the energy industry to find rapid solutions, much more effective in cooling and heating. Bearing these in mind, a recent research activity of the author of this book has brought to light new solutions, enjoying a high potential in primary energy saving, which can be applied immediately, without long-term research.

After an introductory part, providing the reader with the selected topic on thermodynamics, this book presents briefly the most relevant theoretical aspects of this research. Reference is first made to *the coabsorbent technology*. Although the coabsorbent technology bases on the classic absorption technology, it is more general. The coabsorbent technology can find effective solutions, practically for all kinds of heat pumping (cooling and/or heating) applications, met in industry, agriculture, district, household, etc., provided that two supplying sources with temperatures outdistanced by minimum (12–15) °C are available. It is mostly indicated that the coabsorbent technology be utilized in applications that recover free low-grade heat sources, coming of naturally, or from the industry technological processes. The book describes, in this respect, *the new coabsorbent cycles, of nontruncated, truncated, hybrid truncated and multi-effect type*, with applications in cooling (industrial, medium, and air conditioning) and heating (domestic warm water, house heating, and industrial). The operation in cogeneration of cooling and heating and in trigeneration of mechanical work, cooling and heating working modes of some coabsorbent cycles with special design is also presented. The first principle recommendation of improving cycle COP through internal sensible and latent heat recovery has been constantly taken into consideration in the cycle design. A new, important, and very useful tool of investigation for the absorption processes heat exchange, *the divided device method*, is introduced. This method has been applied extensively to absorption processes suffering latent–sensible or latent–latent heat transfer processes. In this respect, with its help, a thorough study of the generation–absorption (gax) recovery taking place at large intervals with temperature overlapping, and the results thereof, are given for the cooling and heating truncated cycles operating with ammonia–water and water–lithium bromide working combinations.

The theoretical presentation is completed by chapters giving the thermodynamical ideal limits of the cooling and heating coabsorbent cycles and showing the way the exergy efficiency of these cycles should be computed when the exergy balance is extended on boundaries comprising not only the processes at hand, but their different supplying sources of energy as well. Particular attention has also been paid to emphasize the second principle recommendations of improving the COP.

The second technology refers to cooling and/or heating production using the mechanical vapor compression. This technology is the most widespread in the world today, occupying the first place in what concerns the number of applications and the cooling and heating capacity. As compared to the classic cycles, this technology proposes as novelty, *the recovery of the discharge gas superheating*, with positive energy consequences. The discharge gas superheat recovery is converted into useful issues with the help of two methods. According to the first, the heat is converted into work which diminishes the compressor work input, and is termed *thermal-to-work recovery compression (TWRC)*. According to the second, the heat is converted into useful cooling and/or heating effect, added to the cycle output effect via the coabsorbent technology, and is termed *thermal-to-thermal recovery compression (TTRC)*. Other important aspects concerning the TWRC and TTRC methods, including the theoretical and ideal COP calculation, the choice of the recovery compression cycles, cycles structure solutions, the coabsorbent technology use in TTRC application, and the computation of the optimum intermediary pressures of multi-stage compression, are given as well. The methods are analyzed for single-, two-, and three-stage compression cooling and heating cycles, and the model effectiveness results are given.

Next, the book includes the author's own researches concerning fundamental aspects of the absorption processes, in completion of the coabsorbent technology. First, reference is made to *a non-equilibrium phenomenological theory of mass and heat transfer in physical and chemical interactions*. This theory postulates the existence of the *natural forces* governing the physical and chemical interactions and brings to light *the ideal point approaching effect* suffered by a natural force in the proximity of an ideal point (the denomination of the classic equilibrium point in the phenomenological approach). With the help of this new effect it was possible to explain phenomena which otherwise were difficult to be explained by the classic theory of mass and heat transfer (e.g. *the problem of the ammonia bubble absorption*, why an absorption process is *a mass phenomenon and not a surface one*, or *the heat pipe high heat transfer properties*). Based on the non-equilibrium phenomenological approach, a *two-point theory (TPT)* of mass and heat transfer is proposed, where *the equilibrium point* and *the ideal point* play an important role in the *non-coupled* and *the coupled mass and heat transfer*, respectively. Further on, *a new wording of the Laplace equation*, more general than the already known wording, and the variational numerical and analytical approach of the liquid capillary rise effect are presented. In the last part of the book, *the Marangoni convection basic mechanism explanation* is given. The Marangoni convection stimulation is a means of increasing the mass and heat transfer, generally, and particularly in the absorption interactions. Its true explanation is a consequence of the

le Chatelier principle respect and is done with the help of the new Laplace equation and the *TPT*. In order to increase the mass and heat transfer of the pseudo-Marangoni cells, a *Marangoni—Gravity Forces Dimensionless Criterion*, created with the help of *TPT*, is applied and effective absorption–desorption mass and heat exchangers with horizontal free surfaces are proposed.

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