Preface

Dear reader,

In this book the reader is shown the design aspects which must be considered when designing distillation columns in practice. The influencing parameters are presented, well explained and the equations governing them given. Several numerical examples are given. This book is written with a focus on both experienced designers as well as those who are new to the subject.

In spite of the multitude of available literature on distillation, a void still exists. Most of the existing works are academic. Hence there is a need for a book which covers the comprehensive information necessary to practically design distillation columns in a compact, clear and concise way. This book is written to fill this gap.

Today, computer programmes are used for column design. However, before the 1960s, in the pre-computer era, diverse distillation processes were also designed and operated including azeotropic distillation.

In those days the required number of trays and the reflux ratio were graphically determined with the McCabe–Thiele diagram or with Fenske–Underwood–Gilliland short cut methods.

While working with the McCabe–Thiele diagram on graph paper one appreciates the difficulty of separation.

Nowadays, you get computer output with all the data. The calculation results are generated very quickly. If the user does not have a thorough understanding of what the computer is asked to do, the user can easily misinterpret the output as an accurate design even if this is not the case. Some process simulators facilitate the trace of the calculation steps performed by the computer to a desired level. It is therefore possible to generate a very large output containing all the calculation steps. If desired, the user can then check each step by written calculation. However, this is very impractical due to the enormous effort involved. Following the guide given in this book, the designer will be able to develop the required skills needed for practical column design and will therefore be in a position to make a better judgement of the calculation results presented by the computer.

A very good understanding of the principles involved is inevitable. Starting with the selection of the appropriate equilibrium correlation, there is a great number of

measured equilibrium data for the same material system. For instance, there are more than 100 for ethanol/water. Besides, different computer models also exist for the calculation of equilibrium. If another method for the calculation of the equilibrium is chosen, for instance, direct input of vapor pressure data or if different models are used for the equilibrium calculation, such as NRTL, Wilson, Uniquac or UNIFAC, the resulting required number of trays and reflux ratios will be different. Further inaccuracies occur in the determination of the efficiency of cross-flow trays or the HTU and HETP values in random and structure packed columns.

In Chap. 1 it is shown right from the start how small inaccuracies in equilibrium and in tray efficiency influence the calculated results. Often, an additional pilot plant distillation is required for the design, for instance if an odour or colour specification has to be met or if a potassium permanganate test has to be performed for methanol or if the water content specification is required in ppm.

A pilot plant distillation is recommended for extractive and azeotropic distillation in order to avoid product impurities by entrained or washing agents. A good fractionation can only be achieved at a uniform hydraulic loading. With pulsating reflux, an intermittent evaporation or a fluctuating vacuum in the column good fractionation is not achievable. In addition, proper functioning of the evaporator and the condenser without a pulsating stream is the prerequisite for a properly functioning distillation plant. An adequate process control system is very important for the given separation task, for instance the control of the pressure, the heating, the loading and the levels. With potentially explosive materials expolosions can occur (own experience) if the maximum allowable temperature is exceeded for a long period of time. All these important aspects of distillation column practical design, along with many more, are covered in this book.

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