

# Preface

It is well known that all physicochemical processes are accompanied by a heat tone. The amount of positive or negative heat released respectively the velocity of its release is principally a measure of the progress respectively the velocity of the process. Both in combination represent—depending on the complexity of the process—a more or less abundant source for a description of changes in physicochemical states. As a rule, the thermal quantities can always be measured.

This book is concerned with carrying out the precise measurement of quantities as well as their utility for chemical engineering, especially their application in the kinetic analysis of reactions within the liquid phase.<sup>1</sup>

The introduction<sup>2</sup> of the book (Chap. 1) explains why caloric investigations aimed at determining the chemical kinetics of liquid-phase reactions can be carried out most efficiently using bench scale calorimeters.

Chapter 2 presents calorimeters for measuring accurately the rate of heat release during discontinuous and continuous reactions versus time under isothermal and nonisothermal conditions. In addition, the chapter contains a description of an apparatus that can be used to record online the rate of heat release within a stirred tank reactor during a reaction.

Chapter 3 offers hints for the practical use of the proposed calorimeters.

Chapter 4 describes the fundamental principles for conducting a kinetic analysis of calorimetric results. The aim of a thermokinetic analysis is the elaboration of the fundamental rules that set the tone for running a chemical conversion in liquid, homogeneous reaction mixtures, i.e.,

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<sup>1</sup> Liquid phase system: liquid, liquid/gas, liquid/solid, liquid/solid/gas; in all cases, a liquid is the main constituent.

<sup>2</sup> List of symbols.

- Independent stoichiometric equations,
- Related rate functions,
- Related reaction enthalpies.

A thermokinetic analysis takes place

- Based on mathematical-analytical relations (examples of several different reaction systems are given)
- Based on numerical calculations (examples of software that has been tested are introduced).

The more complex a chemical process is, the more plentiful must be the variations in calorimetric measurements for kinetic analysis.<sup>3</sup> This holds especially for chemical conversions in concentrated reaction mixtures because increasing concentration complicates the thermokinetic analysis.

Chapter 5 discusses examples of applications to thermokinetic analysis.

Chapter 6 treats the possibilities of bench scale calorimetry in the determination of additional, relevant quantities in chemical engineering.

Chapter 7 discusses the so-called heat flow calorimeter by Regenass respectively subsequently improved models.

The book ends with a list of literature cited in the book that is recommended for further reading, a list of symbols used, and a subject index.

To what end and for whom was the book written?

The book was written first and foremost to stimulate students' interest of chemical engineering and chemistry in the kinetic analysis of liquid-phase reactions on the basis of a calorimetric investigation. Therefore, the illustrations accompanying the chapters are essential, detailed, and coherent. The precise depictions of apparatus and the advantages of their use, as demonstrated by a variety of examples, might encourage scientists and engineers to incorporate one of the apparatus in their professional practice.

The author would consider the book a great success if readers experienced a eureka moment and realized that thermokinetic analysis could be used to solve their existing kinetic problems.

The treatise represents the fusion of literature and experience gained in the domain of bench scale calorimetry, which the author started while working in the applied physics laboratory at Bayer AG Leverkusen in the 1970s.

The author would like to express his special thanks to Dr. Juri Pawlowski for his vivid interest in the progress of the project, Mr. Eberhard Gottschall, Mr. Reinhold Rose, and Mr. Ernst Dykstra for their many ideas and their excellent craftsmanship in mechanics, Dipl.Ing. Dietrich Biehler, Dipl.Ing. Wilfried Braun, and Dipl.Ing. Horst Zwick for their excellent ideas with respect to electronics.

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<sup>3</sup>The same holds for the elaboration of kinetics on the basis of classical chemical analysis.

Last but not least, the author would like to acknowledge a very special debt to his parents, especially to his mother, now age 96, who for several weekends suffered the author's bad temper as a result of sudden revelation of unforeseeable, complex obstacles during the development of the apparatus. In accordance with Murphy's Law, this occurred mostly during or around the weekend.

Cologne, Germany

Wilfried Litz

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Litz, W.

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