

PROCESS AND REACTOR DESIGN FOR THERMO-CHEMICAL ENERGY STORES

Barbara Mette, Henner Kerskes, Harald Drück

University of Stuttgart, Institute for Thermodynamics and Thermal Engineering (ITW)
Research and Testing Centre for Thermal Solar Systems (TZS)
Pfaffenwaldring 6, 70550 Stuttgart, Germany
Tel.: +49 711 / 685-63499, Fax: +49 711 685-63503
email: mette@itw.uni-stuttgart.de

1. Introduction

Thermo-chemical energy storage is a key technology to realize highly efficient short and long term thermal energy stores for various applications such as solar thermal systems or cogeneration systems. By storing the energy in form of chemical bonds of special materials the energy can be stored almost loss-free over arbitrary time periods. At the same time a high energy storage density can be achieved. Both criteria are crucial, especially for compact long term thermal energy storage applications.

Research activities in the field of low temperature thermo-chemical energy stores (TCES) have developed strongly in the last few years - particularly in the field of material development and material optimization. Main focus of this activity is on improving the chemical and thermal properties of the materials such as increasing the energy storage density, enhancing the thermal conductivity or improving the cycle stability. Much less attention is paid to the design of the storage itself and its sub-components such as the reactor required as a key component in a thermo-chemical energy store. Nevertheless, this topic is indispensable to advance and push the developments of this technology and to bring it closer to a market introduction.

Hence, one focus of the work performed at the Institute for Thermodynamics and Thermal Engineering (ITW) of the University of Stuttgart is the development and integration of a thermo-chemical energy store into a complete system concept. Within the three and a half years project "Chemical heat store using reversible gas solid reactions (CWS: Chemische Wärmespeicherung mittels reversibler Feststoff-Gasreaktionen; duration from June 2008 to November 2011) a process design for integrating a thermo-chemical energy store into a solar combisystem is being developed. An essential aspect of the process development was the designing of the reactor and of the reaction conditions. This work has been closely accompanied by material research as, for an optimal utilization of the materials storage density, reaction behaviour and reactor design have to be specially adapted to the material characteristic and to the operation conditions of the system. Within the project, a wide range of materials for thermo-chemical energy stores have been experimentally investigated. In the focus are reversible gas solid reactions with water vapour as one reactant. Very good characteristics in terms of energy storage density and reaction kinetics indicate composite materials of salt impregnated zeolites. However, the reaction kinetic of these composites is instationary (decreasing kinetic with increasing conversion) and strongly dependent on the reaction conditions. This is a challenge especially for the exothermic formation reaction. To make use of the complete energy storage density of the material, it is essential to achieve a maximum conversion of the material with a temperature lift in the reactor which can be used for space heating and hot water preparation.

Different reactor designs have been experimentally and numerically investigated. For a detailed analysis of the heat and mass transfer inside the reactor a finite element model of the reactor has been set up with the simulation software "COMSOL Multiphysics" (Comsol, 2010). The results of the numerical investigation will be presented as well as the derived reactor design for a thermo-chemical energy store. A very detailed overview of the newly developed process design, the CWS-NT-Concept (Chemische Wärmespeicherung - Niedertemperatur: chemical heat storage - low temperature) as well as the energy performance of the CWS-NT-concept will be given in (Kerskes et al., 2011b).

Process And Reactor Design For Thermo Chemical Energy Stores

Kaveh Rajab Khalilpour



Process And Reactor Design For Thermo Chemical Energy Stores:

This book delves into Process And Reactor Design For Thermo Chemical Energy Stores. Process And Reactor Design For Thermo Chemical Energy Stores is a vital topic that needs to be grasped by everyone, ranging from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Process And Reactor Design For Thermo Chemical Energy Stores, encompassing both the fundamentals and more intricate discussions.

1. This book is structured into several chapters, namely:
 - Chapter 1: Introduction to Process And Reactor Design For Thermo Chemical Energy Stores
 - Chapter 2: Essential Elements of Process And Reactor Design For Thermo Chemical Energy Stores
 - Chapter 3: Process And Reactor Design For Thermo Chemical Energy Stores in Everyday Life
 - Chapter 4: Process And Reactor Design For Thermo Chemical Energy Stores in Specific Contexts
 - Chapter 5: Conclusion
 2. In chapter 1, this book will provide an overview of Process And Reactor Design For Thermo Chemical Energy Stores. This chapter will explore what Process And Reactor Design For Thermo Chemical Energy Stores is, why Process And Reactor Design For Thermo Chemical Energy Stores is vital, and how to effectively learn about Process And Reactor Design For Thermo Chemical Energy Stores.
 3. In chapter 2, the author will delve into the foundational concepts of Process And Reactor Design For Thermo Chemical Energy Stores. This chapter will elucidate the essential principles that must be understood to grasp Process And Reactor Design For Thermo Chemical Energy Stores in its entirety.
 4. In chapter 3, this book will examine the practical applications of Process And Reactor Design For Thermo Chemical Energy Stores in daily life. The third chapter will showcase real-world examples of how Process And Reactor Design For Thermo Chemical Energy Stores can be effectively utilized in everyday scenarios.
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 6. In chapter 5, this book will draw a conclusion about Process And Reactor Design For Thermo Chemical Energy Stores. This chapter will summarize the key points that have been discussed throughout the book.
- The book is crafted in an easy-to-understand language and is complemented by engaging illustrations. This book is highly recommended for anyone seeking to gain a comprehensive understanding of Process And Reactor Design For Thermo Chemical Energy Stores.

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Table of Contents Process And Reactor Design For Thermo Chemical Energy Stores

1. Understanding the eBook Process And Reactor Design For Thermo Chemical Energy Stores
 - The Rise of Digital Reading Process And Reactor Design For Thermo Chemical Energy Stores
 - Advantages of eBooks Over Traditional Books
2. Identifying Process And Reactor Design For Thermo Chemical Energy Stores
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Process And Reactor Design For Thermo Chemical Energy Stores
 - User-Friendly Interface
4. Exploring eBook Recommendations from Process And Reactor Design For Thermo Chemical Energy Stores
 - Personalized Recommendations
 - Process And Reactor Design For Thermo Chemical Energy Stores User Reviews and Ratings
 - Process And Reactor Design For Thermo Chemical Energy Stores and Bestseller Lists
5. Accessing Process And Reactor Design For Thermo Chemical Energy Stores Free and Paid eBooks
 - Process And Reactor Design For Thermo Chemical Energy Stores Public Domain eBooks
 - Process And Reactor Design For Thermo Chemical Energy Stores eBook Subscription Services
 - Process And Reactor Design For Thermo Chemical Energy Stores Budget-Friendly Options
6. Navigating Process And Reactor Design For Thermo Chemical Energy Stores eBook Formats
 - ePub, PDF, MOBI, and More
 - Process And Reactor Design For Thermo Chemical Energy Stores Compatibility with Devices
 - Process And Reactor Design For Thermo Chemical Energy Stores Enhanced eBook Features

7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Process And Reactor Design For Thermo Chemical Energy Stores
 - Highlighting and Note-Taking Process And Reactor Design For Thermo Chemical Energy Stores
 - Interactive Elements Process And Reactor Design For Thermo Chemical Energy Stores
8. Staying Engaged with Process And Reactor Design For Thermo Chemical Energy Stores
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Process And Reactor Design For Thermo Chemical Energy Stores
9. Balancing eBooks and Physical Books Process And Reactor Design For Thermo Chemical Energy Stores
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Process And Reactor Design For Thermo Chemical Energy Stores
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Process And Reactor Design For Thermo Chemical Energy Stores
 - Setting Reading Goals Process And Reactor Design For Thermo Chemical Energy Stores
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Process And Reactor Design For Thermo Chemical Energy Stores
 - Fact-Checking eBook Content of Process And Reactor Design For Thermo Chemical Energy Stores
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

Process And Reactor Design For Thermo Chemical Energy Stores Introduction

In this digital age, the convenience of accessing information at our fingertips has become a necessity. Whether its research

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