

## Table of Contents

### **Preface IX**

### **1 Introduction 1**

*Klaus Reders*

- 1.1 History of the Spark Ignited "Otto" Engine and of Gasoline 2
- 1.2 History of the Diesel Engine and of Diesel Fuel 11

### **Oil Refining 17**

*Gunter Alfke, Walther W. Irion, Otto S. Neuwirth*

- 2.1 Introduction 17
- 2.2 Crude Oils and Products 22
- 2.3 Oil Refining Processes 29
- 2.4 Environmental Protection in Oil Refining 71
- 2.5 Integrated Refinery Models 85
- 2.6 Corrosion and Materials 89
- 2.7 Testing and Analysis 91
- 2.8 Storage and Transport 93
- 2.9 References 93
- Abbreviations 95

### **3 Automotive Fuels 97**

*Werner Dabelstein, Arno Reglitzky, Andrea Schütze, Klaus Reders*

- 3.1 History 97
- 3.2 Engine Technology 99
- 3.3 Fuel Composition and Engine Efficiency 103
- 3.4 Fuel Components 114
- 3.5 Fuel Additives 121
- 3.6 Fuel Standardization and Testing 136
- 3.7 Storage and Transportation 138

## VI Contents

- 3.8 Alternative Fuels 139
  - 3.8.1 Liquefied Petroleum Gas 140  
*Stephen M. Thompson, Gary Robertson, Robert Myers*
  - 3.8.2 Natural Gas 152  
*Klaus Reders, Margret Schmidt*
  - 3.8.3 Synthetic Fuels 166  
*H. P. Calis, Wolfgang Luke, Ingo Drescher*
  - 3.8.4 Bioethanol 175  
*Lutz Guderjahn*
  - 3.8.5 Fatty Acid Methyl Esters (FAME) 187  
*Klaus Reders, Margret Schmidt*
- 3.9 References 192
  
- 4 Hydrogen 197**  
*Harald Klein, Harald Ranke*
  - 4.1 History 197
  - 4.2 Properties 198
  - 4.3 Occurrence 202
  - 4.4 Production 203
  - 4.5 Handling 216
  - 4.6 Hydrogen Fuel Systems 226
  - 4.7 References 232
  
- 5 Fuel Cells 235**  
*Matthias Duisberg, Marco Lopez, Katharina Seitz, Cerhard Sext*
  - 5.1 The Function of Fuel Cells 235
  - 5.2 History 236
  - 5.3 Fuel Cells and their Applications 238
  - 5.4 Polymer Electrolyte Fuel Cells 241
  - 5.5 Fuel Processing 247
  - 5.6 Fuel Cells for Vehicle Propulsion 248
  - 5.7 References 250
  
- 6 Octane Enhancers 253**
  - 6.1 Methyl Tert-Butyl Ether and Ethyl Tert-Butyl Ether 253  
*Udo Peters, Franz Nierlich, Ekkehard Schulte-Korne,  
Michael Sakuth, Rula Deeb, Maryline Laugier, Martti Suominen,  
Michael Kavanaugh*
  - 6.2 Other Octane Enhancers 275  
*Kuno Schädlich, Peter Schug, Jorg Fabri, Werner Dabelstein, Arno Reglitzky*
  - 6.3 References 296

<b>7</b>	<b>Automobile Exhaust Control</b>	299
	<i>Martin Votsmeier, Thomas Kreuzer, Cerhard Lepperhoff</i>	
7.1	Introduction	299
7.2	Pollutant Formation and Limitation	300
7.3	Developments in Engine Technology	303
7.4	Catalytic Exhaust Aftertreatment, General Concepts	304
7.5	Catalytic Aftertreatment of Stoichiometric Exhaust Gas	308
7.6	Catalytic Aftertreatment of Lean Exhaust Gas	313
7.7	Conclusion and Outlook	319
7.8	References	319
<b>8</b>	<b>Aviation Turbine Fuels</b>	321
	<i>Geoff J. Bishop</i>	
8.1	History	321
8.2	Fuel Types and Specifications	321
8.3	Production	333
8.4	Handling, Storage, and Transportation	336
8.5	Legal Aspects	337
8.6	Environmental Aspects	337
8.7	Economic Aspects	338
8.8	Future Trends	338
8.9	References	340
<b>9</b>	<b>Marine Fuels</b>	343
	<i>Klaus Reders, Torsten Mundt</i>	
9.1	History	343
9.2	Specifications	344
9.3	Composition	344
9.4	Properties	347
9.5	Outlook	350
	<b>Index</b>	351