

Preface

Greenhouse gas emissions limit the expansion of many industries and especially considering the whole life cycle it may be difficult and costly to remarkably reduce existing CO₂ sources. It is therefore expected that CO₂ separation from various gases may be required in the future in order to mitigate emissions and associated climate change. CO₂ capture may be required not only in coal-fired power plants but also in many other industries. Besides, it may be needed not only for fossil fuel processing but also for biomass processing. In addition, by efficiently separating and concentrating CO₂ a new carbon resource may be created for CO₂ utilisation technologies. Consequently, CO₂ capture is a very important process that will play a significant role in the future. Its high efficiency achieved by applying innovative techniques will greatly contribute to commercial success of many CO₂ emitting and CO₂ utilising industries.

This edited book is dedicated to developments of solvents for CO₂ capture by gas–liquid absorption. The entire process involving these solvents needs to be characterised by very high energy efficiency to enable implementation of this technology in actual industries. Book chapters put emphasis on compounds, their blends and advanced solvent-based capture processes (ASBCPs). Single compound solvents are usually simple and easy to handle. Solvent blends are used for enhancing CO₂ capturing processes and are often characterised by reduced energy requirements. Finally, emerging innovative advanced solvent-based capture processes make use of novel phenomena and innovative approaches capable of creating disruptive innovations. The ASBCPs involve for instance two immiscible liquid phases or microencapsulated solvents which have very favourable operating characteristics. Therefore, ASBCPs may greatly contribute to the increase of energy efficiency of CO₂ capture plants.

The book includes a selection of Chapters dedicated to energy efficient solvents for CO₂ capture by gas–liquid absorption. It also discusses the whole technical context of using CO₂ capture solvents in practical applications. Chapter “[Introduction to Carbon Dioxide Capture by Gas–liquid Absorption in Nature](#),”

Industry, and Perspectives for the Energy Sector and Beyond” introduces CO₂ capture by gas–liquid absorption in nature, industry and discusses challenges in the energy sector. Chapter “Assessment of Thermodynamic Efficiency of Carbon Dioxide Separation in Capture Plants by Using Gas–liquid Absorption” assesses thermodynamic efficiency of a CO₂ separation process relying on gas–liquid absorption. In Chapter “Process Implications of CO₂ Capture Solvent Selection” the process implications in the selection of energy efficient solvents with the overall message that the process should not limit the choice of solvent but be designed to make best use of the advantages of the energy efficient solvent choice and minimise the disadvantages. Chapter “Useful Mechanisms, Energy Efficiency Benefits, and Challenges of Emerging Innovative Advanced Solvent Based Capture Processes” analyses advanced solvent-based capture processes for energy efficient carbon dioxide capture by gas–liquid absorption. Chapter “Phase Change Solvents for CO₂ Capture Applications” investigates solvent systems that separate into two phases upon absorption of CO₂ having significant potential as energy efficient solvents due to only the CO₂ rich stream being heated in the regenerator resulting in reduced sensible and latent heating requirements. Chapter “Aqueous Amino Acid Salts and Their Blends as Efficient Absorbents for CO₂ Capture” is dedicated to aqueous amino acid salts and their blends having high CO₂ loading, high reaction rate, being less corrosive, less toxic, and requiring less regeneration energy compared to commercial amines. Further, Chapter “Ionic Liquids: Advanced Solvents for CO₂ Capture” relates to ionic liquids (ILs) which have become more attractive for CO₂ capture because of their excellent properties and potential energy saving efficiency. It reviews and analyses the research progress on CO₂ capture with ILs including the absorption capacity, the absorption mechanism and the process simulation and assessment. Furthermore, Chapter “Amine-Blends Screening and Characterization for CO₂ Post-combustion Capture” provides the CO₂ loading and heat of absorption experimental data of amine blends for CO₂ capture which can be useful for future industrial application in the selection of amine blend solvents. Chapter “Post-combustion Carbon Dioxide Capture with Aqueous (Piperazine + 2-Amino-2-Methyl-1-Propanol) Blended Solvent: Performance Evaluation and Analysis of Energy Requirements” critically discusses the properties of the AMP+PZ blended solvent characterised by a regeneration energy demand of 2.9–3.7 GJ/tCO₂. Chapter “Energy Efficient Absorbents for Industry Promising Carbon Dioxide Capture” reviews and analyses energy efficient absorbents for industrially relevant carbon dioxide capture systems. Chapter “The Absorption Kinetics of CO₂ into Ionic Liquid—CO₂ Binding Organic Liquid and Hybrid Solvents” is dedicated to absorption kinetics of CO₂ into ionic liquids and hybrid solvents as measure to achieve higher efficiency energy utilisation in carbon capture. Finally, Chapter “Solubility of Carbon Dioxide in Aqueous Solutions of Linear Polyamines” provides information on the solubility of carbon dioxide in aqueous solutions of linear polyamines. Overall, this book provides a useful engineering resource for the

development of energy efficient CO₂ capture solvent systems involving gas–liquid absorption. The invited leading authors from different continents give their own perspectives on the associated problems and hence the whole picture is well balanced and up-to-date.

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Absorption

Compounds, Blends and Advanced Solvent Systems

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