

Preface

Carbon dioxide (CO₂) mineralization and utilization is an important technology wherein CO₂ is captured and stored for utilization instead of being released into the atmosphere. CO₂ mineralization and utilization demonstrated in the waste-to-resource supply chain can “reduce carbon dependency, promote resource and energy efficiency, and lessen environmental quality degradation,” thereby reducing the environmental risks and increasing the economic benefits towards sustainable development goals. This book provides comprehensive information on CO₂ mineralization and utilization using alkaline wastes via accelerated carbonation technology from theoretical and practical considerations, presented in 20 chapters. Engineers, scientists, government officers, and project managers will consider this book as an essential reference on CO₂ mineralization and utilization.

In this book, the concept of carbon cycle from the thermodynamic point of view was first introduced. The principles, applications, and environmental impact assessment of carbon capture and storage technologies also are illustrated in Part I. Among the carbon capture and utilization processes, CO₂ mineralization via accelerated carbonation technology is especially focused in Part II. Throughout the carbonation process, huge amounts of CO₂ and alkaline wastes generated from industries can be reclaimed and reused. From the theoretical consideration, the process chemistry, reaction kinetics, mass transfer, and system analysis for accelerated carbonation are systematically presented. On the other hand, from the practical consideration, the analytical methods and the application of accelerated carbonation are introduced as well. In Part III, it then explores the utilization of carbonated products as green materials such as supplementary cementitious materials and high value-added chemicals. Key performance indicators for evaluating the function and properties of carbonated products are developed. Lastly, an integral approach for waste treatment and resource recovery is proposed to establish a waste-to-resource supply chain towards a circular economy system. It discusses the challenges, barriers, and strategies of integrated air pollution control at industry in detail, and then illustrates the importance and significance of establishing waste-to-resource green supply chain. Furthermore, the carbonation system is

critically assessed and optimized from aspects of engineering, environmental, and economic analysis.

Reduction in CO₂ emission in industries and/or power plants should be a portfolio option. Integrated alkaline waste treatment with CO₂ mineralization and utilization is an attractive approach to achieving direct and indirect reduction in greenhouse gas (GHG) emissions in industries. The accelerated carbonation can not only stabilize alkaline wastes but also fix CO₂ in flue gas from industries as a safe and stable carbonate precipitate. On the other hand, the amount of CO₂ reduction by carbonation could be certified as emission reduction credits, in conjunction with the joint implementation (JI), emission trading scheme (ETS), and clean development mechanism (CDM) issued by the Kyoto Protocol. Therefore, it suggests that the establishment of a waste-to-resource supply chain should provide a method of overcoming the barriers of energy demand, waste management, and GHG emissions to achieve a circular economy system, under which the “win-win” philosophy demonstrating green economy and healthy environment can be coexisted.

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Pen-Chi Chiang
Shu-Yuan Pan

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Chiang, P.-C.; Pan, S.-Y.

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