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Integrated Sewage Sludge Management and Energy Recovery in Türkiye: A Circular Economy Perspective

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Abstract

The rapid expansion of wastewater treatment infrastructure in Türkiye has led to a significant increase in the volume of sewage sludge generated, making sludge management a critical environmental and technical challenge. While progress has been made in sludge stabilization and disposal methods, major gaps remain in developing environmentally safe and economically feasible strategies. This study provides a comprehensive assessment of current sewage sludge management in Türkiye, focusing on regulatory frameworks, treatment technologies, and end-use applications. It places special emphasis on the energy recovery potential of biochemical and thermochemical processes, such as anaerobic digestion, incineration, and gasification. These technologies not only help reduce the volume and environmental impacts of sludge but also contribute to Türkiye's renewable energy targets. However, several barriers exist, including technical limitations, high capital requirements, and the lack of a national integrated sludge management strategy. Based on an assessment of current field practices and national data, this study proposes a roadmap for sustainable sludge utilization. It highlights the need for regional planning, policy alignment, and investment in innovative energy recovery systems. By utilizing sewage sludge in accordance with circular economy principles, Türkiye could transform this waste stream into a valuable resource, contributing to both environmental protection and energy security.

Keywords: Sludge Management, Sewage Sludge, Energy Recovery, Circular Economy, Gasification

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