Turning cavitation into a business opportunity

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Cavitation technology, encompassing acoustic and hydrodynamic methods, represents a transformative approach to process intensification, enabling high-efficiency energy and mass transfer across diverse industrial applications [1]. Acoustic cavitation exploits high-frequency ultrasonic waves to generate transient and stable bubbles, leading to localized high temperatures, pressures, and reactive species formation. Hydrodynamic cavitation, achieved through fluidic devices, such as Venturi tubes and vortex diodes, generates cavities under controlled low-pressure zones, providing scalable solutions for large-scale operations. This presentation critically examines the industrial viability of cavitation technologies, emphasizing their unique ability to combine mechanical, thermal, and chemical energy release. A detailed comparative analysis reveals the limitations of acoustic cavitation, including energy attenuation and equipment wear, against the superior scalability of hydrodynamic systems. Key challenges, such as enhancing hydroxyl radical yield, reducing operational costs, and improving system robustness, are explored alongside potential synergies with complementary technologies, like advanced oxidation processes and photocatalysis. Emerging industrial implementations, including biogas enhancement and chemical processing, underscore the evolving landscape of cavitation-based innovations. This presentation highlights the necessity for multidisciplinary strategies, integrating experimental, computational, and engineering perspectives to advance cavitation technology. By addressing scalability and cost-effectiveness, cavitation systems can unlock transformative opportunities for sustainable industrial applications, aligning with global environmental and economic imperatives.

[1] Galloni, M.G. *et al.*, Applications and applicability of the cavitation technology, Current Opinion in Chemical Engineering, **48** (2025) 101129.