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A Comprehensive Review of Major Water Desalination Techniques from Saline Water

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Abstract: *In light of the critical challenge of global freshwater scarcity, this review paper underscores the paramount importance of ocean water desalination as a sustainable solution. While the majority of existing studies have concentrated on the technical aspects and efficiency of desalination techniques, this paper distinguishes itself by examining not only these operational principles and their cost-effectiveness but also by shedding light on the often-overlooked valuable mineral by products of the desalination process. We provide a comprehensive analysis comparing emerging desalination technologies, highlighting their environmental impacts alongside a novel perspective on the potential for valuable mineral extraction during desalination. This dual approach not only addresses the urgent need for fresh water but also introduces an innovative method for resource recovery, presenting a shift towards more sustainable and economically viable water management practices. Contrary to the common perception, our findings reveal that, except for the osmotically assisted reverse osmosis method, other common zero liquid discharge (ZLD) methods have shown better cost-effectiveness. Furthermore, we have investigated the most valuable minerals present in seawater and the common methods for their separation, indicating that focusing on mineral separation could significantly reduce if not completely remove, the costs associated with these desalination technologies. This paper aims to inform and influence decision-making in the field of water management, advocating for solutions that not only alleviate water scarcity but also enhance resource utilization for industry applications.*

Keywords: Desalination; Reverse Osmosis; Membrane Fouling; Brine Management

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