

A Comprehensive Review of Green Solvents and their Applications

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ABSTRACT

The chemical process industry relies heavily on solvents that are typically important in the reactions and separation. Beyond their facilitative role, solvents dictate the solubility, and stability of reactants, and significantly shape economic and environmental outcomes. However, despite their crucial impacts, conventional solvents pose environmental and health risks. That is why the adaptation of green chemistry, which is established to reduce the production and usage of potentially harmful chemicals and promote the use of green solvents is of utmost importance. This paper explores the typical sources, advantages and disadvantages, physical and chemical properties, mechanisms, and applications of green solvents as aligned with the principles of green chemistry for sustainable and environmentally responsible practices. It includes a discussion of the currently studied green solvents such as bio-based solvents, ionic liquids, deep eutectic solvents, petroleum alternatives, liquid polymers, fatty acid esters, supercritical fluids, and terpenes. Challenges in terms of economic feasibility, application limitations, and life-cycle environmental impact assessments were indicated. The paper emphasizes the importance of discerning environmental claims, considering toxicological evidence, and scrutinizing the challenges of industrial scaling for effective adoption. Future research outlooks encompass integrating green solvents into industrial practices by sustainable synthesis methodologies, intermolecular interactions, and reliable predictive models to enhance performance and safety.

Keywords: *green solvents; green chemistry; biomass solvents; sustainability,*