

Green Solvents: Alternatives to Hazardous Chemicals

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Description

The increasing awareness of environmental issues and the push for sustainable practices have catalysed the search for greener alternatives in various industries. One significant area of focus is the use of solvents in chemical processes. Traditional solvents, often derived from petrochemical sources, are known for their toxicity, flammability, and environmental persistence, posing significant health and ecological risks. Green solvents have emerged as a promising solution to these challenges, offering a more sustainable and less hazardous option for numerous applications. Green solvents are characterized by their low toxicity, biodegradability, and minimal environmental impact. They are designed to replace conventional solvents that contribute to air, water, and soil pollution. The goal is to find solvents that maintain or enhance the efficiency of industrial processes while reducing harmful side effects. Several types of green solvents have gained popularity, each offering unique benefits depending on the application. Derived from renewable resources like plants, bio-based solvents include ethanol, ethyl lactate, and glycerol. These solvents are often biodegradable and have a lower environmental footprint compared to their petroleum-based counterparts. Carbon Dioxide (CO₂) in its supercritical state is one of the most widely used green solvents. Supercritical CO₂ is non-toxic, non-flammable, and can be easily removed from the product by depressurization. It is particularly effective in extraction processes, such as decaffeinating coffee and extracting essential oils. These are salts in a liquid state at room temperature. Ionic liquids have unique properties, such as negligible vapour pressure and high thermal stability, making them suitable for various chemical reactions and separations. However, their biodegradability and toxicity vary, so careful selection and design are crucial. Formed from a mixture of two or more components that, at a certain ratio, form a eutectic mixture with a melting point lower than that of each individual component. DES are versatile and can be tailored for specific applications, offering benefits like low toxicity and high biodegradability. Green solvents are making their way into diverse industries, revolutionizing traditional processes. The pharmaceutical industry relies heavily on solvents for synthesis and purification of compounds. Green solvents, like ethanol and supercritical CO₂, are increasingly used to reduce harmful emissions and improve worker safety. Supercritical CO₂ is extensively used in the extraction of flavours, fragrances, and essential oils. It offers a clean, residue-free extraction process, essential for products consumed by humans. Green solvents help in the formulation of pesticides and fertilizers, minimizing environmental contamination. They ensure safer products for both farmers and consumers. Solvents play a critical role in polymer production and processing. Green solvents, such as bio-based alternatives, are used to create more sustainable plastics and coatings. Solvents are key components in many cleaning agents. Green solvents like ethyl lactate are used in formulations to reduce toxicity and improve biodegradability, making household and industrial cleaning products safer for the environment. While the shift towards green solvents is promising, it is not without challenges. Some green solvents may be expensive to produce or have limitations in terms of their physical and chemical properties. Additionally, regulatory frameworks and industry standards need to adapt to facilitate the broader adoption of these alternatives. Research and development are crucial to overcoming these obstacles. Advancements in biotechnology, materials science, and chemical engineering are driving the discovery and optimization of new green solvents. Collaboration between academia, industry, and government agencies will be essential to accelerate this transition. Green solvents represent a significant stride towards sustainable industrial practices. By replacing hazardous chemicals with environmentally friendly alternatives, industries can reduce their ecological footprint and enhance safety for workers and consumers. As technology and innovation continue to advance, green solvents will play an increasingly vital role in fostering a greener, healthier planet.

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Conflict of Interest

We have no conflict of interests to disclose and the manuscript has been read and approved by all named authors.

