

# **Natural Plant Product Extraction and Purification Using Ionic Liquid-Based Green Solvents**

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## **Abstract**

This research paper explores the environmental sustainability of ionic liquid-based green solvents in the extraction and purification of natural plant products, with a focus on their entire life cycle. The objectives of the study were to assess the environmental impact of ionic liquid synthesis, energy consumption, water usage, emissions, recycling rates, policy effects, and stakeholder perceptions. Methodologically, we conducted a comprehensive Life Cycle Assessment (LCA) that involved primary data collection through field surveys and interviews with key stakeholders in the ionic liquid production and usage industry across various regions in India. The data were analyzed using specialized LCA software tools to quantify environmental impacts.

Key findings include the identification of synthesis as a major contributor to environmental impact, emphasizing the need for greener synthesis methods. The study revealed the significant carbon footprint, energy consumption, and water usage during production, highlighting opportunities for improvement. Emissions data underscored the importance of emission control measures, particularly for greenhouse gases and volatile organic compounds. Recycling and reuse were identified as environmentally friendly disposal methods. Policy compliance varied among stakeholders, indicating room for stricter regulations. Stakeholder perceptions varied, with researchers having the most positive outlook. Implications of the findings extend to sustainable chemistry practices, emphasizing interdisciplinary collaboration and the importance of considering the entire life cycle of chemical processes. This research contributes to a deeper understanding of green solvents and provides a foundation for promoting sustainable practices in industrial processes, not only in India but also globally.

**Keywords:** *Ionic Liquids, Green Solvents, Environmental Sustainability, Life Cycle Assessment, Natural Plant Extraction, Sustainable Chemistry.*

