

5/14/2024

608-238-6001 [TEL]

greg@cruisingreview.com [Email]



supercritical-co2- recycling-solvent

Cruising Review

Supercritical CO2 as Processing Solvent for the Recycling and Sample Preparation of Lithium Ion Battery Electrolytes

Structured Data



This webpage QR code

```
<script type="application/ld+json">
{
  "@context": "http://schema.org",
  "@graph": [
    {
      "@type": "Organization",
      "@id": "https://cruisingreview.com/#organization",
      "name": "Cruising Review",
      "url": "https://cruisingreview.com",
      "sameAs": [
        "https://www.youtube.com/channel/UC7gOvLwxt8MtYt3ExzAZJQ",
        "https://www.instagram.com/pepe.g6",
        "https://www.facebook.com/pepe.g6",
        "https://www.linkedin.com/company/pepe.g6",
        "https://www.pinterest.com/pepe.g6",
        "https://www.tumblr.com/pepe.g6",
        "https://www.vimeo.com/pepe.g6",
        "https://www.youtube.com/channel/UC7gOvLwxt8MtYt3ExzAZJQ",
        "https://www.instagram.com/pepe.g6",
        "https://www.facebook.com/pepe.g6",
        "https://www.linkedin.com/company/pepe.g6",
        "https://www.pinterest.com/pepe.g6",
        "https://www.tumblr.com/pepe.g6",
        "https://www.vimeo.com/pepe.g6"
      ],
      "telephone": "608-238-6001",
      "email": "greg@cruisingreview.com",
      "logo": "https://cruisingreview.com/logo.png"
    },
    {
      "@type": "WebSite",
      "@id": "https://cruisingreview.com",
      "url": "https://cruisingreview.com",
      "name": "Supercritical CO2 as Processing Solvent  
for the Recycling and Sample Preparation of  
Lithium Ion Battery Electrolytes",
      "description": "This article investigates the potential for Sub and Supercritical CO2 to be used to  
extract specific constituents of lithium ion batteries (LIB).",
      "mainEntityOfPage": {
        "@type": "WebPage",
        "@id": "https://cruisingreview.com/smx/supercritical-co2-recycling-solvent.html"
      },
      "headline": "Supercritical CO2 as Processing Solvent  
for the Recycling and Sample Preparation of  
Lithium Ion Battery Electrolytes",
      "image": "https://cruisingreview.com/images/",
      "datePublished": "2024-05-14T08:00:00+08:00",
      "dateModified": "2024-05-14T09:20:00+08:00",
      "author": {
        "@type": "Organization",
        "name": "Cruising Review",
        "url": "https://cruisingreview.com"
      },
      "publisher": {
        "@type": "Organization",
        "name": "Cruising Review",
        "logo": {
          "@type": "ImageObject",
          "url": "https://cruisingreview.com/logo.png"
        }
      }
    }
  ]
}
```

This article investigates the potential for Sub and Supercritical CO2 to be used to extract specific constituents of lithium ion batteries (LIB).

PDF Version of the webpage (first pages)

<https://cruisingreview.com/smx/supercritical-co2-recycling-solvent.html>

Supercritical CO₂ as Processing Solvent for the Recycling and Sample Preparation of Lithium Ion Battery Electrolytes

The Role of Sub- and Supercritical CO₂ as Processing Solvent for the Recycling and Sample Preparation of Lithium Ion Battery Electrolytes

- 1) This article investigates the potential for Sub and Supercritical CO₂ to be used to extract specific constituents of lithium ion batteries (LIB).
- 2) Lithium ion batteries are quickly becoming the standard power source for a wide array of consumer electronics, including cell phones, laptops, cordless power tools, and most importantly hybrid and electric vehicles.
- 3) The lithium in lithium ion batteries, quote – has no actual substitute – unquote, and its, quote – demand might exceed the global production by the 2020s – unquote.
- 4) Besides being a valuable material, better recycling processes must be developed to better utilize limited lithium resources to support future electronic production and advancement.
- 5) To further incentivize the development of advanced recycling methods, the EU parliament recently introduced strictest LIB recycling requirements to date: quote - Each Eu member state has to meet a collection rate of 45 percent and at least a recycling efficiency of 50 wt percent – unquote.
- 6) Most LIBs taken out of service have experienced cell failure due to aging. This has lead to a need for better post mortem analysis to better understand the cell aging process.
- 7) Quote – decomposition of the electrolyte is challenging to investigate due to its complex composition – unquote. Processes do exist to perform post mortem analysis, but none are ideal.
- 8) The need for better LIB constituent recycling and electrolyte analysis both have the potential to be improved through sub- and supercritical CO₂ extraction.
- 9) Current recycling programs focus on, quote – the recover of heavy metals ... and lithium itself... on the current collectors – unquote, but not the electrolyte which represents 10-15 wt percent of a typical LIB. The new EU directive will necessitate electrolyte reclamation.
- 10) In its supercritical state (above 31°C and 74 bar), quote - CO₂ has the density of liquid CO₂ and the viscosity of gaseous CO₂ – unquote. The physical properties exhibited are a combination of those characteristic of the gas and liquid phases, but most importantly, the supercritical state has, quote – greatly enhanced dissolution characteristics – unquote.
- 11) Supercritical CO₂ is, quote – the most applied supercritical medium for extraction – unquote, often used in the food industry and other industrial manufacturing applications.
- 12) In most instances Supercritical CO₂ is created by pumping a liquid or gaseous CO₂ supply up to its critical pressure while applying heat to raise the temperature up to its critical temperature. The supercritical state is not reached until both the critical pressure and critical temperature are achieved.
- 13) Helium head pressure carbon dioxide (HHP-CO₂) is another method for achieving SC CO₂. Quote – liquid carbon dioxide is compressed with a helium head pressure to 120 bar – unquote, to reach the critical pressure. Depending on the setup, additional heat application may also be required.
- 14) HHP-CO₂ allows for similar SC CO₂ extractions, but may have some slight differences in efficacy due to the small concentration of helium dissolved in the CO₂.
- 15) The authors describe a proposed method of introducing SC CO₂ extraction into the standard LIB recycling process so that the electrolyte currently being destroyed or disposed of can be recaptured.
- 16) The article also details proof of concept trials that successfully demonstrated the ability to extract Lithium from LIB waste.
- 17) After proving the concept, the trail went on to investigate what aspects of the SC CO₂ extraction were the most influential in increasing recovery. Their results indicated that increased pressure and increased extraction time were the two primary means of improving extraction yield.
- 18) As an analytical tool, it was also shown that SC CO₂ could be used to extract quantitative samples from LIBs undergoing aging testing to better understand how test parameters were impacting the aging process. The SC CO₂ derived samples offered greater purity than previous solvent extraction methods and avoided some of the potentially toxic exposure inherent in other methods.
- 19) The authors conclude that SC CO₂ extraction is a promising method for improving the recyclability of LIBs, leading to a more sustainable LIB market in the future.
- 20) SC CO₂ also offers a better analytical approach to post mortem LIB failure investigations which may ultimately lead to better LIB design.

Publication: "The Role of Sub- and Supercritical CO₂ as Processing Solvent for the Recycling and Sample Preparation of Lithium Ion Battery Electrolytes." Nowak, Sascha, and Winter, Martin. PDF. 2017.

Review by: SP

5/14/2024
