TSCFA台灣超臨界流體協會
Taiwan Supercritical Fluid Association

電子報第 201 期

活動訊息

- **製藥製程減碳新契機：超臨界CO_2在醫藥原料純化與微粒設計之應用工作坊**
  日期：**113年2月2日(五)**
  地點：台北科技大學化學工程館101會議室
  報名網址：https://docs.google.com/forms/d/e/1FAIpQLSft3TewjquMMJmZVG-s3fw-szzxgDZuaQkRupHXp_Rp4Rx4_w/viewform

- ***International Chemical Engineering Symposia 2024***
  日期：**18-20 March, 2024**
  地點：Nakamozu Campus, Osaka Metropolitan University
  CHAIR：Prof. Hirohisa UCHIDA
  IChES - International Chemical Engineering Symposia (scej.org)
  https://www4.scej.org/meeting/89a/pages/en_gen-sympK.html

- ***19 TH ISSF, (European Meeting on Supercritical Fluids EMSF)***
  日期：**26-29 MAY 2024**
  地點：MARIBOR, SLOVENIA
  CHAIR：ZELJKO KNEZ, SLOVENIA
  Scientific Meetings – ISASF (supercriticalfluidsociety.net)

- ***14 TH ISSF(International Symposium on Supercritical Fluids)***
  日期：**JUNE 2025**
  地點：BALI
  CHAIR：JAEHOON KIM, SOUTH KOREA
  Scientific Meetings – ISASF (supercriticalfluidsociety.net)

會員動態

- 恭賀本會團體會員亞果生醫(股)公司榮獲『112 年度傑出生技產業獎』！

淨零永續

◆ IDB 產業節能減碳資訊網 INDUSTRIAL ENERGY SAVING AND CARBON REDUCTION INFORMATION WEB https://ghg.tgpf.org.tw/	◆ 淨零永續學校 https://college.itri.org.tw/nzschool/

團體會員介紹

- 易度股份有限公司

教育訓練班

- (日間班)高壓氣體特定設備操作人員安全衛生教育訓練班 01/08~01/12
- (夜間班)高壓氣體特定設備操作人員安全衛生教育訓練班 02/20~03/03

技術文摘

- A multi-index evaluation method of supercritical CO_2 Brayton cycle for nuclear power plants design 核電廠設計超臨界 CO_2 布雷頓循環多指標評估方法
- Comparisons of Supercritical Loop Flow and Heat Transfer Behavior Under Uniform and Nonuniform High-Flux Heat Inputs 均勻和非均勻高通量熱輸入下超臨界環流和傳熱行為之比較
- Influence of the Main Working Parameters and Geometrical Parameters on the Supercritical CO_2 Flow Instability in a Heated Tube 主要工作參數與幾何參數對加熱管內超臨界 CO_2 流動不穩定性的影響
- Performance Analysis of Heat Exchangers and Integrated Supercritical CO_2 Brayton Cycle for Varying Heat Carrier, Cooling and Working Fluid Flow Rates 針對不同熱載體、冷卻和工作流體流量的熱交換器和整合超臨界 CO_2 布雷頓循環之性能分析
- Progress and Prospects for Research and Technology Development of Supercritical CO_2 Thermal Conversion Systems for Power, Energy Storage, and Waste Heat Recovery 超臨界 CO_2 於電力、儲能及餘熱回收熱轉換系統研究與技術發展之進展與展望
- Technoeconomic analysis of supercritical fluid extraction process for recycling rare earth elements from neodymium iron boron magnets and fluorescent lamp phosphors 超臨界流體萃取從釹鐵硼磁體和螢光燈螢光粉回收稀土元素製程技術經濟分析
- Valorization of food side streams by supercritical fluid extraction of compounds of interest from apple pomace 透過超臨界流體從蘋果渣中提取標的化合物來提高食品下腳料價值

台灣超臨界流體協會
電話：(07)355-5706　E-mail：tscfa@mail.mirdc.org.tw

製藥製程減碳新契機: 超臨界 CO_2 在醫藥原料純化與微粒設計之應用

在製藥產業的製程設計與開發過程當中，透過使用 CO_2 取代有機溶劑，是另一種可以達到製程減碳的手段之一。近年的學術研究與產業應用方面，超臨界 CO_2 已經被應用於諸多製藥的程序當中，如果進一步搭配成熟的 CO_2 回收技術，將可以更有效地達成減碳的目的。本工作坊，將邀請專家學者，針對如何利用超臨界 CO_2 進行醫藥中間體的純化，以及中後段的微粒製備與製劑設計等進行介紹，以促進產學研的交流，同時拓展超臨界流體在醫藥產業的新契機。

時間：2024 年 2 月 2 日 (五)

地點：台北科技大學化學工程館 101 會議室

報名費：

- 會員: 1,500 元
- 非會員: 2,500 元
- 學生: 1,000 元

議程：

時間	議程	講員
09:00~09:30	報 到	
09:30~09:40	引 言	台灣超臨界流體協會 梁明在理事長
09:40~10:40	超臨界流體層析原理與 API 純化應用	喬璞科技有限公司 包曉青經理
10:40~11:00	茶 歇	
11:00~12:00	超臨界流體模擬移動床層析技術與設備導覽	喬璞科技有限公司 包曉青經理
12:00~13:30	午 餐	
13:30~14:30	超臨界流體技術在肺部釋放藥物製劑之應用	明志科技大學 吳弦聰教授
14:30~14:50	茶 歇	
14:50~15:50	超臨界 CO_2 在 API 固態物性控制、共晶製備與非晶型固體分散微粒設計之應用	台北科技大學 蘇至善教授
15:50~16:20	綜合座談	

主辦單位

台灣超臨界流體協會

協辦單位

臺北科技大學化學工程與生物科技系

臺北科技大學專利暨技術轉移中心

交通方式:

1. 抵達臺北科技大學

搭乘捷運

藍線【板南土城線】忠孝新生站或橘線【中和新蘆線】忠孝新生站，4 號出口台北科技大學。

搭乘公車

【台北科技大學站】: 212、212 直達車、232、262、299 及 605。

【忠孝新生路口站】: 72、109、115、214、222、226、280、290、505、642、665、668、672 及松江新生幹線。

搭乘火車或高鐵

由台北火車站或高鐵台北站直接轉捷運【板南線】至忠孝新生站，4 號出口台北科技大學。

自行開車

【國道一號】: 於建國北路/松江路交流道下(靠左走建國北路高架橋)於忠孝東路出口下(循右線右轉忠孝東路)續行約 100 公尺即達本校。

【國道三號】: 於新店交流道接木柵交流道下辛亥路轉建國南路直走至忠孝東路口即達

※ (由於校內空間有限，恕無法提供停車位，請於學校周邊停車場停車後前來)

2. 校園導覽圖

報名網址：

https://docs.google.com/forms/d/e/1FAIpQLSft3TewjquMMJmZVG-s3fw-szzxgDZuaQkRupHXp_Rp4Rx4_w/viewform

聯絡人

台灣超臨界流體協會 吳家瑩秘書
E-mail: tscfa@mail.mirdc.org.tw Tel: (07)355-5706

恭賀本會團體會員亞果生醫(股)公司榮獲『112 年度傑出生技產業獎』！

易度企業股份有限公司

關於易度

臺灣易度企業自 1989 年 8 月設立起，從事表面處理設備製作與開發研究工作，秉持著堅強團隊陣容，以最專業、最優秀品質，創造最理想設備，這十幾年的成長過程中，不斷精益求精，期間榮獲振動電鍍裝置、電鍍滾桶改良構造等五項專利，並獲得德國大廠 KISSLER、LPW & BLASBEGR 之技術轉移。

多年來在各種產業之表面處理設備製作、製程深耕之經驗成果，提供各種製程專用之自動化表面處理設備。並引進歐洲先進技術，在台製造銷售；期使本土產業能以台制價格，享受歐洲高品質、高效能之處理設備。設備之設計除考慮製程之高良率、高效率外，亦設計節水、減廢之功能。以認真用心的設計、技術上的突破、深厚的硬體製作經驗及完善的程式控制，給予客戶最佳的生產設備。

企業名稱由來

「易度」各字義有不同含義，而這些內涵是易度企業文化的重要準則。

「易」的字義有變異、不易及容易三個層面。變異代表變動快速的意思，延伸成為企業的靈活快速迎合市場需求及變動。不易另外可解釋為不變的意思，做為一個企業需要一個赤子之心並隨時警惕自己勿忘初心。容易代表簡單的意思，我們為客戶提供化繁為簡的解決方案一直視為企業自豪的精緻服務。

「度」的字義有衡量、尺寸的含意也可以象徵精準量度的意思，延伸成為精準的做事態度及方法。

企業定位：從電鍍設備到廢水處理為客戶作最完善的精緻服務。

產品定位：不是為環保局的罰單作環保是要為世世代代的子孫作保育。

產品：

- 五金、汽車業、航太、塑膠電鍍、裝飾電鍍、電子
- 手動設備、吊鍍設備、迴轉電鍍、連續電鍍、微電鑄、實驗設備、滾鍍設備、廢水設備、廢氣設備

主要設備及服務：

聯絡資訊：

地址：桃園市龍潭區高楊北路 106 巷 85 號

電話：(03)411-7983

信箱：sales@eidorado.com.tw

TSCFA台灣超臨界流體協會
Taiwan Supercritical Fluid Association

(日間班)高壓氣體特定設備操作人員安全衛生教育訓練班

需要有操作證照的單位，歡迎向協會報名。

●上課日期：**113/01/08~01/11 08:00~17:00；01/11~01/12 08:00~17:00(實習)**

●上課時數：高壓氣體特定設備操作人員安全衛生教育訓練課程時數 35 小時＋2 小時(測驗)。

●課程內容：高壓氣體概論 3HR、種類及構造 3HR、附屬裝置及附屬品 3HR、自動檢查與檢點維護 3HR、安全裝置及其使用 3HR、操作要領與異常處理 3HR、事故預防與處置 3HR、安全運轉實習 12HR、高壓氣體特定設備相關法規 2HR，共 35 小時。(另加學科測驗 1 小時及術科測驗約 1~2 小時)

●上課地點：高雄市楠梓區高楠公路 1001 號【金屬工業研究發展中心研發大樓 2 樓　產業人力發展組】

●參加對象：從事高壓氣體特定設備操作人員或主管人員。

●費　　用：本班研習費**新台幣 7,000 元整**，**本會會員享九折優惠**。

●名　　額：每班 30 名，額滿為止。

●結訓資格：期滿經測驗成績合格者，取得【高壓氣體特定設備操作人員安全衛生訓練】之證書。

●報名辦法：1.傳真報名：(07)355-7586台灣超臨界流體協會
2.報名信箱：tscfa@mail.mirdc.org.tw
3.研習費請電匯至 兆豐國際商銀 港都分行(代碼017)
戶名：社團法人台灣超臨界流體協會 帳號：002-09-018479（註明參加班別及服務單位）或以劃線支票抬頭寫「台灣超臨界流體協會」連同報名表掛號郵寄台灣超臨界流體協會，本會於收款後立即開收據寄回。

※洽詢電話：(07)355-5706 吳小姐繳交一吋相片一張及身份證正本

報　　名　　表

課程名稱	高壓氣體特定設備操作人員安全衛生教育訓練			上課日期	113 年 01/08~01/12	
姓　　名	出生年月日	身份證字號	手機號碼	畢業校名		公司產品
服務單位				電　　話		
服務地址	□□□			傳　　真		
發票住址	□□□			統一編號		
負 責 人	人	訓練聯絡人 / 職稱		email：		
參加費用	共　　元	參加性質		□公司指派　　□自行參加		
繳費方式	□郵政劃撥　□支票　□附送現金			報名日期	年　　月　　日	

※ 出生年月日、身份證字號、畢業校名、電話、地址須詳填，以利製作證書。

上課日期時間表

課程名稱：(日間班)高壓氣體特定設備操作人員安全衛生教育訓練班

2024/01/08 (一)	08:00 ~ 17:00
2024/01/09 (二)	08:00 ~ 17:00
2024/01/10 (三)	08:00 ~ 17:00
2024/01/11 (四)	08:00 ~ 17:00 (實習第 1 組)
2024/01/12 (五)	08:00 ~ 14:00 (實習第 1 組)

TSCFA 台灣超臨界流體協會
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(夜間班)高壓氣體特定設備操作人員安全衛生教育訓練班

需要有操作證照的單位，歡迎向協會報名。

●上課日期：**(夜班)113/02/20~03/01 18:30~21:30；03/02~03/03 08:00~17:00(實習)**

●上課時數：高壓氣體特定設備操作人員安全衛生教育訓練課程時數 35 小時＋2 小時(測驗)。

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●上課地點：高雄市楠梓區高楠公路 1001 號【金屬工業研究發展中心研發大樓 2 樓　產業人力發展組】

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●費　　用：本班研習費**新台幣 7,000 元整**，**本會會員享九折優惠**。

●名　　額：每班 30 名，額滿為止。

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2.報名信箱：tscfa@mail.mirdc.org.tw
3.研習費請電匯至 兆豐國際商銀 港都分行(代碼017)
戶名：社團法人台灣超臨界流體協會 帳號：002-09-018479（註明參加班別及服務單位）或以劃線支票抬頭寫「台灣超臨界流體協會」連同報名表掛號郵寄台灣超臨界流體協會，本會於收款後立即開收據寄回。

※洽詢電話：(07)355-5706 吳小姐繳交一吋相片一張及身份證正本

報　　名　　表

課程名稱	高壓氣體特定設備操作人員安全衛生教育訓練			上課日期	113 年 02/20~03/03	
姓　　名	出生年月日	身份證字號	手機號碼	畢業校名		公司產品
服務單位					電　　話	
服務地址	□□□				傳　　真	
發票住址	□□□				統一編號	
負 責 人	人	訓練聯絡人 / 職稱		email：		
參加費用	共　　元	參加性質		□公司指派　　□自行參加		
繳費方式	□郵政劃撥　□支票　□附送現金			報名日期	年　　月　　日	

※ 出生年月日、身份證字號、畢業校名、電話、地址須詳填，以利製作證書。

上課日期時間表

課程名稱：(日間班)高壓氣體特定設備操作人員安全衛生教育訓練班

2024/02/20 (二)	18:30 ~ 21:30
2024/02/21 (三)	18:30 ~ 21:30
2024/02/22 (四)	18:30 ~ 21:30
2024/02/23 (五)	18:30 ~ 21:30
2024/02/26 (一)	18:30 ~ 21:30
2024/02/27 (二)	18:30 ~ 21:30
2024/02/29 (四)	18:30 ~ 21:30
2024/03/01 (五)	18:30 ~ 21:30
2024/03/02 (六)	08:00 ~ 17:00 (實習第 1 組)
2024/03/03 (日)	08:00 ~ 14:00 (實習第 1 組)

A multi-index evaluation method of supercritical CO_2 Brayton cycle for nuclear power plants design

核電廠設計超臨界 CO_2 布雷頓循環多指標評估方法

By **Yongfeng Cheng, Na Zhang, Tianxin Yuan & Guopeng Yu**

Sino-French Institute of Nuclear Engineering and Technology, Sun Yat-sen University, Nanchang, China

Abstract

This paper investigated four different S-CO_2 Brayton cycle layouts for nuclear energy conversion: simple recuperation cycle (SR), recompression cycle (RC), re-heating cycle (RH), and intercooling cycle (IC). We compared these S-CO_2 Brayton cycle schemes for nuclear energy conversion using the G1+TOPSIS multi-index evaluation method. The evaluation results of different schemes based on their safety, thermodynamics, techno-economic and compactness are given. The results show that for Generation IV reactors with the same designed thermal power, the thermodynamic performance of the S-CO_2 system is better for higher reactor exit temperature. Among the schemes, the gas-cooled fast reactor (GFR)+RC scheme has the highest thermal efficiency (47.4%) and exergy efficiency (56.48%). The GFR+IC scheme has the lowest specific cost (1861.3$/W) and the internal rate of return (24.8%). The re-heating cycle (RH) has worse indexes, but it requires the lowest initial investment cost. The intercooling cycle (IC) has the lowest levelized cost of electricity (0.0134 $/KW•h) coupling to GFR. Considering all indexes of four aspects, the reactor's performance ranking is MSR>LFR>SFR>GFR, and the S-CO_2 system's performance ranking is RC>SR>IC>RH. For Generation IV nuclear energy conversion technologies, the molten salt reactor (MSR)+RC scheme should be given priority, while GFR+RH schemes should be carefully considered.

Keywords: Supercritical CO_2 Brayton cycle, nuclear energy generation, techno-economic comparison, thermodynamic analysis, multi-index evaluation method

資料來源：https://doi.org/10.1080/15435075.2023.2281346

Comparisons of Supercritical Loop Flow and Heat Transfer Behavior Under Uniform and Nonuniform High-Flux Heat Inputs

均勻和非均勻高通量熱輸入下超臨界環流和傳熱行為之比較

By **Dong Yang, Lin Chen, Yongchang Feng & Haisheng Chen**

a Institute of Engineering Thermophysics, Chinese Academy of Sciences, Beijing100190, China

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Abstract

The heat transfer characteristic of supercritical water is one of the crucial issues in SuperCritical Water-Cooled Reactors (SCWRs). The efficiency and safety of the SCWR system are largely dependent on the local heat transfer performance. This paper establishes the numerical model for supercritical water in a long vertical circular loop (inside diameter = 10 mm) and analyzes the flow and heat transfer mechanism during the transition process from subcritical to supercritical states under various heat fluxes (uniform and nonuniform). The results reveal that the difference in thermophysical properties between the boundary layer and the core region is the main reason for the heat transfer behavior, especially during the transition from subcritical to supercritical and liquidlike to gaslike. The flow structure on the buffer layer is a dominating factor for heat transfer deterioration. The cases under variable nonuniform heat fluxes have a higher heat transfer coefficient compared with uniform heat fluxes. But, this will cause large changes of the parameter locally. The dominating factors of heat transfer deterioration under these conditions are also identified.

Keywords: Supercritical water, heat transfer, variable heat fluxes, boundary layer, flow stability

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Influence of the Main Working Parameters and Geometrical Parameters on the Supercritical CO_2 Flow Instability in a Heated Tube

主要工作參數與幾何參數對加熱管內超臨界 CO_2 流動不穩定性的影響

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Abstract

Supercritical CO_2 (sCO_2) flow instability is an issue that must be considered in the reasonable design of sCO_2 boiler. Because it can cause equipment vibration and heat transfer deterioration. In this article, a numerical model for the sCO_2 flow instability in the single tube was developed. Different from the traditional model, the effects of metal heat storage and axial heat conduction in the tube wall were considered. The influence of main parameters on trans-pseudo-critical number (N_{TPC}) and oscillation period (t_0) was studied, with the tube length (L) from 3 to 11 m and the inner diameter (D_{in}) from 10 to 22 mm. N_{TPC} increases with increasing the inlet pressure (P_{in}), mass flux (G), inclination angle (α), and the inlet local resistance coefficient (K_{in}). N_{TPC} decreases with D_{in} and outlet local resistance coefficient (K_{out}). The effects of the sub-pseudo-critical number (N_{SUBPC}), wall thickness (WT) and L on N_{TPC} are nonlinear. With increasing N_{SUBPC}, WT, L, D_{in}, and K_{out}, t_0 increase. As G, α, and K_{in} increase, t_0 becomes smaller. When N_{SUBPC} is lower than 0.9146, t_0 rises with P_{in} increasing. It is opposite with N_{SUBPC} higher than 0.9146.

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Performance Analysis of Heat Exchangers and Integrated Supercritical CO_2 Brayton Cycle for Varying Heat Carrier, Cooling and Working Fluid Flow Rates

針對不同熱載體、冷卻和工作流體流量的熱交換器和整合超臨界 CO_2 布雷頓循環之性能分析

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Abstract

Supercritical CO_2 power systems offer the potential of reduced system footprint and improved thermal efficiency, through the development and adoption of compact heat exchangers. Among these heat exchangers, the microtube, printed circuit, and plate heat exchangers are emerging as the most promising technologies for heat addition to the cycle, heat recuperation and heat rejection, respectively. To investigate the performance of supercritical CO_2 recuperated Brayton cycle for heat to power conversion, simulation models of the heater, recuperator and cooler were developed using the distributed modeling approach and the *ε-NTU* method and then integrated with turbomachinery models to form the cycle model. The influences of flow rates of the heat carrier, cooling and working fluids on the heat exchanger performance and the integrated system were investigated. For the studied power system and under the off-design operating conditions, the net thermal efficiency of the cycle varies between 14.1% and 16.8%. Results show that increasing in the working fluid flow rate remains the net power output of the cycle but decreases the net cycle thermal efficiency, while increasing in the heat carrier fluid increases both, and the increase of cooling fluid increases the net power output but maintains the net thermal efficiency.

資料來源：https://doi.org/10.1080/01457632.2022.2140640

Progress and Prospects for Research and Technology Development of Supercritical CO_2 Thermal Conversion Systems for Power, Energy Storage, and Waste Heat Recovery

超臨界 CO_2 於電力、儲能及餘熱回收熱轉換系統研究與技術發展之進展與展望

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Abstract

CO_2 is an environmentally friendly heat transfer fluid and has many advantages in thermal energy and power systems due to its peculiar thermal transport and physical properties. Supercritical CO_2 (S-CO_2) thermal energy conversion systems are promising for innovative technology in domestic and industrial applications including heat pump, air-conditioning, power generation, renewable energy systems, energy storage, thermal management, waste heat recovery and others. Both S-CO_2 and transcritical CO_2 thermodynamic cycles have been extensively investigated in order to improve the efficiencies of thermal and power systems and achieve net zero carbon emissions. This paper focuses on the progress and prospects for current research and technology development of S-CO_2 thermal energy conversion systems and their applications including power generation, energy storage and waste heat recovery. First, the CO_2 thermal transport and physical properties and benefits using CO_2 as a heat transfer fluid in thermal energy and power systems are discussed. Then, classification of CO_2 thermodynamic systems is presented. Next, S-CO_2 for power generation, energy storage and waste heat recovery systems are presented. Finally, research needs of subcritical and supercritical CO_2 heat transfer, fluid flow and heat exchangers for the development of various thermal energy and power systems are discussed.

資料來源：https://doi.org/10.1080/01457632.2023.2282765

Technoeconomic analysis of supercritical fluid extraction process for recycling rare earth elements from neodymium iron boron magnets and fluorescent lamp phosphors

超臨界流體萃取從釹鐵硼磁體和螢光燈螢光粉回收稀土元素製程技術經濟分析

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Abstract

This study offers a comprehensive and rigorous analysis of the technoeconomics of supercritical fluid extraction (SCFE) technology as applied to the recovery of rare earth elements (REEs) from end-of-life neodymium iron boron magnets and fluorescent lamp phosphors. Drawing on an array of data sources including laboratory results, literature data, scaling models, scenario analysis, and sensitivity analysis, this study conducts a sound economic analysis of the SCFE process at an industrial scale. The study renders a detailed estimation of the costs and revenues associated with the process and identifies the primary factors that impact its profitability. The findings demonstrate that the SCFE of REEs from these feedstocks can be economically viable under certain circumstances, with the efficiency of extracting terbium, dysprosium, and neodymium and the price of their respective oxides emerging as key drivers of profitability. By providing valuable insights into the feasibility of the SCFE process for REEs recovery, this study informs future research and development activities in the field.

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Valorization of food side streams by supercritical fluid extraction of compounds of interest from apple pomace

透過超臨界流體從蘋果渣中提取標的化合物來提高食品下腳料價值

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Abstract

Supercritical CO_2 ($scCO_2$) extraction, a green technology still little applied to side streams, has been used to explore the potential recovery of beneficial compounds from apple pomace, a food industry byproduct. The study examines the potential of $scCO_2$ extraction on freeze-dried and airflow dried apple pomace, using laboratory-scale equipment with varying pressures (200–400 bar), temperatures (35–55 °C) with a fixed CO_2 flow rate. Extracts were analyzed through LC-MS and GC-MS, while antioxidant capacity was assessed using the ABTS assay. The results were compared to those from Soxhlet n-hexane extraction. Optimal conditions of 300 bar and 55 °C with freeze-dried apple pomace yielded the highest mass loss. The main compounds identified included glyceryl dilinoleate, linoleic acid, and diacyl glycerol, with significant ursolic acid content. A preliminary higher scale feasibility test under optimal conditions demonstrated promising, duplicable outcomes, supporting prior claim that apple pomace contains valuable ingredients that can be reused in various industrial sectors.

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