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

電子報第 196 期

活動訊息

- ***論文徵稿***

  即日起徵求「能源與綠色製程」、「食品與生技醫藥」、「材料與精密製造」等3大主題領域的研究論文，邀請各界踴躍投稿，及蒞臨與會交流。

  https://www.tscfa.org.tw/ec99/rwd1480/news.asp?newsno=32

- ***ISSFT 2023***

  日期：**10月16-20日**

  地點：水原市成均館大學(Sungkyunkwan University, Suwon)

  https://www.issft2023.com/

- **超臨界流體技術工作坊**

  日期：**8月29日(二)、9月12日(二)**

  地點：冷研碳索館 (嘉義縣鹿草鄉馬稠後園區一路38號)

  名額：每場次限額**15位**

  報名網址：https://docs.google.com/forms/d/1-qw3yWrSPMvYsE5K7Gwy1nYdR7Wr04R6bMi9yvagK6E/edit

產業新聞

- 亞洲生技大會展前記者會 2023 傑出生技產業獎出爐

  資料來源：https://udn.com/news/story/7241/7308680

- 亞果生醫 再生醫學的引光者

  資料來源：https://www.chinatimes.com/newspapers/20230727000458-260210?chdtv

會員動態

- 徵才活動—綠茵生技股份有限公司

團體會員介紹

- 大儀股份有限公司

教育訓練班

- (夜間班)高壓氣體特定設備操作人員安全衛生教育訓練班 08/29~09/10

技術文摘

- An Explanation for the Flutter Paradox in the Supercritical Region of a Simply-Supported Fluid-Conveying Pipe 簡支流體輸送管道超臨界區顫振悖論的解釋
- Analysis of 10 Phthalate Esters in Water-Based Adhesives by Supercritical Fluid Chromatography–Tandem Mass Spectrometry Combined With Spherical Carbons-Based Dispersion Solid-Phase Extraction 超臨界流體色譜-串聯質譜聯用球形碳基分散固相萃取分析水基粘合劑中的 10 種鄰苯二甲酸酯
- Chemistry and Dynamics of Supercritical Carbon Dioxide and Methane in the Slit Pores of Layered Silicates 層狀矽酸鹽狹縫孔中超臨界二氧化碳和甲烷的化學和動力學
- Numerical simulation of flow and heat transfer performance during supercritical water injection in vertical wellbore: A parameter sensitivity analysis 直井超臨界注水流動傳熱性能數值模擬：參數敏感性分析
- Recycling Hazardous and Valuable Electrolyte in Spent Lithium-Ion Batteries: Urgency, Progress, Challenge, and Viable Approach 回收廢舊鋰離子電池中有害且有價值的電解質：緊迫性、進展、挑戰和可行的方法
- Supercritical CO_2 and Water Injection Induced Fracturing - Application to Geological Carbon Sequestration 超臨界 CO_2 和注水誘導壓裂——在地質碳封存中的應用
- Unveiled Supercapacitive Performance of Se-doped Graphene Nanoarchitectonics prepared via Supercritical Fluid technique 通過超臨界流體技術製備的硒摻雜石墨烯納米結構的超級電容性能

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

TSCFA 台灣超臨界流體協會

第二十二屆
超臨界流體技術應用與發展研討會

論文徵稿

發表日期｜2023年10月21日(六)

申請收件截止日期｜2023年9月15日(五)

審查結果通知日期｜2023年9月25日(一)

發表地點｜ 國立中興大學食品暨應用生物科技學系
食品生物科技大樓 演講廳 (台中市南區興大路145號)

論文主題

- 能源與綠色製程
- 食品與生技醫藥
- 材料與精密製造

聯絡資料：
台灣超臨界流體協會 吳家瑩小姐 專線：(07)355-5706 投稿信箱：tscfa@mail.mirdc.org.tw
協會網址：https://www.tscfa.org.tw

主辦單位｜國立中興大學食品暨應用生物科技學系 TSCFA 台灣超臨界流體協會

超臨界流體技術工作坊

「超臨界流體技術」為公認之綠色化學製程，在台灣超臨界流體協會之產官學研各領域專家會員協助推廣下，近二十年來已累積相當之產業應用成果。「超臨界流體技術工作坊」在疫情期間中斷三年，今年恢復辦理，僅訂於 112 年 8 月 29 日(二)、9 月 12 日(二) 在嘉義舉辦兩場次。

工作坊之目的在介紹超臨界流體萃取、分離、純化技術於天然物產品開發、產品設計與產業應用之實例，以及從實驗到商業化設備之介紹，並參觀全台首家以二氧化碳為主題的教學觀光工廠—冷研碳索館。講師陣容有金屬工業研究發展中心天然物創新應用研究所(NPiL)資深研究員，協會秘書長等。

期許與會先進能於本工作坊中，對超臨界流體技術之應用有更進一步之認識，並能共同推動與參與超臨界流體技術之產業化。誠摯邀請您撥空參加並提供您的寶貴意見！

議程：

時間：112 年 8 月 29 日(二)、9 月 12 日(二)

地點：冷研碳索館 (嘉義縣鹿草鄉馬稠後園區一路 38 號)

名額：每場次限額 15 位

時間	講題	講者
09:30~10:00	報到	
10:00~11:00	超臨界流體應用在天然物產業技術簡介	NPiL
11:00~11:15	茶歇	
11:15~12:15	超臨界流體於天然生技產品開發實例	NPiL
12:15~13:30	午餐	
13:30~15:00	觀光工廠導覽&SCCO2萃取DEMO	冷研
15:00~16:00	超臨界流體萃取/分離/純化設備介紹	郭子禎
16:00~16:15	茶歇	
16:15~17:00	綜合座談	

交通方式：

- 國道一號

  在 272-嘉義系統出口下交流道，朝東石前進，走台 82 線，於 14 祥和出口 (嘉 45 鄉道 出口) 下交流道，朝鹿草/太保/朴子前進，分岔路口靠左，繼續朝嘉 45 鄉道前進，右轉進入馬稠後園區一路約 1 分鐘即可到達，冷研碳索館位於右手邊。

- 高鐵與公車資訊

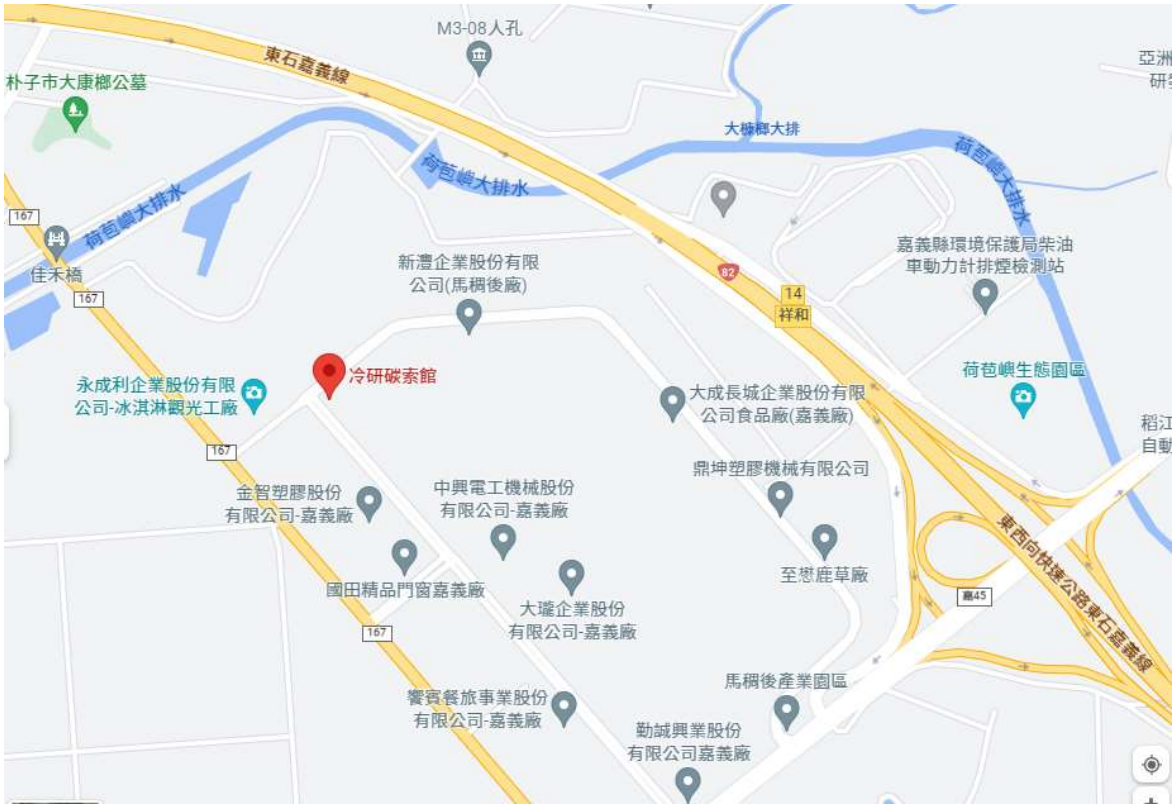
  於嘉義高鐵站出站後，轉乘阿里山客運 166 路【高鐵嘉義站-鹽水】至馬稠後產業園區站下車，再步行約 11 分鐘抵達碳索館。

166路線乘車時刻表【高鐵嘉義站<>鹽水】					
◎高鐵嘉義站時刻	9:30	10:30	12:30	14:30	16:00
◎鹽水站時刻	9:00	10:00	11:00	13:00	15:00

- 租車自由行 - 綠悠遊-嘉義輕旅行

  鄰近嘉義高鐵，走路不用 3 分鐘（高鐵 2、3 號出口，車站廣場正對面），提供機車、電動機車、電動車、腳踏車出租及接駁等服務。

★冷研碳索館館內附設停車場停放，100 公尺轉角處也設有公共停車場！



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

亞洲生技大會展前記者會 2023 傑出生技產業獎出爐

2023-07-18 記者/胡經周

台灣生物產業發展協會今天舉行亞洲生技大會展前記者會，並宣佈「2023 Taiwan BIO Awards 傑出生技產業獎」得主，經過長達三個月的初審、複審及決審，選出共 13 家機構及產品技術：「產業金質獎」獲獎名單分別為保瑞藥業、長聖生技、啟新生技、利統；「潛力標竿獎」獲獎名單分別為：中裕新藥、安基生技、長佳智能、和康生技；「產業創新獎」則是由**亞果生醫「超臨界二氧化碳平台技術於再生醫療產業之應用」**、晉弘科技「赫羅斯拋棄式鼻咽內視鏡」、博晟生醫「『舒效切』自體脂肪前驅細胞收集套組」、正瀚生技「永續型農化產品 - Radiate NEXT」、葡萄王生技「機能性植物乳桿菌 GKM3®」獲選。

資料來源：https://udn.com/news/story/7241/7308680

亞果生醫 再生醫學的引光者

2023/07/27　工商時報/周榮發

已在國際市場打開能見度，並吸引國際級生醫公司及投資團隊進行跨國合作的亞果生醫（6748），今（27）日在亞洲生技大展，以全球首創再生醫學技術「超臨界二氧化碳平台技術於再生醫療產業之應用」，獲得評審團一致肯定，榮獲 2023 Taiwan BIO Awards 傑出生技產業的「產業創新獎」，該獎除表彰該公司之技術已是業界領先，更進一步確認將是未來生醫市場的主要應用技術。

亞果生醫執行長謝達仁博士表示，臺灣在生物醫藥領域的發展，全球有目共睹，而每年的亞洲生技大展盛會，吸引國內外頂尖生醫企業參與，除概論全球生技產業發展趨勢，也頒獎表揚傑出生技企業；亞果生醫即是榮獲 2023 傑出生技產業三大獎項之一的「產業創新獎」。

事實上，亞果生醫耗資多時推動的再生醫學正全面收網中，所成功開發的骨填料與骨基質產品，由於人體臨床表現出乎意料的好，吸引諸多廠商爭取策略合作，並於去年底分別與博而美國際及久億生醫兩家大型通路商簽訂複數年醫材供應合約，計劃從今（2023）年開始逐步增溫出貨。而國際間執醫材通路牛耳的瑞士商 DKSH，也看好亞果生醫的生物醫材，特別是骨填料及敷料，正洽談越南的總代理權。

謝達仁更指出，亞果生醫國際步伐正大步展開，最新生醫技術「去細胞器官及其製備方法」取得歐洲專利核准，將是臺灣生醫技術進軍歐洲應用市場的最佳典範。另外，毛髮增生技術已在臺灣取得智財發明專利，目前已著手於北部三總、中部秀傳及南部高醫進行人體臨床，該技術已在香港自由許可制度下，開展為苦於毛髮稀疏患者進行毛囊激增生髮，受到患者一致好評。

再生醫學確實為人類的後天殘缺開啟一道光明，而亞果生醫正是這道光源的引光者，期待光明照耀人間與大地。

資料來源：https://www.chinatimes.com/newspapers/20230727000458-260210?chdtv

綠茵生技 GREENYN BIOTECHNOLOGY

JOIN US

R&D Team

研發人員

Job Description

- 保健食品原料R&D，新品專案提報與執行。
- 最適製程開發與試產導入。
- 功效試驗設計&執行、機制分析&驗證。
- 檢驗分析方法開發&確效。
- 市場趨勢分析&資料建立。

Job Conditions

- 具動植物萃取、分析方法與產線製程開發經驗者佳，食品、生科相關領域者為優。
- 個性樂觀積極、開朗活潑。

報名請掃描　104人力銀行　公司網頁

Human Resources Department
04-22382867#171 Cherry
cherrychiang@greenyn.com.tw

大儀股份有限公司

關於大儀

大儀股份有限公司成立於 1987 年，為日商 Nikkiso Co., Ltd.、德商 LEWA GmbH 及美商 Sundyne, LLC 之台灣總代理。多年來致力於提供優質產品並不斷成長，堅持以更專業的技術實現更完善的售後服務，時時以客戶滿意作為我們努力的目標。

多元的產品線

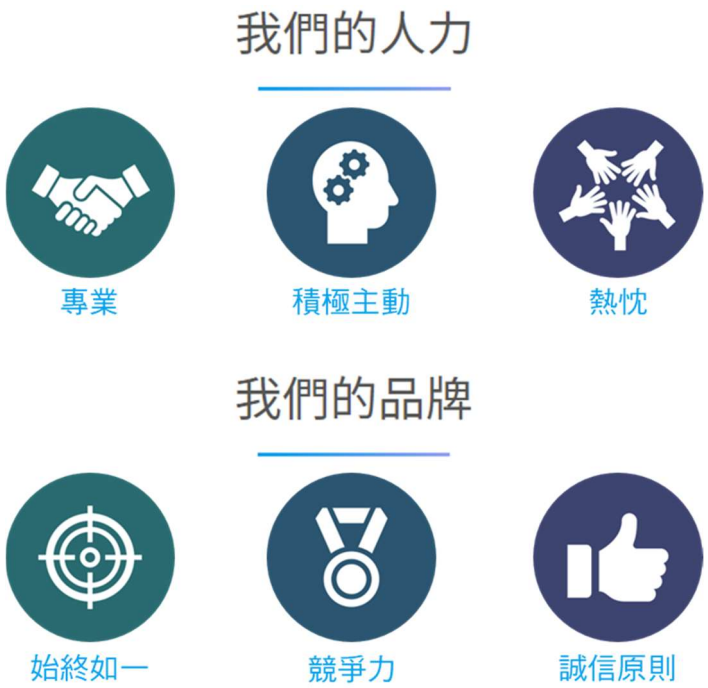
包含各類型工業用泵浦、壓縮機、蒸發器、攪拌機、工商業及民生使用之 UVC LED 殺菌模組與封裝品等。

廣泛的應用產業

除耕耘多年的石化、煉油、化纖、鋼鐵、核能電廠、半導體、化學品倉儲、食品工業、醫藥研發、海水淡化等應用，近年並新增蒸發器與 UVC LED 產品線，服務範圍擴及工業氣體、液化天然氣及深紫外線殺菌應用等領域。

貼近客戶的服務據點

大儀除了臺北總部，另於彰化設有維修工廠與零件倉庫；並在台中、麥寮、高雄及上海設有貼近客戶的服務據點。



LEWA 超臨界萃取解決方案（大儀總代理）

超臨界萃取製程要求在低溫及中等壓力條件下溫和處理產品，因此對設備中的定量泵浦和製程膜片泵浦的要求非常特殊。

大儀代理的LEWA 超臨界萃取解決方案非常適合這些應用領域，因為它們能滿足所有相關的製程條件。

LEWA 解決方案優點與特色

- 完全無洩漏
- 用於液化氣（製冷設備）的高壓泵浦及其週邊設備佈局
- 適用於稀薄、無潤滑介質
- 操作可靠性高
- 由於泵頭運動零件少，因此磨損低，幾乎沒有顆粒污染物
- 容易清潔，食品級設計
- 用於製藥領域的衛生等級設計（Ra < 0.5 µm 電拋光，ASME BPE）
- 安裝在 GMP 區域/無塵室
- 材質符合 FDA（美國食品藥品管理局）規範（GRAS：Generally Recognized As Safe）
- 可安裝於防爆區域內
- 理想的泵頭材質，例如哈氏合金，可用於高腐蝕介質
- 適用各種接口形式
- 可為客戶量身訂製閥件（Valve）
- 品質批准/證明文件
- 經驗證可用於晶片的清洗（弗勞恩霍夫 IPA Tested Device®）

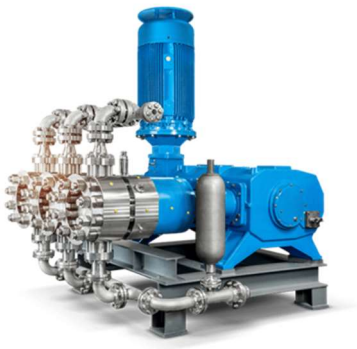



應用範圍

LEWA 定量泵浦和製程膜片泵浦已成功應用於以下製程：

- 以超臨界 CO_2 進行的萃取製程（超臨界流體萃取 Supercritical Fluid Extraction, SFE），如脫咖啡因、脫脂、植物萃取，以及油籽、Ω 魚油、香精和香料的萃取。
- 超臨界製備液相色譜法（Supercritical Fluid Chromatography SFC）以及光學活性物質的分離。
- 超臨界流體反應（Supercritical Fluid Reactions, SFR）。
- 顆粒形成（如來自氣體飽和溶液的顆粒 Particles from Gas Saturated Solutions, PGSS），例如用於粉碎油脂，烘焙食品等高壓噴塗製程。
- 清潔程序，例如：物質處理過程的整合與分離，如殺蟲劑去除（wool grease 羊毛油脂、lanolin 羊毛脂）。
- 細胞分解、滅活（溫和滅菌）。

▲ LEWA ecoflow®
定量泵浦



▲ LEWA triplex®
製程膜片泵浦

資料來源：taikkiso.com.tw

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

(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)08/29~09/07 18:30~21:30；09/09~09/10 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	112 年 8/29~9/10	
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

2023/08/29 (二)	18:30 ~ 21:30
2023/08/30 (三)	18:30 ~ 21:30
2023/08/31 (四)	18:30 ~ 21:30
2023/09/01 (五)	18:30 ~ 21:30
2023/09/04 (一)	18:30 ~ 21:30
2023/09/05 (二)	18:30 ~ 21:30
2023/09/06 (三)	18:30 ~ 21:30
2023/09/07 (四)	18:30 ~ 21:30
2023/09/09 (六)	08:00 ~ 17:00 (實習第 1 組)
2023/09/10 (日)	08:00 ~ 14:00 (實習第 1 組)

An Explanation for the Flutter Paradox in the Supercritical Region of a Simply-Supported Fluid-Conveying Pipe

簡支流體輸送管道超臨界區顫振悖論的解釋

By **Ding Ming, Meng Shuai, Liu Zhen, Zhan Junhan**

State Key Laboratory of Ocean Engineering, Shanghai Jiao Tong University, Shanghai 200240, China

Abstract

Employing traditional Galerkin method, a coupled-mode flutter is predicted in the supercritical region of simply-supported pipes which constitutes a paradox since the internal flow effect is conservative and there is no energy to sustain the oscillation. Although there is a consensus that the flutter does not exist, the intrinsic mechanism remains to be clarified. This study has found that the internal flow induced Coriolis force term cannot be decoupled in traditional Galerkin method which leads to the dissatisfaction of the convergence conditions required in weighted residual approach (WRA). Moreover, the disparities in the predicted complex frequencies have been witnessed at different base function numbers when the internal flow velocity is sufficiently large. A modified Galerkin method adopting a new set of weighting functions is proposed based on WRA, and the Coriolis force term disappears by use of the orthogonality relations (it is stated that the Coriolis force is not directly omitted). Thus, a convergent solution for the set of residual functions which are identically equal to zeros can be guaranteed. Employing the modified method, the convergence in simulations is confirmed and the flutter phenomenon does not occur. This study can be a workbench for the study on the unsolved or partly solved issues in simulations of fluid-conveying pipes. Moreover, it has demonstrated that the predictions in traditional Galerkin method overestimate the natural frequencies, and it becomes more profound in higher-order natural modes at larger internal flow velocities which are of practice significance for dynamic analysis of flexible pipeline systems.

Keywords: simply-supported pipe, internal flow effect, paradox explanation, weighted residual approach, fluid-structure interaction, pipeline technology

資料來源：https://doi.org/10.1115/1.4062718

Analysis of 10 Phthalate Esters in Water-Based Adhesives by Supercritical Fluid Chromatography–Tandem Mass Spectrometry Combined With Spherical Carbons-Based Dispersion Solid-Phase Extraction

超臨界流體色譜-串聯質譜聯用球形碳基分散固相萃取分析水基粘合劑中的 10 種鄰苯二甲酸酯

By **Jun Yan, Zhiyan Chen, Chunqiong Wang, Yun Xue, Li Lin, Chen He, Xiao Zhou, Fei Yang, Yun Zhou, Gangling Tang**

China National Tobacco Quality Supervision and Test Center, Zhengzhou 450001, China

Abstract

Background

Spherical carbons have a porous structure and large surface area for adsorption of macromolecules in water-based adhesives. Supercritical fluid chromatography (SFC) can improve selectivity and obtain better separation for phthalate esters (PAEs).

Objective

The aim of this study was to develop a simple and green method for the simultaneous determination of 10 PAEs in water-based adhesives using SFC–tandem mass spectrometry with dispersion solid-phase extraction by spherical carbons.

Method

Separation of PAEs on a Viridis HSS C18 SB column and the parameters affecting the extraction were evaluated.

Results

Good accuracy and precision were obtained with the recoveries at 0.5, 2.0, and 10.0 mg/kg ranging from 82.9 to 99.5% and the intra- and inter-day precision less than 7%. The method had excellent sensitivity with limits of detection in the range of 0.015–0.029 mg/kg. In the 10–500 ng/mL concentration range, the linear correlation coefficients of all compounds were between 0.9975 and 0.9995.

Conclusions

The method was applied to the determination of 10 PAEs in actual samples. This method is simple and rapid with low solvent consumption and high extraction efficiency. When applied to the determination of PAEs in actual samples, the method

is sensitive and accurate and can meet the batch processing requirements for trace PAEs in water-based adhesives.

Highlights

PAEs in water-based adhesives can be determined using inexpensive materials and simple procedures with SFC.

資料來源：https://doi.org/10.1093/jaoacint/qsad048

Chemistry and Dynamics of Supercritical Carbon Dioxide and Methane in the Slit Pores of Layered Silicates

層狀矽酸鹽狹縫孔中超臨界二氧化碳和甲烷的化學和動力學

By **Geoffrey M. Bowers*, Narasimhan Loganathan, John S. Loring, Herbert Todd Schaef, and A. Ozgur Yazaydin**

Department of Chemical Engineering, University College London, London, U.K.

Abstract

In the mid 2010s, high-pressure diffraction and spectroscopic tools opened a window into the molecular-scale behavior of fluids under the conditions of many CO_2 sequestration and shale/tight gas reservoirs, conditions where CO_2 and CH_4 are present as variably wet supercritical fluids. Integrating high-pressure spectroscopy and diffraction with molecular modeling has revealed much about the ways that supercritical CO_2 and CH_4 behave in reservoir components, particularly in the slit-shaped micro- and mesopores of layered silicates (phyllosilicates) abundant in caprocks and shales. This Account summarizes how supercritical CO_2 and CH_4 behave in the slit pores of swelling phyllosilicates as functions of the H_2O activity, framework structural features, and charge-balancing cation properties at 90 bar and 323 K, conditions similar to a reservoir at ∼1 km depth. Slit pores containing cations with large radii, low hydration energy, and large polarizability readily interact with CO_2, allowing CO_2 and H_2O to adsorb and coexist in these interlayer pores over a wide range of fluid humidities. In contrast, cations with small radii, high hydration energy, and low polarizability weakly interact with CO_2, leading to reduced CO_2 uptake and a tendency to exclude CO_2 from interlayers when H_2O is abundant. The reorientation dynamics of confined CO_2 depends on the interlayer pore height, which is strongly influenced by the cation properties, framework properties, and fluid humidity. The silicate structural framework also influences CO_2 uptake and behavior; for example, smectites with increasing F-for-OH substitution in the framework take up greater quantities of CO_2. Reactions that trap CO_2 in carbonate phases have been observed in thin H_2O films near smectite surfaces, including a dissolution–reprecipitation mechanism when the edge surface area is large and an ion exchange–precipitation mechanism when the interlayer cation can form a highly insoluble carbonate. In contrast, supercritical CH_4 does not readily associate with cations, does not react with smectites, and is only incorporated into interlayer slit mesopores when

(i) the pore has a z-dimension large enough to accommodate CH_4, (ii) the smectite has low charge, and (iii) the H_2O activity is low. The adsorption and displacement of CH_4 by CO_2 and vice versa have been studied on the molecular scale in one shale, but opportunities remain to examine behavioral details in this more complicated, slit-pore inclusive system.

資料來源：https://doi.org/10.1021/acs.accounts.3c00188

Numerical simulation of flow and heat transfer performance during supercritical water injection in vertical wellbore: A parameter sensitivity analysis

直井超臨界注水流動傳熱性能數值模擬：參數敏感性分析

By

Qiuyang Zhao[a], Yuhuan Lei[a], Hui Jin[ab], Lichen Zheng[a], Yechuan Wang[ab], Liejin Guo[a]

[a] State Key Laboratory of Multiphase Flow in Power Engineering, Xi'an Jiaotong University, Xi'an, 710049, China

[b] Xinjin Weihua Institute of Clean Energy Research, Foshan, 528216, China

Abstract

Supercritical water injection is a promising technology for heavy oil thermal recovery. Predicting and regulating the thermophysical parameters of supercritical water at bottomhole are the prerequisite for achieving high recovery efficiency. In this paper, a novel numerical model was proposed to simulate wellbore flow and heat transfer of supercritical water injection. A modified correlation of frictional coefficient was developed to calculate water flow resistance near its critical point, where its properties change abruptly. The unsteady heat loss to the formation was calculated directly by solving two-dimensional unsteady heat conduction equations. They were respectively coupled in momentum and energy balance equations using an iterative scheme. This model was proved to be accurate by two oilfield cases in which the relative errors of wellbore fluid pressure and temperature are less than 1%. Then parameters sensitivity analysis of the injection pressure, temperature, mass flux and the apparent heat conductivity of insulating tube was conducted. The results indicated that the temperature variation of wellbore fluid depended on both enthalpy drop (or heat loss) and Joule-Thomson effect. An abnormal phenomenon that the fluid temperature increased with wellbore depth near the critical and pseudo-critical points was found because of the sudden increase in high heat capacity and Joule-Thomson coefficient of water. Raising the bottomhole fluid temperature was the key to enhanced oil recovery by supercritical water injection. Low apparent heat conductivity of insulating tube contributed richly to raise bottomhole fluid temperature by enlarging thermal resistance and reducing wellbore heat loss. There existed an optimal mass flux for maximizing bottomhole temperature, because when the mass flux increased, the shortened resident time within wellbore and the decreased fluid pressure favored temperature increase and decrease respectively. Selecting an injection pressure near the critical or pseudo-critical point and raising the injection

temperature would increase the bottomhole temperature and reduce relative fluid heat loss.

Keywords: Supercritical water injection, Wellbore flow and heat transfer, Joule Thomson effect, Near-critical area, Parameter sensitivity analysis

資料來源：https://doi.org/10.1016/j.ijthermalsci.2022.107855

Recycling Hazardous and Valuable Electrolyte in Spent Lithium-Ion Batteries: Urgency, Progress, Challenge, and Viable Approach

回收廢舊鋰離子電池中有害且有價值的電解質：緊迫性、進展、挑戰和可行的方法

By **Bo Niu*, Zhenming Xu, Jiefeng Xiao, and Yufei Qin**

College of Resources and Environmental Science, Hebei Agricultural University, Hebei Baoding 071000, People's Republic of China

Abstract

Recycling spent lithium-ion batteries (LIBs) is becoming a hot global issue due to the huge amount of scrap, hazardous, and valuable materials associated with end-of-life LIBs. The electrolyte, accounting for 10–15 wt % of spent LIBs, is the most hazardous substance involved in recycling spent LIBs. Meanwhile, the valuable components, especially Li-based salts, make recycling economically beneficial. However, studies of electrolyte recycling still account for only a small fraction of the number of spent LIB recycling papers. On the other hand, many more studies about electrolyte recycling have been published in Chinese but are not well-known worldwide due to the limitations of language. To build a bridge between Chinese and Western academic achievements on electrolyte treatments, this Review first illustrates the urgency and importance of electrolyte recycling and analyzes the reason for its neglect. Then, we introduce the principles and processes of the electrolyte collection methods including mechanical processing, distillation and freezing, solvent extraction, and supercritical carbon dioxide. We also discuss electrolyte separation and regeneration with an emphasis on methods for recovering lithium salts. We discuss the advantages, disadvantages, and challenges of recycling processes. Moreover, we propose five viable approaches for industrialized applications to efficiently recycle electrolytes that combine different processing steps, ranging from mechanical processing with heat distillation to mechanochemistry and in situ catalysis, and to discharging and supercritical carbon dioxide extraction. We conclude with a discussion of future directions for electrolyte recycling. This Review will contribute to electrolyte recycling more efficiently, environmentally friendly, and economically.

資料來源：https://doi.org/10.1021/acs.chemrev.3c00174

Supercritical CO_2 and Water Injection Induced Fracturing - Application to Geological Carbon Sequestration

超臨界 CO_2 和注水誘導壓裂——在地質碳封存中的應用

By **Blessed C. A. Amoah; Son T. Dang; Chandra S. Rai; Carl H. Sondergeld**

Mewbourne School of Petroleum and Geological Engineering, University of Oklahoma

Abstract

To safely sequester carbon dioxide (CO_2) in the subsurface, it is vital to maintain the injection pressure below formation breakdown pressure, which is dominantly governed by lithology, principal stresses, and presence of natural fractures. This prevents the creation of injection-induced fractures and its associated seismicity which are undesirable occurrences for CO_2 sequestration projects. However, higher injection pressure allows more formation fluids to be displaced, thus enhancing the effective storage capacity of the sequestration zone. To optimize the injection pressure, leak-off tests are typically conducted with a water-based drilling fluid to determine the breakdown pressure. But, considering the significant dissimilarity in fluid properties between water and supercritical CO_2 ($ScCO_2$) the resulting breakdown pressure, failure mechanism and extent of damage can vary. In this study, we investigate how different injectates ($ScCO_2$ and water) impact rock fracturing.

We conducted six triaxial fracturing tests on 2.5% KCl brine saturated samples using $ScCO_2$ and water. All 4 inches diameter cylindrical rock samples were plugged from the same block of Tennessee sandstone. The injection pressure and acoustic emissions were simultaneously recorded in real time. We mounted an array of sixteen 1 MHz piezoelectric transducers around the samples to capture acoustic emission (AE) attributes which were used to calculate the events' location, chronological order, and amplitude. After the fracturing tests, vertical plugs were drilled along the main fracture and used to measure permeability under confining stress. We also imaged the fractures using the scanning electron microscope (SEM).

For samples fractured with $ScCO_2$, the breakdown pressure was reduced by ~ 16% as compared to the breakdown pressure with water, and the permeability of the plugs taken along the main fracture was consistently one order of magnitude greater, across the entire range of confining pressure (500 psi to 4000 psi). Physical examination of the fractured samples revealed that $ScCO_2$ fracturing created bi-wing fractures that spanned the entire length of the sample, whereas water fracturing created fractures

which propagated only through the lower half of the samples. The number of AEs in $ScCO_2$ fracturing increased by a factor of 4 on average, and the AEs had broader distribution perpendicular to the fracture plane, compared to that of water fracturing. SEM imaging of fractures created by $ScCO_2$ injection revealed wider fracture aperture (~ 4 times) and intense cracking with several lose grains over fractures created by water injection.

Based on the experimental results, we have observed that fracturing with $ScCO_2$ occurs at a lower breakdown pressure; therefore, the value estimated from leak-off test should be used as the upper limit for injection pressure. The lower breakdown pressure with $ScCO_2$ could be attributed to the fact that CO2 has greater diffusivity, enabling it to reach the crack tip more easily and promote propagation. $ScCO_2$ fracturing will result in larger damage in both fracture propagation extent and permeability due to the sudden expansion of $ScCO_2$, which releases energy to further the crack extension. Consequently, $ScCO_2$ fractures can propagate over longer distances vertically, potentially compromising the integrity of the seal above and below the storage zone. These fractures are highly transmissive, which could facilitate CO_2 leakage by providing a pathway for migration. To safely operate the sequestration zone, testing core samples in the laboratory using CO_2 to know the exact breakdown pressure is recommended.

Keywords: geologist, upstream oil & gas, wellbore design, drilling fluids and materials, united states government, rock type, sedimentary rock, geology, subsurface storage, clastic rock

資料來源：https://doi.org/10.15530/urtec-2023-3855608

Unveiled Supercapacitive Performance of Se-doped Graphene Nanoarchitectonics prepared via Supercritical Fluid technique

通過超臨界流體技術製備的硒摻雜石墨烯納米結構的超級電容性能

By **Vivekanand ., Srinivasan Suresh Balaji, Kabeer Nasrin, Marappan Sathish**

Functional Materials Division, CSIR-Central Electrochemical Research Institute, Karaikudi, 630003, Tamilnadu, India

Abstract

Doping of graphene with variety of heteroatoms is presently focused for electrochemical supercapacitor applications because it functions as a hybrid supercapacitor. Herewith, we report the fabrication of Se-doped graphene with selenium dioxide using supercritical fluid technique. Both existence, as well as the quantity of Se-doping in graphene are established using XPS and EDAX techniques. The Se-doped graphene derived from the weight ratio of selenium dioxide and graphene oxide in 1:3 has realized an enriched gravimetric capacitance achieving 581 F g-1 (1 M H2SO4). The specific capacity of the optimised Se-doped graphene based symmetric supercapacitor in 0.01 M solution of ammonium vanadate in 1 M H2SO4 solution is found to be 420 C g-1 and attained an improved capacitance retention of 85% over 50000 cycles along with 94% coulombic efficiency. The energy density of the Se-doped graphene symmetric supercapacitor is found to be 23.33 Wh kg-1 in 0.01 M solution of ammonium metavanadate in 1 M H2SO4 solution.

資料來源：https://doi.org/10.1002/cnma.202300209