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

電子報第 202 期

活動訊息

◆ *International Chemical Engineering Symposia 2024*
日 期：**18-20 March, 2024**
地 點：Nakamozu Campus, Osaka Metropolitan University
CHAIR：Prof. Hirohisa UCHIDA
※海外線上參加，免費註冊!!!
IChES - International Chemical Engineering Symposia (scej.org)
議程：https://www4.scej.org/meeting/89a/ICprog/en_session_K-3.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)

產業新聞

◆ 生技業急搶占小分子藥代工商機 經濟部射 4 箭助攻
資料來源：https://www.chinatimes.com/realtimenews/20240111002440-260410?chdtv

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

◆ 連淨綠色股份有限公司

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 02/20~03/03

◆ (日間班)高壓氣體特定設備操作人員安全衛生教育訓練班 03/04~03/08

技術文摘

◆ An Explanation for the Flutter Paradox in the Supercritical Region of a Simply-Supported Fluid-Conveying Pipe 簡支流體輸送管路超臨界區顫振悖論的解釋

◆ Development and Validation of a Segregated Conjugate Heat Transfer Procedure on a sCO_2 Dry Gas Seal Test Bench 在 sCO_2 乾氣密封試驗台上 開發並驗證分離共軛傳熱程序

◆ Formulation and characterization of micro-emulsions of peppermint and coriander oils extracted by using a supercritical fluid system 使用超臨界流體系統提取薄荷油和香菜油的微乳液配製和表徵

◆ Integrated Aerodynamic and Mechanical Design of a Large-Scale Axial Turbine Operating With A Supercritical Carbon Dioxide Mixture 使用超臨界二氧化碳混合物運行的大型軸流式渦輪機的氣動和機械整合設計

◆ Quasi-One-Dimensional Loss Model of Volute Using Boundary Layer Approach for Inward Flow Radial Supercritical CO_2 Turbines 內流徑流式超臨界 CO_2 渦輪機蝸殼之準一維損失模型邊界層法

◆ Synthesis of novel azo pyrazole disperse dyes for dyeing and antibacterial finishing of PET fabric under supercritical carbon dioxide

◆ Synthesis and evaluation of aromatic stationary phases based on linear solvation energy relationship model for expanded application in supercritical fluid chromatography

◆ Supercritical hydrothermal synthesis of copper nanoparticles: Experimental and kinetic study

親愛的 TSCFA 會員，您好

農曆春節即將到來之際，衷心感謝各位一如既往對 TSCFA 的支持與厚愛！

值此新年之際，TSCFA 梁明在理事長暨全體理監事 敬祝 新年快樂、生意興隆、持續追求卓越成功！
懇請持續支持台灣超臨界流體協會（TSCFA），為產業的繁榮和可持續發展貢獻更多力量！

佳節愉快，闔家安康！

生技業急搶占小分子藥代工商機 經濟部射 4 箭助攻

2024/01/11 中時

為了協助台灣生技業搶占國際小分子「專業委託代工」市場，經濟部長王美花 10 日召開「小分子藥品 CDMO(委託開發暨製造服務)產發策略座談會」，邀集國內前 10 大原料藥廠商、西藥製劑、相關公協會逾 20 位意見領袖，以及衛福部、工業技術研究院、醫藥工業技術發展中心等法人，從資源整合、強化研發能量及增強國際鏈結等面向討論，最後敲定出 4 大作法，由經濟部投入資源，助攻我國小分子藥品 CDMO 產業發展。

藥物可依照分子量大小區分為小分子、大分子，前者分子量小於 1000，為治療藥物主力。小分子藥品 CDMO 全球的市場規模達到 897 億美元，複合成長率 6.5%，我國製藥產值為 1089 億台幣，小分子藥品占七成。

這次產官學大會討論非常熱烈，最後獲致具體的共識，決定以四大作法協助小分子藥品。首先是「開發高門檻的技術平台及製程」，經濟部將結合業者共同開發小分子藥品的關鍵技術平台，如原料藥中間體、連續性製程、特殊傳輸劑型等高門檻技術平台。

其次為「輔導廠商進行碳盤查」，我國原料藥有九成外銷，為加速原料藥廠符合國際客戶 2050 年淨零排放要求，產業發展署將積極輔導業者進行碳盤查，以符合國際碳關稅及國內碳費法規需求。

第三是「活化人脈資源增進國際市場鏈結」，透過建立及盤點國外的資源，如旅外華人於國際藥廠擔任研發高層的人脈，及盤點國外產學研的技術，由政府帶領活化人脈資源，建立合作管道。

最後一個做法是「簡化行政流程以利爭取 CDMO 國際商機」，針對原料藥進口、參考歐洲專利權延長制度等行政流程議題，請業者提供實例，由技術司、智慧局與食藥署共同研議解決方案。

經濟部表示，未來將針對 4 大作法強化投入資源，發展高門檻產業技術平台及製程、強化輔導碳盤查、增進國際鏈結及改善行政流程等，引導業者於國際小分子藥品 CDMO 產業占有一席之地。

資料來源：https://www.chinatimes.com/realtimenews/20240111002440-260410?chdtv

連淨綠色科技股份有限公司

🌿 關於連淨

從「以科技促進健康」這個最初的想法開始，連淨實行「從農場到餐桌」以及永續經營的概念，也讓越來越多重視健康的人開始思考環境與自身的關係。

連淨堅持「安全、無毒、不造成人體與環境傷害」的核心理念，對於品質，我們絕不讓步，真誠的為人的健康著想。

「科技讓人們幸福了嗎？」

我們期望，因為連淨的存在，這個答案可以是肯定的。

重拾社會的信任感，現在開始健康的選擇：

連淨，連結你的每個美好時刻。

🌿 特色產品

1、連淨苦茶油

來自原生農地，從土壤就開始把關。採用第一道初榨純淨好油，每一瓶都具備完整生產履歷。把握每個細節，才能做出風味絕佳的透明口感。深獲國際肯定。

鮮 山茶油的好壞 原料是關鍵

淨 食品級潔淨室 全製程管理

四大堅持

穩 嚴格製程控管 確保品質穩定

純 100%初榨 只取第一道鮮榨油

2、口袋農園

品牌名中的「口袋」，呈現其輕便、不受拘束的型態；「農園」則是反映新鮮、「全食物」的概念。使用整顆、整株、整朵植物，乾燥後直接粉碎，不添加人工香精、防腐劑、人工色素等添加物，保留真食物的原味以及植物完整的營養，清新的口感，彷彿置身於農場田園直接取得最新鮮的食物。

3、安心蔬果

全環控潔淨室水耕栽種，杜絕重金屬、農藥與害蟲，口味乾淨口感清脆，不用洗菜即可食。主要耕種生菜、香料等特別需要注意安全的菜種。

4、生醫產品

連淨生醫致力於精準保健研發與原料配方，以此定位發展創新研發核心力與原料開發競爭力：以天然草本營養為基礎，融匯東方醫哲及西方論證，聚焦於整體性、連動性的生理機能調節，以「微分子矯正」為理論基礎，經由給予身體「分子」正確的營養素，開發一系列健康促進商品。

五膳：提供五日的餐食規劃+14 天的營養師餐盤檢查服務，調整體質，建立正確的飲食習慣，從飲食中實踐健康。

機能性保健品：針對各種需求開發各項保健食品，提高生活品質。

5、ORIGIN 精品茶、咖啡、巧克力

『一壺茶，一杯咖啡，一片巧克力，他們背後有著多少故事？

讓 ORIGIN 帶您深入產地，了解這些美好的風味從何而來。』

ORIGIN 品牌創立於 2021 年，致力於鑽研風味最原始的味道。初登場即拿下「巧克力界奧斯卡」 ICA 世界巧克力大賽（International Chocolate Awards）多面獎牌。被讚譽為世界級的巧克力，入口即化的「大人味」更帶給眾人愉悅和諧的感受。

《70% 貢布粉紅胡椒風味巧克力》是 2023 年新研發的風味，一推出即榮獲 2023 ICA 世界巧克力大賽亞太區「銀牌」殊榮，貢布胡椒是胡椒界的精品，強烈的辛辣香氣結合溫潤花果香，入口宛如煙花在口腔裡綻放般驚喜，是一嚐就能被永遠記住的風味。

巧克力的核心關鍵在於產地、品種及風味，而 ORIGIN 巧克力秉持著「從產地到餐桌」的理念，用心栽種優質品種的可可，採 Bean to Bar 的巧克力工藝，結合全台獨創的微米粉碎技術，投入極長時間精力全心研製，從挑選可可豆、烘焙、微米粉碎、研磨、調溫、入模到包裝等十多道關卡，再經由巧克力工藝師、品管師們的層層把關，最後遞送到人們手中。

咖啡，由品牌主理人陳聖杭親自選豆、烘焙、品味，只為求給大家品嚐最美好的精品滋味。

茶對身體本來是好的，但常常因為產量的不足以及為了賣相被噴灑農藥、使用化肥，我們認為那就連喝茶最基本的訴求都失去了，所以 ORIGIN 所有的茶，第一選擇條件即為無毒，包含農藥、重金屬皆要為零檢出。茶葉本身會因為不同的氣候、品種、土壤而有不一樣的風味，再經由茶農、製茶師、焙茶師、泡茶師自己對茶的理解來詮釋他們覺得這支茶該有的最佳呈現，所以身為泡茶師的你們，其實也參與在其中。

ORIGIN ，在尋找好風味的路上不斷發現驚喜，邀請你跟我們一同探尋不同產區獨有的風土之味。

🌿 觀光工廠-連淨綠色科技概念館

- ✓ 開放時間：週一 ~ 週五 9:00~18:00
  (每月加開一日週六，日期以預約表單為主)
- ✓ 導覽時間：10:00、15:00 (4 人成團)
- ✓ 預約方式：採預約制，可線上填寫預約表單、來電預約
- ✓ 預約專線：0909-845-668、0800-585-598
- ✓ 地址：新北市新店區寶興路 45 巷 9 弄 2 號 (統帥工業園區，附停車場)
- ✓ DIY 活動：每月更換主題，如手工研磨皂、天然彩染香氛沐浴鹽、香氛精油滾珠......等
- ✓ 歡迎來電詢問或參考概念館網站、連淨 FB 粉絲團
- ✓ 費用：門票(含 DIY 材料費)150 元
- ✓ 網址：連淨概念館 http://www.aconpure.com/en/index.php/tourism-factory-home/

(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)。

● 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 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。

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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)

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：**113/03/04~03/06 08:00~17:00；03/07~03/08 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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● 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**。

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● 報名辦法：1.傳真報名：(07)355-7586 台灣超臨界流體協會
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　　　　　　 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 03/04~03/08	
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。

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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

2024/03/04 (一)	08:00～17:00
2024/03/05 (二)	08:00～17:00
2024/03/06 (三)	08:00～17:00
2024/03/07 (四)	08:00～17:00 (實習第 1 組)
2024/03/08 (五)	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

简支流體輸送管路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.

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

Development and Validation of a Segregated Conjugate Heat Transfer Procedure on a sCO₂ Dry Gas Seal Test Bench

在 sCO₂乾氣密封試驗台上 開發並驗證分離共軛傳熱程序

By **Isacco Rafanelli, Giulio Generini, Antonio Andreini, Tommaso Diurno, Gabriele Girezzi, Andrea Paggini**

Heat Transfer and Combustion Group, University of Florence, Via S. Marta 3, Florence 50139, Italy

Abstract

Carbondioxide at supercritical state shows particularly favorable thermodynamic properties for closed-loop Brayton and Rankine cycles. High density, close to a liquid, and low viscosity, close to a gas, drive to achieve higher energy conversion efficiency with smaller size turbines and components. Since minimizing the sCO₂ leakage flows drives to a further increasing of overall efficiency, dry gas seals (DGS) are considered as a key enabling technology for achieving this purpose and for achieving a carbon footprint in line with the increasingly stringent targets. DGSs are gas-lubricated, mechanical, noncontacting, end-face seals, consisting of a mating (rotating) ring and a primary (stationary) ring. The operating equilibrium clearance of the seal is determined by the balance of opening dynamic forces, mainly depending on angular velocity and grooves shape, and closing forces caused by pressure gradients and spring force. Due to high rotational speeds, typical small size sealing gaps (order of magnitude of Micron), high fluid pressure and density, the heat generated by friction through the seal has a large impact on the temperature distribution, therefore a thermal design is needed to stay below the seal allowable temperature; this requirement has been even amplified in the last years with the DGS application to hot turbomachinery. Nowadays, numerical conjugate heat transfer (CHT) analysis is a good industrial practice to quantify the thermal distribution in turbomachinery components. On the other hand, due to different order of magnitude of secondary flows cavity sizes and DGS seal gaps, simulating the whole fluid domain with three-dimensional (3D) computational fluid dynamic (CFD) calculation could drive to prohibitive computational costs. In this regard, this paper presents a fast numerical iterative procedure based on a commercial one-dimensional flow network modeler (ALTAIR flow simulator), with real gas effects included, coupled with a commercial finite element solver (ANSYS mechanical). Additional 3D CFD simulations are carried out to enhance the predictability of the fluid solver in specific critical areas. The

proposed procedure is applied and validated in a DGS specific test bench designed, owned and operated by Flowserve. The validation dataset has been generated operating the DGS in the test bench at 15 different conditions in terms of angular velocity and housing temperature with sCO$_2$ as working fluid aligned with those expected on the unit. Test rig consists of a rotor and housing where the turbomachine operating condition (pressure, speed, temperature and sealing fluid) are mirrored to verify the seal performance. The rig is equipped with test seal and a plug seal mounted in a back-to-back configuration. Data set used for this comparison is composed by thermocouples on the statoric rings, retainers and housing of each seal, operating at five different angular speeds and three minimum levels of housing temperature (100 °C, 210 °C, and 250 °C). These temperatures are designed to mirror turbomachinery conditions around the seal, and, if friction heat is not enough to guarantee them, a series of 18x1 kW heating elements circumferentially distributed in the test bench housing, are activated. The nominal operating condition has been considered as the starting point of the model predictions and, there, several sensitivity analyses have been carried out to align the model to test bench measurements; then, the selected configuration has been frozen and used to assess the model performance on other operating conditions. The numerical results have shown a good agreement with experimental data at each operating condition in terms of punctual temperatures previously described and with extremely low computational times.

資料來源：https://doi.org/10.1115/1.4063716

Formulation and characterization of micro-emulsions of peppermint and coriander oils extracted by using a supercritical fluid system

使用超臨界流體系統提取薄荷油和香菜油微乳液的配製和表徵

By **Ana Javaid, Ali Imran, Muhammad Umair Arshad, Muhammad Afzaal & Mohd Asif Shah**

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Division of Research and Development, Lovely Professional University, Phagwara, India

Abstract

The present study was designed to formulate and characterize the micro-emulsions of peppermint and coriander oil that extracted by using supercritical fluid extraction system. Moreover, Guar gum and maltodextrin were used as coating materials while preparing encapsulates of peppermint and coriander through freeze-drying. The moisture contents of mint leaves and coriander were 81.28 ± 7.12 and $84.62 \pm 6.46\%$ respectively whereas the recorded protein content in mint and coriander leaves were 1.456 ± 0.13 and $5.06 \pm 0.03\%$ respectively. The crude fat was high in mint leaves as compared to coriander. However, the ash content was 2.98 ± 0.278 in mint and 2.8 ± 0.12 in coriander leaves. The total phenolic contents (TPC) and antioxidant activity coriander essential oil was high as compared to peppermint oil. The results showed the better antioxidant activity of coriander than peppermint. Encapsulation efficiency of powder showed significant results of wall material. T3 (maltodextrin and coriander oil) exhibited better binding capability of bioactive components as compared to guar gum and mint. T3 was coriander and maltodextrin better ability to inhibit the oxidation process and had good DPPH assays as compared to other treatments. This study showed that the T3 (maltodextrin and coriander oil) exhibited better binding capability of bioactive components as compared to guar gum and mint. T3 was (coriander and maltodextrin) better ability to inhibit the oxidation process and had good DPPH assays to other treatments.

Keywords: Peppermint, coriander, freeze drying, encapsulated powder, Guar gum, maltodextrin

Integrated Aerodynamic and Mechanical Design of a Large-Scale Axial Turbine Operating With A Supercritical Carbon Dioxide Mixture

使用超臨界二氧化碳混合物運行的大型軸流式渦輪機的氣動和機械整合設計

By **Abdelrahman Abdeldayem, Andrea Paggini, Tommaso Diurno, Claudio Orazi, Martin White, Marco Ruggiero, Abdulnaser Sayma**

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Abstract

In this paper, the design of a large-scale axial turbine operating with supercritical carbon dioxide (sCO$_2$) blended with sulfur dioxide (SO$_2$) is presented considering aerodynamic and mechanical design aspects as well as the integration of the whole turbine assembly. The turbine shaft power is 130 MW, designed for a 100 MW$_e$ concentrated-solar power plant with turbine inlet conditions of 239.1 bar and 700 °C, total-to-static pressure ratio of 2.94, and mass-flow rate of 822 kg/s. The aerodynamic flow path, obtained in a previous study, is first summarized before the aerodynamic performance of the turbine is evaluated using both steady-state and unsteady three-dimensional numerical models. Whole-annulus unsteady simulations are performed for the last turbine stage and the exhaust section to assess the unsteady loads on the rotor due to downstream pressure field distortion and to assess the aerodynamic losses within the diffuser and exhaust section. The potential low engine order excitation at the last rotor stage natural frequency modes due to downstream pressure distortion is assessed. The design of the turbine assembly is constrained by current manufacturing capabilities and the properties of the proposed working fluid. High-level flow-path design parameters, such as pitch diameter and number of stages, are established considering a trade-off between weight and footprint, turbine efficiency, and rotordynamics. Rotordynamic stability is assessed considering the high fluid density and related cross coupling effects. Finally, shaft end sizing, cooling system design, and the integration of dry gas seals are discussed.

Keywords: axial turbine, sCO$_2$ mixtures, exhaust section, rotordynamics, thermal analysis, aeromechanical integration

Quasi-One-Dimensional Loss Model of Volute Using Boundary Layer Approach for Inward Flow Radial Supercritical CO₂ Turbines

內流徑流式超臨界 CO₂ 渦輪機 蝸殼之準一維損失模型邊界層法

By **Syed Jiaul Hoque, Pramod Kumar, Pramod Chandra Gopi**

Department of Mechanical Engineering, Indian Institute of Science, Interdisciplinary Center for Energy Research, Bengaluru 560012, India

Abstract

Inward flow radial sCO₂ turbines operate at considerably higher speeds than conventional gas or steam turbines making only the low specific speed designs practically realizable. Low-specific speed designs suffer from significantly higher viscous losses in the volute due to long and narrow flow passages. The volute loss in low specific speed designs results in an 8% to 12% efficiency drop, which is approximately 50% of the total loss. The paper proposes a quasi-one-dimensional (quasi-1D) model to estimate the total pressure loss in a volute with acceptable accuracy while consuming negligible computational power compared to a three-dimensional computational fluid dynamics simulation. The model converts the three-dimensional flow in a volute into an equivalent quasi-1D flow. Boundary layer-based momentum integral method is used on the quasi-1D flow path to calculate the total pressure loss. A computer program is developed to implement the proposed model. The accuracy of the model is tested with three-dimensional computational fluid dynamics results in the kW to MW power scale for different boundary conditions. The validation exercise is performed for two volute cross sections—circular and trapezoidal, to check the universality of the model. The model predicts the total pressure loss with less than 10% error for all test conditions. In contrast, a fully developed pipe flow model shows a considerably higher error (~50%) in total pressure loss prediction for identical flow conditions. The model can also incorporate the effect of surface roughness of the volute. In addition, the model accurately calculates losses under off-design operations.

資料來源：https://doi.org/10.1115/1.4063548

Synthesis of novel azo pyrazole disperse dyes for dyeing and antibacterial finishing of PET fabric under supercritical carbon dioxide

By   Mamdouh Sofan,   Fathy El-Taweel,   Adel Abdel-Rahman,   Hagar Salman   &   Elham Negm

Chemistry Department, Faculty of Science, Damietta University, New Damietta, Egypt

Abstract

Supercritical carbon dioxide ($scCO_2$) has been suggested as a good substitution to environmentally harmful water-based tincturing. The present study describes the successful synthesis of some biologically active dispersion tinctures for supercritical carbon dioxide tincturing of polyester fabric. The coupling of 1-cyanoacetylpiperidine **(1)** with the diazonium salt of aryl amine derivatives **(2a–d)** produced 1-((aryldiazenyl) cyanoacetyl piperidines **(3a–d)**. To create the derivatives of 4-(phenyldiazenyl)-5-(piperidin-1-yl)-1*H*-pyrazol-3-amine **(5a)**, the propane nitriles **(3a–d)** were condensed with hydrazine hydrate. However, the unexpected 3-aminopyrazol-5-ol yellow–red dispersion dyes **(4a–d)** were identified as the reaction results. The MS, IR, and NMR spectra were used to describe the novel dyes, and the results exactly matched the suggested structures. The antibacterial test, which was conducted using the AATCC method, revealed that some of the compounds **(3a–d)** and **(4a–d)** had impressive antibacterial capabilities against the researched +ve and gram −ve bacteria. For eight dyestuffs, the dyeability, color strength, and color fastness of the tincturing process were evaluated. The evaluation focused on determining color uptake using a gauge for color strength (K/S). All dyes displayed excellent rubbing, washing, and light fastness (color change and staining grade of 4–5).

資料來源：https://www.nature.com/articles/s41598-023-48740-y

Synthesis and evaluation of aromatic stationary phases based on linear solvation energy relationship model for expanded application in supercritical fluid chromatography

By

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Abstract

In the last decade, the separation application based on aromatic stationary phases has been demonstrated in supercritical fluid chromatography (SFC). In this paper, four aromatic stationary phases involving aniline (S-aniline), 1-aminonaphthalene (S-1-ami-naph), 1-aminoanthracene (S-1-ami-anth) and 1-aminopyrene (S-1-ami-py) were synthesized based on full porous particles (FPP) silica, which were not end-capped for providing extra electrostatic interaction. Retention mechanism of these phases in SFC was investigated using a linear solvation energy relationship (LSER) model. The aromatic stationary phases with five positive parameters (a, b, s, e and d^+) can provide hydrogen bonding, π-π, dipole-dipole and cation exchange interactions, which belong to the moderate polar phases. The LSER results obtained using routine test solutes demonstrated that the aforementioned interactions of four aromatic stationary phases were influenced by the type and bonding density of the ligand, but to a certain extent. Furthermore, the LSER data verified that the S-1-ami-anth column based on full porous particles silica had higher cation exchange capacity (d^+ value), compared to the commercialized 1-AA column (based on the ethylene-bridged hybrid particles). The relationship between the d^+ value and SFC additive was quantitatively proved so as to regulate electrostatic interaction reasonably. This value was greatly increased by phosphoric acid, slightly increased by trifluoroacetic acid and formic acid, but significantly reduced by ammonium formate and diethylamine. Taking the S-1-ami-naph column as an example, better peek shape of the flavonoids was obtained after the addition of 0.1 % phosphoric acid in MeOH while isoquinoline alkaloids were

eluted successfully within 11 min after adding 0.1 % diethylamine in MeOH. Combined with the unique π-π interaction and controllable electrostatic interaction, the aromatic stationary phases in this study have been proven to have expandable application potential in SFC separation.

資料來源：https://doi.org/10.1016/j.chroma.2024.464640

Supercritical hydrothermal synthesis of copper nanoparticles: Experimental and kinetic study

By

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Abstract

Copper nanoparticles are widely used in electronics, catalysis, energy storage and other fields. But the traditional preparation technology has the defects of high cost, low yield, and poor product dispersion, which prevent industrialization and application. Supercritical hydrothermal synthesis (SCHS) technology is a green frontier technology for the preparation of nanomaterials, which can overcome the deficiencies of the existing technology and achieve industrialization. In this paper, the material system of SCHS of copper nanoparticles is optimized, and the effects of precursor, reductant, reductant dosage and PVP dosage on the particle size and morphology of the products are investigated, and the influence mechanism is analyzed. In addition, the effect of PVP dosage on the antioxidant capacity of copper nanoparticles was investigated in the context of the oxidation kinetics of copper nanoparticles. The optimal material system for the synthesis of antioxidant copper nanoparticles was finally obtained.