



化工进展

Chemical Industry and Engineering Progress

2020

第39卷

EI 收录期刊

增刊 2

广告

BEOT®

波特十八年之工程化经验

为客户提供金属膜分离整体解决方案与技术服务

BEOT 波特无机膜分离设备有限公司

中国·石家庄市和平东路336-2号1103 (050011)
Tel : +86-311-85119058 85119078
Fax : +86-311-85119038
E-mail : info@hebbeot.com

ISSN 1000-6613



9 771000 661201



主办



中国化工学会



化学工业出版社有限公司



目次

化工过程与装备

- 电渗析-超滤耦合技术研究进展 苏慧超, 张田明, 吴云奇, 徐国荣(1)
- 流体动力学过程在流动腐蚀行为中的作用机制 王凯, 南翠红, 卢金玲(8)
- 基于金字塔形扰动结构的双层梯形微通道热沉传热性能模拟 陈然, 唐晟(19)
- 耦合表面张力的封闭腔体内管外自然对流传热特性 苗国民, 雷海燕, 戴传山, 马非(26)
- 相变微胶囊悬浮液圆管内换热特性模拟 赵敬德, 叶鸿鑫(36)
- 基于制备超细复合含能材料的对置受限式撞击流反应器微观混合性能 梁鹏飞, 张阿芳, 陈锦芳, 郭新俊, 刘所恩(42)
- 采用快速蒸发电离质谱技术对化妆品开展质量溯源 刘鸣畅, 苏宁, 林继红, 杨悦, 王秀娟, 吴亚君(48)
- 异丁烯提纯装置换热网络的能效分析 邵纛迪, 胡建杭, 刘慧利, 蔡正达(57)
- 隔壁反应精馏合成碳酸甲乙酯节能新工艺 王红星, 李海勇, 周庆, 张路(66)
- 基于利润核算的常减压装置中段取热优化 王子健(73)
- 可溶性硅酸钠盐水溶液对金属腐蚀性分析 吴保意, 刘奥林, 张金梅, 李运才(78)
- 高含硫气井井控安全评价及井喷应急能力提升对策 高凯歌, 李勇, 朱先俊, 葛鹏飞, 赵桂利, 刘铭刚, 逢铭玉(83)
- 旋涡式氢气循环泵的设计及性能分析 王学科, 沈义伟, 赵洪滨, 曹岭, 陈山, 贾彩, 谢晓峰(89)
- 基于系统工程法的沉积物分析体系及诊断技术 姜红杰, 张先松, 姜兴剑, 黄起中, 刘威, 何建华, 周苗苗, 胡艳晶(97)

能源加工与技术

- 化学吸收剂强化微藻固碳研究进展 白丽菊, 侯博, 江波, 陈思铭(106)
- 延迟焦化加热炉技术现状 李娜, 李朋(115)
- 制氢加氢“子母站”建设规划浅析 王业勤, 杜雯雯, 叶根银, 何清保, 易竖棚(121)
- 不同煤阶的原生煤、构造煤等量解吸焓的比较 张学梅, 马青华, 郝静远, 李东(128)
- 塔河超稠油掺苯乙烯焦油降黏实验及黏度预测模型 裴海华, 刘冬鑫, 张贵才, 单景玲, 蒋平(135)
- 宁夏庆华煤镜质组和惰质组显微组分的分子结构及对比分析 王强, 毛宁, 杨妍, 张金鹏, 白红存(142)
- 基于热重-红外联用技术分析油酸的热解特性及动力学分析 田霖, 胡建杭, 刘慧利(152)
- 中煤级煤甲烷饱和吸附量的数值模拟计算 张学梅, 马青华, 郝静远, 李东(162)
- 固体聚合物电解水制氢性能衰减分析 李微微, 谢晓峰, 王树博(168)

工业催化

- 锰基催化剂协同等离子降解 VOCs 研究进展 赵亚飞, 叶凯, 庄烨, 郑进保(175)
- 挥发性有机物燃烧催化剂的研究进展 王炜月, 赵培培, 金凌云, 岑丙横, 陈建, 罗孟飞(185)
- 均一介孔 Al₂O₃ 劣质蜡油加氢脱氮催化剂研究进展 黄文斌, 魏强, 周亚松(196)
- 芳烃与烯烃烷基化反应的催化机理进展 李云鹏, 彭东岳, 管翠诗(204)
- 乙醇胺缩合胺化反应合成乙二胺研究进展 赵锋伟, 惠丰, 袁俊, 张前, 梅苏宁, 秦泰伟, 杨建明, 刘昭铁, 吕剑(212)
- 原位红外研究噻吩在硫化后 Co-Mo/γ-Al₂O₃ 催化剂上吸附行为 陈俊霖, 赵基钢, 江洪波, 陈文斌, 秦康, 沈本贤(221)

材料科学与技术

- 碳纤维微观结构表征: Raman 光谱 郝俊杰, 吕春祥, 李登华(227)
- 高频感应燃烧-红外吸收法测定石墨烯中总硫含量 鲁毅, 袁亚文, 吴立军, 柳洪超, 郭国建, 刘霞(234)
- 氙常温吸附性能与多孔碳材料孔径分布关联分析 刘蜀疆, 陈占营, 赵永刚, 常印忠(243)

生物与医药化工

- 高氯酸盐还原菌的代谢过程及应用研究进展……………程丽杰,高宁博,楚华,全翠,张力恒,李兴刚(251)
细菌纤维素合成与鉴定研究综述……………赵鑫,熊健力,任叶琳,杨家鑫,李伟,韩雪容(262)

精细化工

- 小型特种精细化工过程自动化和信息化研究发展趋势探讨……………邹志云,朱文超,刘英莉,孟磊,郭宁,于蒙(269)
金属双极板表面改性涂层的评价方法研究进展……………刘敏,杨铮(276)
亚马逊莓(*Euterpe oleracea*)美白相关成分和作用研究现状……………武亭羽,王成军,王雪,齐秀玉,未伟,郑成栋(285)
响应面法优化微波辅助水蒸气蒸馏法提取油樟精油工艺……………张圆圆,孟永斌,张琳,祖元刚(291)
铠装硅酸钾胶黏剂在特殊工况下的绝缘失效分析……………赵宇航,李依帆(300)
盐酸为氯源“一锅法”绿色高效合成 α -氯噻吩……………孙小康,冯宇,李国梅,刘妙青,卢建军(305)
复合固体推进剂中固体填料的安息角测试与仿真……………王建,赵亚风,乔晓林,李兴刚,赵慧(312)

资源与环境化工

- 离子交换水软化技术研究与应用进展……………徐勇,陈青柏,王建友(319)
水处理电絮凝技术的研究进展与挑战……………周杰,宋小三,王三反(329)
低浓度挥发性有机物吸附浓缩材料的研究进展……………冷星月,胡彩虹,王炜月,李丹丹,陈建,罗孟飞(336)
超临界CO₂法再生油气回收用活性炭机理研究进展……………孙宪航,朱忠泉,黄维秋,浮历沛,王雨雨,吕爱华(346)
生物炭的制备、改性及其在环境修复中应用的研究进展……………王中宛,郑晓燕,校导,郑丽丽,杨旸,艾斌凌,钟爽,盛占武(352)
湿垃圾组分对厌氧消化抑制作用的研究进展……………邹联沛,宋琳,李小伟,万雨岚,李曼,刘建勇,欧阳创,奚慧,钱光人,戴晓虎(362)
油气集输过程中含油污泥减量化……………张军,贾悦,刘博,张则俊,安静,蔡贤明(372)
改良多级A/O对低C/N生活污水强化除磷效果研究……………王宏伟,张国珍,武福平,明驹,闵芮,严婉钰,程锦(379)
热风分布器结构对脱硫废水旋转喷雾蒸发特性影响的数值模拟……………李飞,陈海杰,孙宗康,谷小兵,白玉勇,高飞,杨林军(385)
基于改进灰色-多元回归组合预测模型的燃煤电厂智慧水务研究……………熊远南(393)
15000m³/h耐火材料厂焙烧窑炉烟气低温脱硝工程实验……………唐彤,杨永见,万祖德,池少聪,赵攀,黄文凤,李明(401)
柱淋滤模式下生活垃圾焚烧炉渣中Cu²⁺和Zn²⁺浸出规律……………徐斌,何昌轩,胡艳军,王琳洁,朱永豪,乔欣(406)
油田含聚污水过滤工艺因素及臭氧处理效果评价……………柴德民(413)
流量分配比对改良多级A/O污染物的去除影响……………闵芮,张国珍,武福平,明驹,亢瑜,王万红(421)
撞击对稀碱液去除稻草秸秆木质素过程中的强化作用……………符起旋,邓胜松,王淮,姚日生(427)
改性凹凸棒土负载铜和稀土催化氧化印染废水……………尚建平,刘锐,覃孝平,赵彬(434)
添加剂对单膜双室同槽电解膜电积工艺的影响……………郑洋洋,宋小三,王三反,张志华,宋正平,马林(440)
干湿联合冷却塔冷却节水分析软件开发及应用……………胡少华,高沙沙,刘忠超,赵延春,许向阳,赵元宾(447)

责任编辑:黄丽娟 奚志刚

主管	中国科学技术协会	主编	谭天伟	国际标准连续出版物号	ISSN 1000-6613
主办	中国化工学会	编辑部主任	黄丽娟	国内统一连续出版物号	CN 11-1954/TQ
	化学工业出版社有限公司	编辑部电话	010-64519466/9499/9500/ 9501/9502	增刊刊号	(2020)京新出刊增准字第(219)号
出版	化学工业出版社有限公司	E-mail	hgjz@263.net	广告发布登记号	京东市监广登字 20170106 号
编辑	《化工进展》编辑部	网 址	www.hgjz.com.cn	国内邮发代号	82-311
通讯地址	北京市东城区青年湖南街13号	印 刷	北京科信印刷有限公司	国外发行代码	M3231
邮 编	100011			定 价	100元(国内); 40美元(国外)



Contents

Chemical processes and equipment

- Development of electrodialysis with ultrafiltration membrane technology ···SU Huichao, ZHANG Tianming, WU Yunqi, XU Guorong (1)
- Mechanism of hydrodynamic process in flow corrosion behavior ···WANG Kai, NAN Cuihong, LU Jinling (8)
- Heat transfer performance simulation of double-layer trapezoidal microchannel heat sink based on pyramidal turbulence structure ···CHEN Ran, TANG Sheng (19)
- Natural convection heat transfer characteristics of coupled surface tension outside the tube in a closed cavity ···MIAO Guomin, LEI Haiyan, DAI Chuanshan, MA Fei (26)
- Numerical simulation of convective heat transfer of microencapsulated phase change material slurry in a circular tube ···ZHAO Jingde, YE Hongxin (36)
- Micromixing efficiency of opposed confined impinging jets reactor base on ultrafine energy-containing materials ···LIANG Pengfei, ZHANG Afang, CHEN Jinfang, GUO Xinjun, LIU Suo'en (42)
- Quality traceability of cosmetics authenticity by rapid evaporation ionization mass spectrometry (REIMS) ···LIU Mingchang, SU Ning, LIN Jihong, YANG Yue, WANG Xiujuan, WU Yajun (48)
- Energy efficiency analysis of heat exchange network of isobutylene purification unit ···SHAO Yingdi, HU Jianhang, LIU Huili, CAI Zhengda (57)
- New energy-saving process for ethyl methyl carbonate preparation by reactive distillation in the dividing-wall column ···WANG Hongxing, LI Haiyong, ZHOU Qing, ZHANG Lu (66)
- Optimization of heat extraction in the middle section of atmospheric and vacuum plant based on profit accounting ···WANG Zijian (73)
- Corrosivity of soluble sodium silicate aqueous solution to metals ···WU Baoyi, LIU Aolin, ZHANG Jinmei, LI Yuncai (78)
- Safety evaluation of well control of high-sulfur gas wells and measures to improve blowout emergency capability ···GAO Kaige, LI Yong, ZHU Xianjun, GE Pengfei, ZHAO Guili, LIU Minggang, PANG Mingyu (83)
- Design and performance analysis of a compact hydrogen circulation pump ···WANG Xueke, SHEN Yuwei, ZHAO Hongbin, CAO Ling, CHEN Shan, JIA Cai, XIE Xiaofeng (89)
- Sediment analysis system and diagnosis technology based on system engineering method ···LOU Hongjie, ZHANG Xiansong, JIANG Xingjian, HUANG Qizhong, LIU Wei, HE Jianhua, ZHOU Miaomiao, HU Yanjing (97)

Energy processes and technology

- Research progress of CO₂ fixation by chemical absorbents enhanced microalgae ···BAI Liju, HOU Bo, JIANG Bo, CHEN Siming (106)
- Present situation of coking heater technology ···LI Na, LI Peng (115)
- A brief analysis on "distributed-centralized hydrogen producing and filling station" planning ···WANG Yeqin, DU Wenwen, YE Gengen, HE Qingbao, YI Shupeng (121)
- Comparative study on the isosteric enthalpy of desorption with different rank of normal coal and deformed coal ···ZHANG Xuemei, MA Qinghua, HAO Jingyuan, LI Dong (128)
- Viscosity-reducing experiment and viscosity-predicting model of Tahe super heavy oil blended with styrene tar ···PEI Haihua, LIU Dongxin, ZHANG Guicai, SHAN Jingling, JIANG Ping (135)
- Molecular structures and comparative analysis of macerals of vitrinite and inertinite for Qinghua coal, Ningxia ···WANG Qiang, MAO Ning, YANG Yan, ZHANG Jinpeng, BAI Hongcun (142)
- Pyrolysis characteristics and kinetics of oleic acid were analyzed by thermogravimetric and infrared spectroscopy ···TIAN Lin, HU Jianhang, LIU Huili (152)
- Numerical simulation of the methane adsorption capacity in middle-rank coal ···ZHANG Xuemei, MA Qinghua, HAO Jingyuan, LI Dong (162)
- Performance degradation analysis of solid polymer electrolyte water electrolysis ···LI Weiwei, XIE Xiaofeng, WANG Shubo (168)

Industrial catalysis

- Progress of manganese catalysts for non-thermal plasma catalysis on VOCs degradation ···ZHAO Yafei, YE Kai, ZHUANG Ye, ZHENG Jinbao (175)
- Recent advances in catalysts for volatile organic compounds combustion ···WANG Weiyue, ZHAO Peipei, JIN Lingyun, CEN Bingheng, CHEN Jian, LUO Mengfei (185)
- Research progress of homogeneous mesoporous Al₂O₃ of hydrodenitrogenation catalyst for inferior gas oil ···HUANG Wenbin, WEI Qiang, ZHOU Yasong (196)
- Progress in catalytic mechanism of aromatics and olefins alkylation ···LI Yunpeng, PENG Dongyue, GUAN Cuishi (204)
- Progress in selective synthesis of ethylenediamine via condensation amination of monoethanolamine ···ZHAO Fengwei, HUI Feng, YUAN Jun, ZHANG Qian, MEI Sunning, YU Qinwei, YANG Jianming, LIU Zhaotie, LYU Jian (212)
- Adsorption behavior of thiophene on Co-Mo/ γ -Al₂O₃ catalyst by *in-situ* IR ···CHEN Junlin, ZHAO Jigang, JIANG Hongbo, CHEN Wenbin, QIN Kang, SHEN Benxian (221)

Materials science and technology

- Characterization of the microstructure of carbon fibers: Raman spectroscopy ···HAO Junjie, LYU Chunxiang, LI Denghua (227)
- Determination of total sulfur in graphene by high frequency induction combustion-infrared absorption method ···LU Yi, YUAN Yawen, WU Lijun, LIU Hongchao, GUO Guojian, LIU Xia (234)

Analysis on adsorption of xenon in micro pore size of porous carbon material

.....LIU Shujiang, CHEN Zhanying, ZHAO Yonggang, CHANG Yinzong (243)

Biochemical and pharmaceutical engineering

Metabolism and application of perchlorate reducing bacteria in microbial reduction of perchlorate: a review

.....CHENG Lijie, GAO Ningbo, CHU Hua, QUAN Cui, ZHANG Liheng, LI Xinggang (251)

Synthesis and identification of bacterial cellulose.....ZHAO Xin, XIONG Jianli, REN Yelin, YANG Jiaxin, LI Wei, HAN Xuerong (262)

Fine chemicals

Discussion on the development trend of small scale special fine chemical process automation and informatization

.....ZOU Zhiyun, ZHU Wenchao, LIU Yingli, MENG Lei, GUO Ning, YU Meng (269)

Research progress of performance evaluation methods of surface modification coatings on metallic bipolar plate

.....LIU Min, YANG Zheng (276)

Skin-whitening ingredients and effects of Açai berry (*Euterpe oleracea*): a review

.....WU Tingyu, WANG Chengjun, WANG Xue, QI Xiuyu, WEI Wei, ZHENG Chengdong (285)

Optimization of microwave-assisted steam distillation extraction of *Cinnamomum longepaniculatum* essential oil by response surface methodology

.....ZHANG Yuanyuan, MENG Yongbin, ZHANG Lin, ZU Yuangang (291)

Failure insulation of armored potassium silicate adhesive in special condition

.....ZHAO Yuhang, LI Yifan (300)

One-pot method for the green and efficient synthesis of α -chlorothiophene with hydrochloric acid as a chlorine source

.....SUN Xiaokang, FENG Yu, LI Guomei, LIU Miaoqing, LU Jianjun (305)

Measurement and simulation of the angle of repose of solid filler in composite solid propellant

.....WANG Jian, ZHAO Yafeng, QIAO Xiaolin, LI Xinggang, ZHAO Hui (312)

Resources and environmental engineering

Research and application progress in the technology of water softening by ion exchange

.....XU Yong, CHEN Qingbai, WANG Jianyou (319)

Research progress and challenge of electrocoagulation technology in water treatment

.....ZHOU Jie, SONG Xiaosan, WANG Sanfan (329)

Recent advance in low concentration volatile organic compounds adsorption and concentration materials

.....LENG Xingyue, HU Caihong, WANG Weiyue, LI Dandan, CHEN Jian, LU Mengfei (336)

Research progress on the regeneration mechanism of activated carbon for oil vapor recovery under supercritical CO₂

.....SUN Xianhang, ZHU Zhongquan, HUANG Weiqiu, FU Lipei, WANG Yuyu, LYU Aihua (346)

Research progress of production, modification and application in environment remediation of biochar

.....WANG Shemian, ZHENG Xiaoyan, XIAO Dao, ZHENG Lili, YANG Yang, AI Binling, ZHONG Shuang, SHENG Zhanwu (352)

Research progress of the inhibition of components of food waste on anaerobic digestion

.....ZOU Lianpei, SONG Lin, LI Xiaowei, WAN Yulan, LI Man, LIU Jianyong, OUYANG Chuang, XI Hui, QIAN Guangren, DAI Xiaohu (362)

Oily sludge reduction in oil and gas gathering process

.....ZHANG Jun, JIA Yue, LIU Bo, ZHANG Zejun, AN Jing, CAI Xianming (372)

Study on enhanced phosphorus removal effect of improved multi-stage A/O on low C/N domestic sewage

.....WANG Hongwei, ZHANG Guozhen, WU Fuping, MING Ju, MIN Rui, YAN Wan'er, CHENG Jin (379)

Numerical evaporation characteristics of desulfurization wastewater by rotating spray with different hot air distributor structure

.....LI Fei, CHEN Haijie, SUN Zongkang, GU Xiaobing, BAI Yuyong, GAO Fei, YANG Linjun (385)

Smart water affair of coal-fired power plant based on improved combination prediction model of grey system and regression analysis

.....XIONG Yuannan (393)

Engineering experiment on low-temperature denitration of 15000m³/h refractory baking furnace flue gas

.....TANG Tong, YANG Yongjian, WAN Zude, CHI Shaocong, ZHAO Pan, HUANG Wenfeng, LI Ming (401)

Column leaching of Cu²⁺ and Zn²⁺ from municipal solid waste incineration bottom ash

.....XU Bin, HE Changxuan, HU Yanjun, WANG Linjie, ZHU Yonghao, QIAO Xin (406)

Filtration factors and ozone treatment effect of oil field waste water containing HPAM

.....CHAI Demin (413)

Influence of flow distribution ratio on the removal of improved multi-stage A/O pollutants

.....MIN Rui, ZHANG Guozhen, WU Fuping, MING Ju, KANG Yu, WANG Wanhong (421)

Enhancement of collision in the process of dilute alkali pretreatment removing lignin from rice straw

.....FU Qixuan, DENG Shengsong, WANG Huai, YAO Risheng (427)

Modified attapulgite clay with copper and rare earth catalytic oxidation printing and dyeing wastewater

.....SHANG Jianping, LIU Rui, QIN Xiaoping, ZHAO Bin (434)

Influence of additives on the electrowinning process of single membrane and double chamber in the same cell

.....ZHENG Yangyang, SONG Xiaosan, WANG Sanfan, ZHANG Zhihua, SONG Zhengping, MA Lin (440)

Development and application of cooling and water-saving analysis software for dry-wet hybrid cooling tower

.....HU Shaohua, GAO Shasha, LIU Zhongchao, ZHAO Yanchun, XU Xiangyang, ZHAO Yuanbin (447)

Executive Editor: HUANG Lijuan XI Zhigang

Superintend: China Association for Science and Technology

Sponsor: The Chemical Industry and Engineering Society of China; Chemical Industry Press Co., Ltd.

Editor: Editorial Department of Chemical Industry and Engineering Progress

Publisher: Chemical Industry Press Co., Ltd.

Address: No.13 Qingnianhu South Street, Dongcheng District, Beijing, China

Post Code: 100011

Editor in Chief: TAN Tianwei

Managing Editor: HUANG Lijuan

Tel: (010) 64519466/9499/9500/9501/9502

E-mail: huagongjz@126.com

hgjz@263.net

http: //www.hgjz.com.cn

Price: \$ 40

ISSN 1000-6613

CN 11-1954/TQ

CODEN HUJIEK