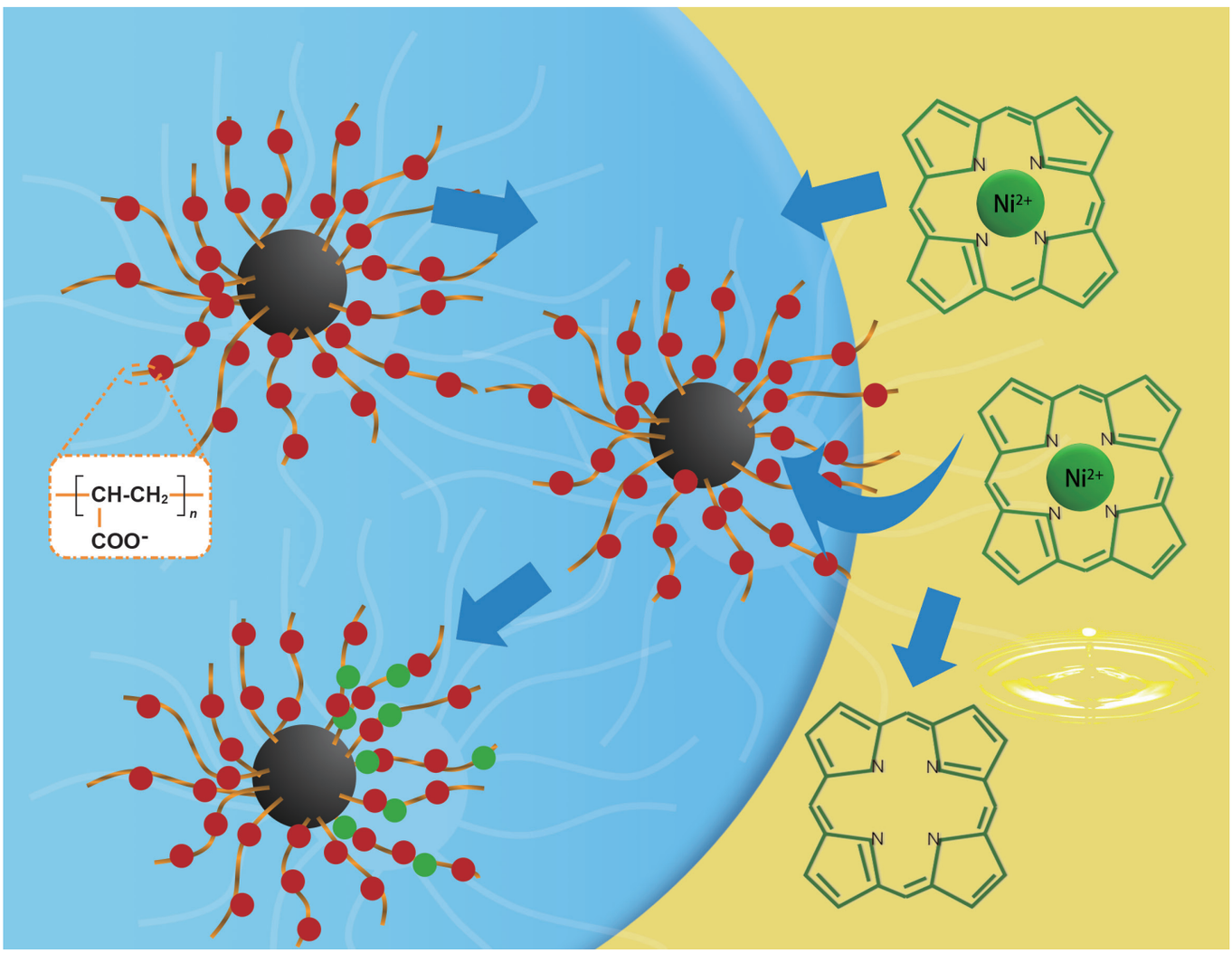
（石油加工）

ACTA PETROLEI SINICA
(PETROLEUM PROCESSING SECTION)



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研究报告

研究报道

信息

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ACTA PETROLEI SINICA

(PETROLEUM PROCESSING SECTION)

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CONTENTS

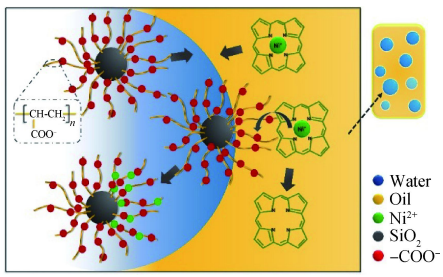
Research Articles

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0001-0009 **doi**: 10.3969/j.issn.1001-8719.2021.01.001

Experimental Study of Polyacrylic Acid Brush Removal of Nickel Porphyrin From Crude Oils

LIU Siyuan GENG Tong XU Jun REN Mannian CAO Fahai

Acrylic polymer brush (PAA@ SiO_2) was successfully synthesized to remove Ni porphyrin from crude oils. Core-shell structure of PAA@ SiO_2 can increase functional group density, and thus improve chelating and attractive ability of carboxylate to Ni. The Ni removal ratio of the synthesized PAA@ SiO_2 can be 89.9%.

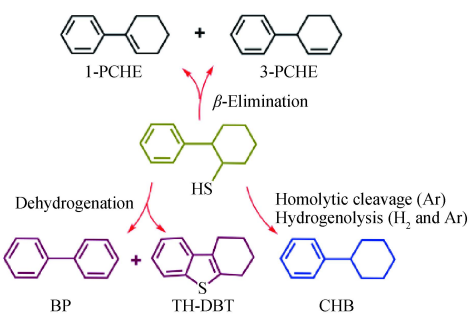


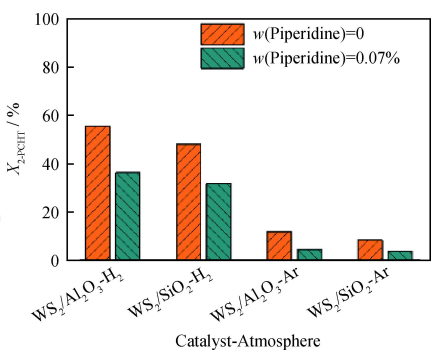
Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0010-0023 **doi**: 10.3969/j.issn.1001-8719.2021.01.002

Desulfurization of 2-Phenylcyclohexanethiol Over WS_2 Catalysts Supported on γ-Al_2O_3 and SiO_2

LIU Shengnan ZHOU Xuerong LI Xiang WANG Anjie WANG Lin

Under H_2, 2-PCHT undergoes desulfurization by three parallel pathways: βelimination, hydrogenolysis and dehydrogenation, while βelimination and hydrogenolysis dominate hydrodesulfurization. Under Ar, the desulfurization paths can be attributed to βelimination, homolytic C—S cleavage and dehydrogenation. Desulfurization occurs mainly through βelimination under Ar. The catalystic performance of WS_2/Al_2O_3 is superior to that of WS_2/SiO_2 in the desulfurization of 2-PCHT both under H_2 and Ar.



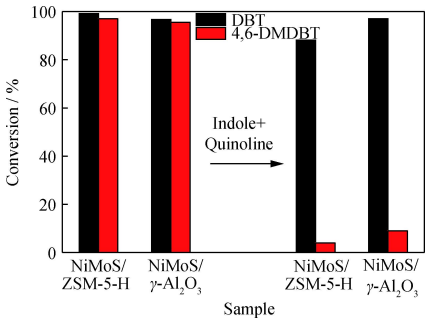


Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0024-0031 **doi**: 10.3969/j.issn.1001-8719.2021.01.003

Effects of Nitrogen Compounds on Hydrodesulfurization Performance of NiMo Catalysts Supported on Hierarchical Pore ZSM-5 Zeolite or Al_2O_3

HE Faduan ZHANG Lei

Effects of nitrogen compounds on the hydrodesulfurization activity of NiMo catalyst supported on hierarchical pore ZSM-5 or γ-Al_2O_3 were studied. The quinoline, a basic nitrogen-containing compound, strongly inhibits the desulfurization activity for 4,6-DMDBT.



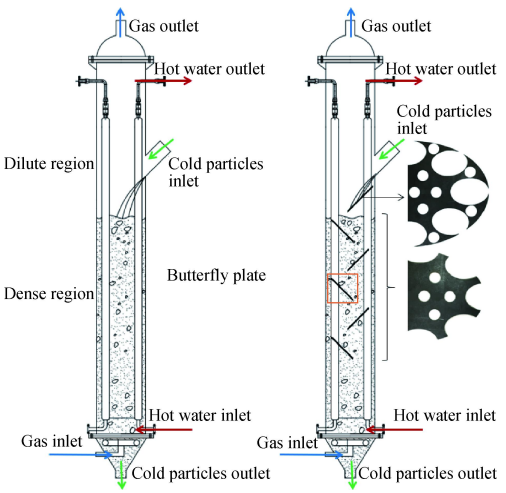
p=6.4 MPa; m(Catalyst)=0.05 g; T=350 ℃; φ(H_2)=25 mL/min; MHSV=80 h^{-1}

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0032-0043 **doi**: 10.3969/j.issn.1001-8719.2021.01.004

Heat Transfer Enhancement Characteristics in Baffle External Catalyst Cooler

LIU Lu YAO Xiuying LI Jiantao LU Chunxi

A new type of baffle catalyst cooler was proposed to solve the problem on low cooling capacity in FCC external catalyst cooler through installing several baffles at the downflow catalyst cooler in current commercial design. Experimental results show that, for the proposed baffle cooler, heat transfer coefficients can relatively increase 26.9% —267.9% and 31.6% —152.5% in dense and dilute regions, respectively.

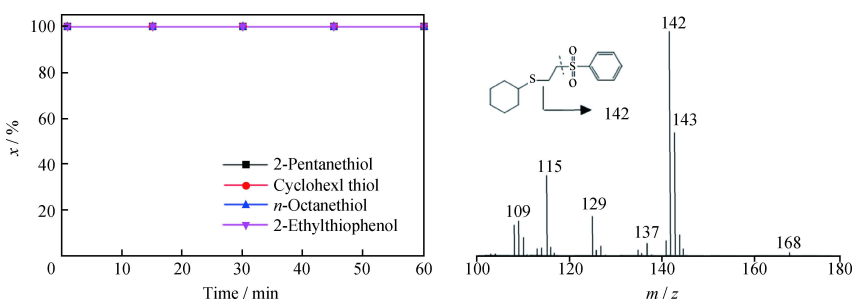


Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0044-0054 **doi**: 10.3969/j.issn.1001-8719.2021.01.005

Analysis of Thiols in Naphtha With Michael Addition Derivatization Followed by Gas Chromatography-Mass Spectrometry

ZHANG Wenqing WANG Naixin WANG Wei LIU Zelong CAI Xinheng

A method based on Michael addition reaction for analyzing thiols in naphtha by gas chromatography-mass spectrometry was established. Using methanol as solvent greatly shortens reaction time. The conversion of thiols is above 99%, thus this method takes great advantages of detection technology.

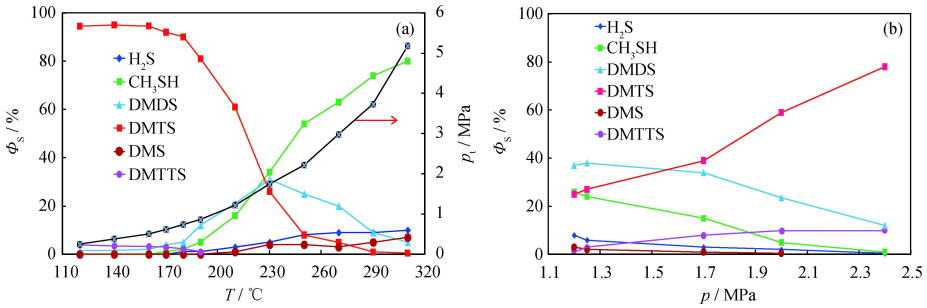


Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0055-0066 **doi**: 10.3969/j.issn.1001-8719.2021.01.006

Pyrolysis of Short-Chain Dialkyl Polysulfides

WU Mingqing WU Xiaoying PAN Luoqi ZENG Guangle LI Tao

Pyrolysis of dimethyl disulfide or dimethyl trisulfide in hydrocarbons can be enhanced with a higher temperature and a lower pressure. Pyrolysis products are mainly methyl mercaptan, hydrogen sulfide and dimethyl sulfides. Dimethyl trisulfides can disproportionate to dimethyl disulfides and dimethyl tetrasulfides in the first step, then both of them further pyrolyze into smaller molecule sulfides.



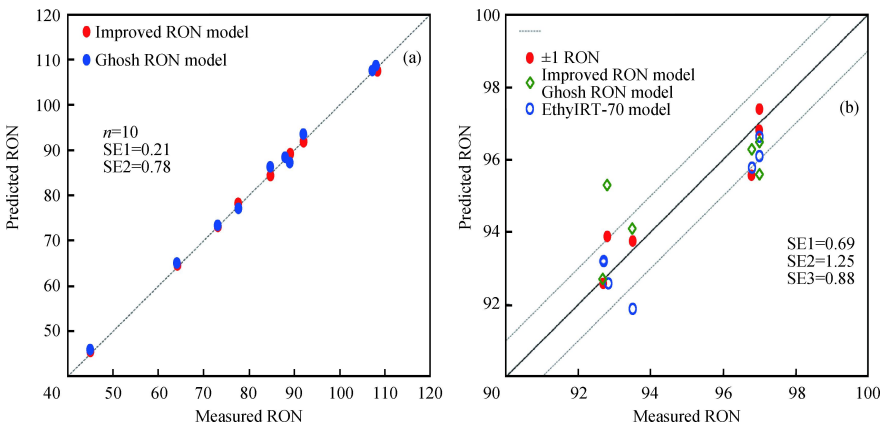
(a) Φ_S vs. T and p_t vs. T for pyrolysis of DMTS, t=120 min; (b) Φ_S vs. p for pyrolysis of DMTS, T=210 ℃, t=120 min;
Φ_S—Ratio of sulfur type in total sulfur; p—Reaction pressure; p_t—Related pressure; T—Reaction temperature;
DMS—Dimethyl sulfide; DMDS—Dimethyl disulfide; DMTS—Dimethyl trisulfide; DMTTS—Dimethyl tetrasulfide

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0067-0078 **doi**: 10.3969/j.issn.1001-8719.2021.01.007

Development of Octane Model Based on Molecular Composition of Gasoline

GUI Xiaojiao WANG Hangzhou JI Ye SUN Baowen WEI Qiang DUAN Wei

The improved RON model has robust prediction accuracy for both different gasoline blending components and blended gasoline products. The standard error of the improved RON model prediction result is 0.21 for the gasoline composition with RON from 45 to 108, and that is 0.69 for blended gasoline products.



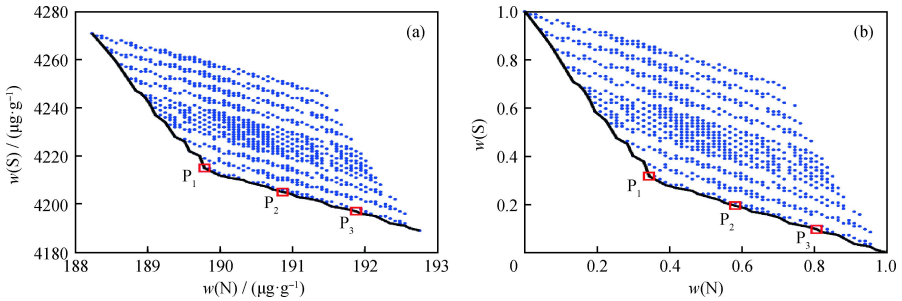
(a) Test data set; (b) Blend gasoline product

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0079-0087 **doi**: 10.3969/j.issn.1001-8719.2021.01.008

Data-Driven Product Prediction and Multi-Objective Optimal Operations of Wax Oil Hydrotreating Unit

TIAN Shuimiao CAO Cuiwen

With the goal of minimizing sulfur and nitrogen contents in the wax oil product, under the condition of various feed quantity of VGO and CGO, multi-objective online optimal operational analysis of wax oil hydrogenation unit was performed.



(a) Anti-normalized data; (b) Normalized data

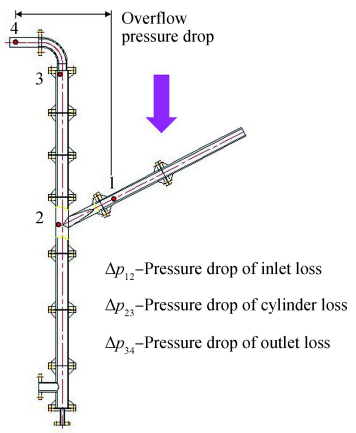
P_1, P_2, P_3—Optimal operation points

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0088-0099 **doi**: 10.3969/j.issn.1001-8719.2021.01.009

Calculation Model of Overflow Pressure Drop in Gas-Liquid Cylindrical Cyclone

WANG Ya'an CHEN Jianyi YE Song YUE Ti YANG Yang
HAN Mingshan

In order to accurately predict overflow pressure drop of gas-liquid cylindrical cyclone (GLCC), a semi-theoretical model is established based on the theory of pressure drop distributes along the path, as well as experimental data. The model considers the impact of structure parameters, gas-liquid operation conditions and fluid physical properties.



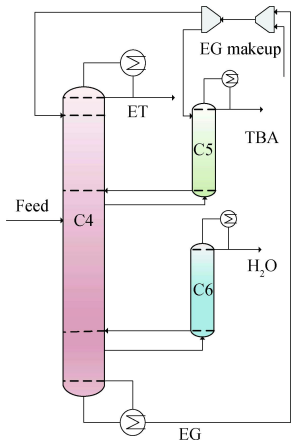
Numbers 1, 2, 3, 4 represent the positions of pressure measurement point.

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0100-0112 **doi**: 10.3969/j.issn.1001-8719.2021.01.010

Energy-Saving Design and Dynamic Control of Extractive Distillation for *tert*-Butanol-Ethanol-Water System

WANG Xiaohong DING Xin LI Wenkui CHEN Jingxuan LI Minggao

For the separation of *tert*-butanol-ethanol-water system, the extractive distillation column with multiple rectifiers is proposed. It is found that it can save 16.16% energy compared with conventional three-column extractive distillation process. The control structure (CS1) with dual temperature controllers of EDCMR process and control structure (CS2) of component-reflux ratio control with reboiler duty/flow rate feed forward controller of EDCMR are established.



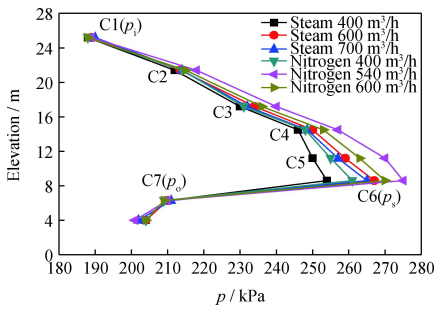
C4—The main column; C5—Side line extractive distillation column; C6—Side line dehydration column; ET—Ethanol; TBA—*tert*-Butanol; EG—Ethylene glycol

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0113-0120 **doi**: 10.3969/j.issn.1001-8719.2021.01.011

Impact Factors of Catalyst Transport in Regeneration Standpipe for FCC Unit

PENG Wei LIU Yansheng HUANG Bingqing XIANG Jigang

Catalyst flow patterns can be monitored by axial pressure distribution measurement in the commercial FCC standpipe. The gas velocity in the standpipe was quantitatively calculated to verify the change of catalyst flow patterns. The above results show that the main reason of various catalyst flow patterns coexistence in the standpipe is unstable gas velocity.



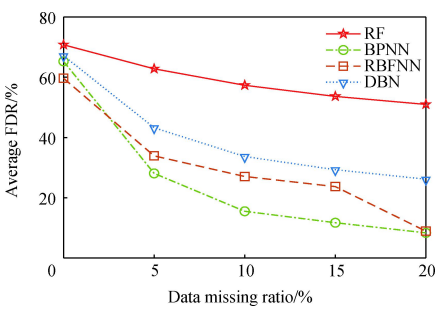
p_i—Inlet Pressure of standpipe (C1);
p_s—Pressure before valve (C6);
p_o—Outlet pressure of standpipe (C7)

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0121-0129 **doi**: 10.3969/j.issn.1001-8719.2021.01.012

Random Forest Based Fault Diagnosis Method for Chemical Process With Unreliable Data

FENG Ziyun WANG Zhihong DAI Yiyang

Compared to the Back Propagation Neural Network (BPNN), Radial Basis Function Neural Network (RBFNN) and Deep Belief Network (DBN), the fault diagnosis rate (FDR) of RF-based fault diagnosis method has the smallest decrease at different data missing ratios. It is shown that RF-based fault diagnosis method can detect and identify fault types more effectively for chemical process with unreliable data.

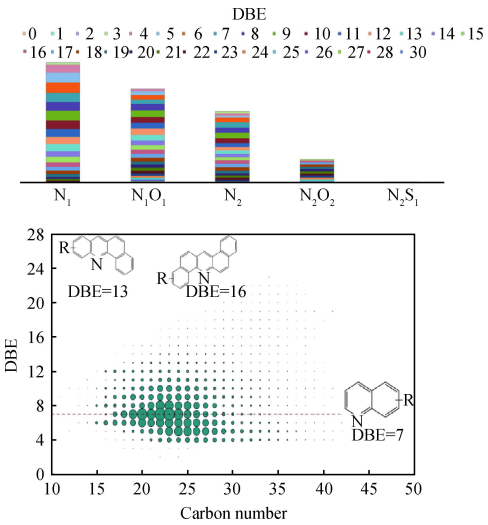


Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0130-0138 **doi**: 10.3969/j.issn.1001-8719.2021.01.013

Molecular Level Characterization of Heteroatom Compounds in Resins and Asphaltenes From Direct Coal Liquefaction Heavy Oils

WANG Qi MAO Xuefeng LI Wenbo QU Sijian LI Junfang ZHONG Jinlong

ESI FT-ICR MS was employed to study the molecular level characterization of heteroatom compounds in resins and asphaltenes of heavy oils from direct coal liquefaction. The main composition and distribution of basic nitrogen compounds, non-basic nitrogen compounds, sulfur compounds and oxygen compounds were investigated.

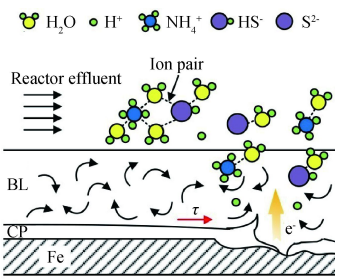


Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0139-0147 **doi**: 10.3969/j.issn.1001-8719.2021.01.014

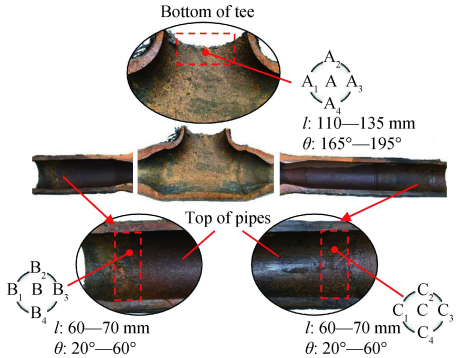
Erosion and Corrosion Characteristics of Multi-Element Water and Salt System in Hydrogenation Air-Cooled Outlet Pipelines

JIN Haozhe XU Henghui LIU Xiaofei OU Guofu HUANG Aibin WANG Jinling

Based on the analysis of technological process and fluid dynamics of the outlet pipelines, the failure mechanism of the multi-component water and salt system was revealed, and the key characterization parameters and prediction system associated to the flow-induced corrosion were established. The accuracy of the prediction results was verified using the failure case.



BL—Turbulent boundary layer; CP—Corrosion product



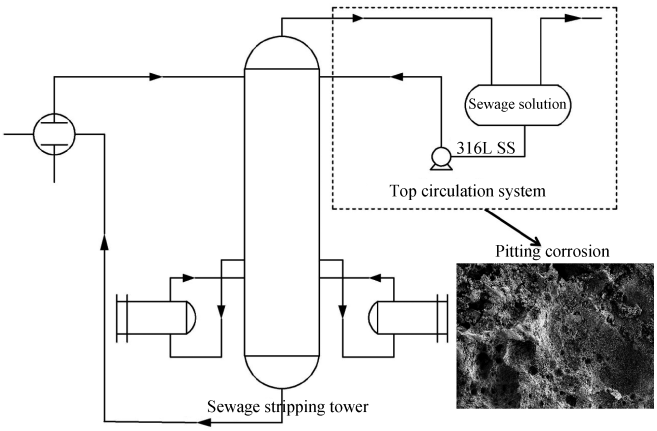
A, B, C—Predicted points; A_1—A_4, B_1—B_4, C_1—C_4—Test point around the predicted points

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0148-0156 **doi**: 10.3969/j.issn.1001-8719.2021.01.015

Corrosion Characteristics of 316L Stainless Steel in the Top Circulation System of Sewage Stripping Tower

LÜ Wenchao OU Guofu LIU Xiaofei XU Henghui

Sewage medium containing NH_4Cl in the top circulation system of the sewage stripping tower can damage the passivation film on the surface of 316L stainless steel and cause pitting corrosion. NH_4Cl content and medium flowrate are key factors which impact the corrosion rate.

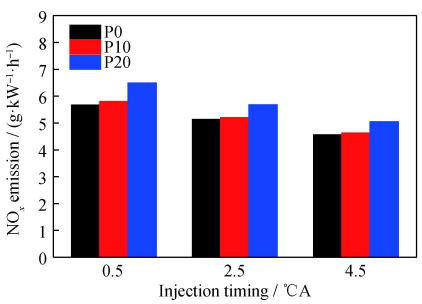


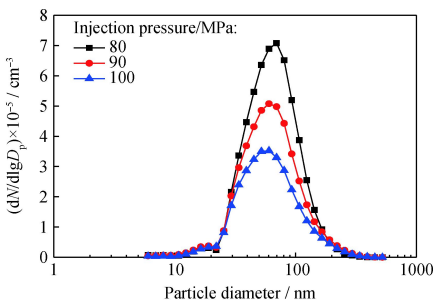
Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0157-0167 **doi**: 10.3969/j.issn.1001-8719.2021.01.016

Effects of Injection Parameters on the Combustion Pollutants Emissions of PODE/Diesel Blended Fuels

JI Qian WANG Tianting LIU Junheng SUN Ping GAO Wanying YANG Chen

This study dealed with the experimental investigation on gaseous emission characteristics and particle size distributions of a common rail-diesel engine operating with PODE/diesel blends at different injection pressures and different injection timings. The effects of delayed injection timing can obviously decrease NO_x emission. The peak value of particle number concentration decreases with increased injection pressure.



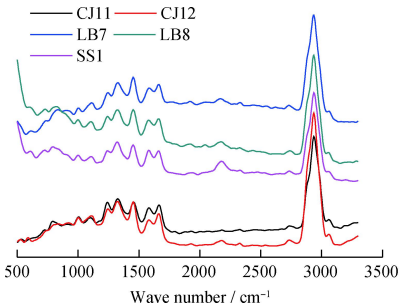


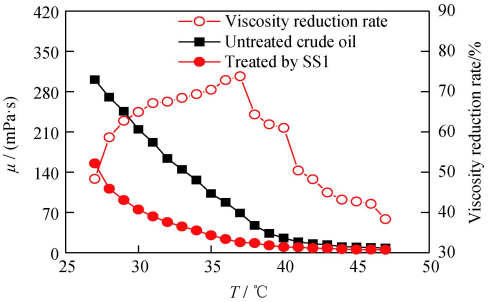
Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0168-0175 **doi**: 10.3969/j.issn.1001-8719.2021.01.017

Properties of *Pseudomonas Aeruginosa* on Wax Removal and Viscosity Reduction in Crude Oil

WANG Weiqiang WU Shangshu CUI Jing BAO Tianyu ZHANG Haijuan ZHANG Zhengyi

A dominant strain SS1 was screened out by single-cell Raman-D_2O isotope labeling technique from five paraffin-degrading bacteria. The results show that the rate of wax degradation is 53.16%, the rate of viscosity reduction reaches 72.84%, indicating the employed technique improves the fluidity of crude oil.





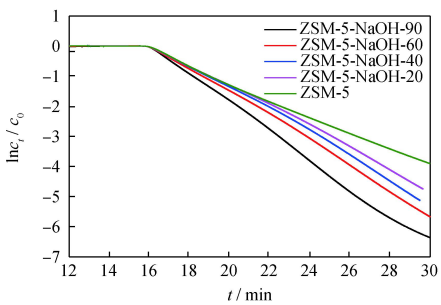
Research Notes

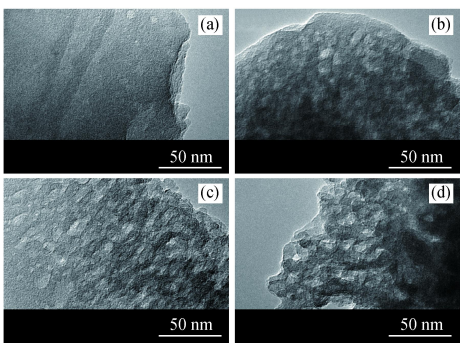
Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0176-0180 **doi**: 10.3969/j.issn.1001-8719.2021.01.018

Impact of Alkali Treatment on Hierarchical Pore Structure and Diffusion Properties of ZSM-5 Zeolites

SHI Yanqiang CHEN Shuai SUN Lijie ZHENG Aiguo XU Guangtong

Zero length column (ZLC) method was used to study the diffusivity of cyclohexane in ZSM-5 zeolites with different NaOH desilication time. The article gives a systemical diffusion data including dynamic and static diffusion results, which can help researchers acquire more comprehensive pore structure information on zeolites.





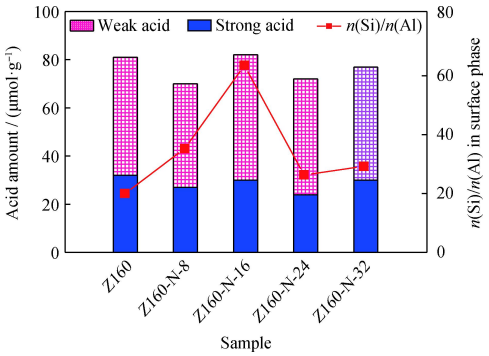
(a) ZSM-5 zeolite; (b) ZSM-5-NaOH-40; (c), (d) ZSM-5-NaOH-90

Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0181-0189 **doi**: 10.3969/j.issn.1001-8719.2021.01.019

Acid Modification of Nanosized HZSM-5 for Alkylation of Benzene With Dilute Ethylene

DUAN Xinrui LI Xiaoguo ZHANG Yongkun BIAN Kai ZHANG Anfeng HOU Zhanggui GUO Xinwen

Nitric acid treatment changes the acid density and acid amount of nanosized HZSM-5. The acid density of molecular sieve pretreated with nitric acid for 16 h was slightly reduced, while the external surface of this zeolite possesses the lowest acid sites.

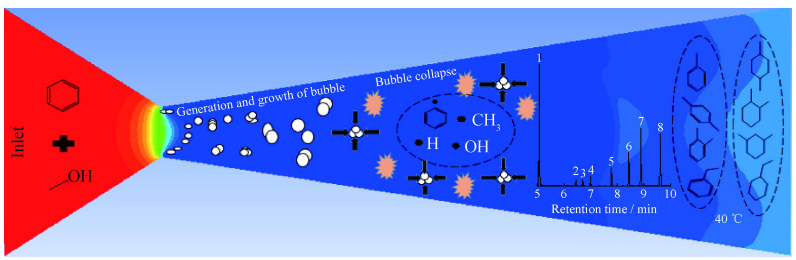


Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0190-0200 **doi**: 10.3969/j.issn.1001-8719.2021.01.020

Low Temperature Alkylation of Benzene and Methanol in Hydrocavitation Field

CHEN Jichao MA Fengyun LIU Jingmei ZHONG Mei LI Xuekuan WEI Xianyong YIN Shuangjie

Alkylation of benzene with methanol at low temperature in the field of hydrodynamic cavitation was studied. The results show that conversions of benzene and methanol are 25.96% and 9.89%, respectively, and selectivity of xylene is 37.86%.

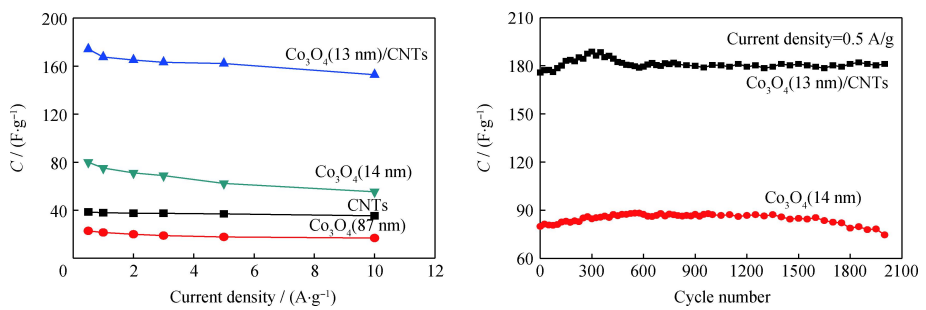


Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0201-0209 **doi**: 10.3969/j.issn.1001-8719.2021.01.021

Hydrothermal Synthesis of the Co_3O_4/CNTs Composite Electrode and Its Electrochemical Performance

SU Weiguang WANG Wenxin SHI Yuchen ZHANG Ce SONG Xudong WANG Jiaofei BAI Yonghui YAO Min YU Guangsuo

The specific capacitance increased by the improvement of conductivity of Co_3O_4 (13 nm)/CNTs composite is much higher than that increased by the decrease of particle size of Co_3O_4. After 2000 charge-discharge cycles, the specific capacitance of Co_3O_4 (13 nm)/CNTs remains at about 180 F/g, exhibiting excellent rate capacity and cycling stability.

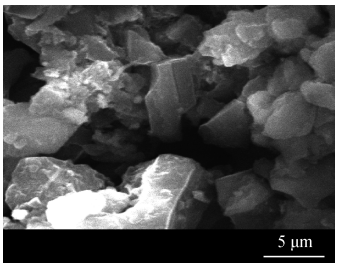


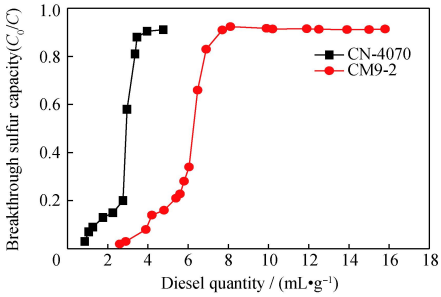
Acta Petrolei Sinica (*Petroleum Processing Section*), 2021, 37(1): 0210-0217 **doi**: 10.3969/j.issn.1001-8719.2021.01.022

Preparation and Evaluation of High Performance Coal-Based Activated Carbon

ZHA Chunmei WANG Wei WANG Li WANG Bin MA Feilong

A new process for preparation of high-performance coal-based activated carbon was developed. Experimental results show that the activated carbon prepared from the optimized carbonization and activation process can demonstrate improved pore size distribution and excellent absorption desulfurization performance.





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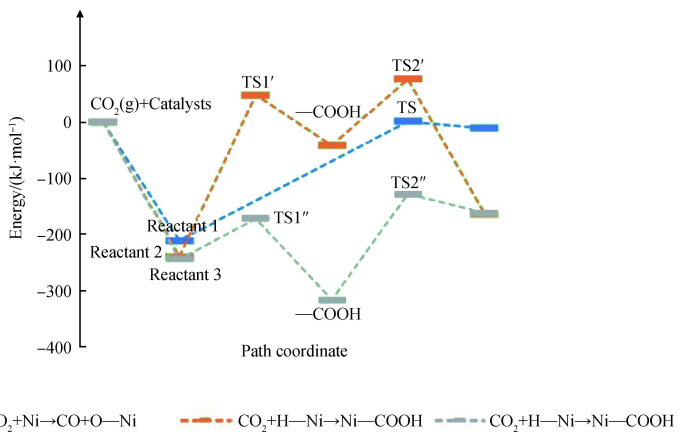
Molecular Simulation on CO_2 Disaggregation of Methane Dry Reforming Reaction

ZHAO Xiaoguang QU Yakun ZHANG Rongjun

Calculation results show that CO_2 dissociation is endothermic reaction. The pathway in which H radical attacks the C atom of CO_2 is the preferred in three proposed mechanism. The Mulliken charge population analysis and other calculated results are in accordance with the activation energy.



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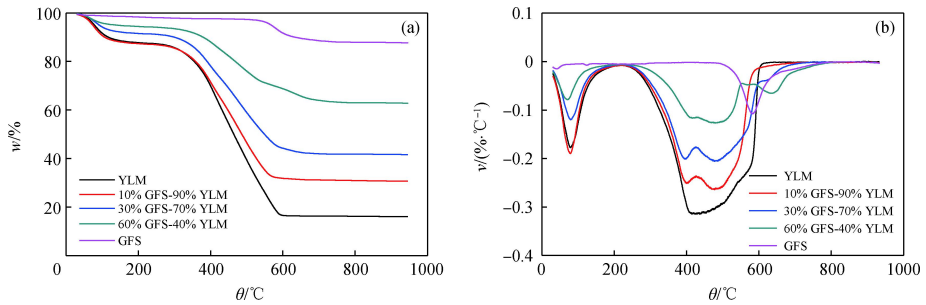
Co-Combustion Characteristics of Gasification Fine Slag and Raw Coal

XU Wenjing LI Ping WANG Feng KAN Haoyong YAN Hanwen HU Xiude GUO Qingjie

The thermogravimetric analysis shows that there is a significant synergistic effect between gasification fine slag and raw coal. The higher proportion of mixed raw coal, the lower the activation energies of mixed combustion, and the better flammability and comprehensive combustion characteristics.



(a) TG profiles; (b) DTG profiles

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Analysis of Gasoline Collected From Gas Station in Jilin by Comprehensive Two-Dimensional Gas Chromatography Coupled With Quadrupole Mass Spectrometry

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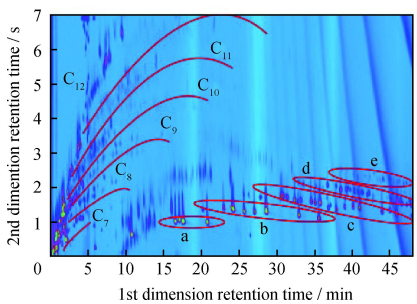
ZHANG Jingshun ZHU Jun LIU Zhanfang SUN Yuyou

A method of comprehensive two-dimensional gas chromatography coupled with quadrupole mass spectrometry has been developed for the qualitative and quantitative analysis of fluid catalytic cracking gasoline. Results show that the proposed method is suitable for the separation of complex samples and qualitative and quantitative analyses of fluid catalytic cracking gasoline.



特约英文编审:范志明,加拿大不列颠哥伦比亚大学化学及生物工程博士,先后在加拿大自然资源部及加拿大国家研究院工作,现供职BP美国公司,研究领域包括重质油加工、石油加工过程中沥青质沉淀及石油化学等。

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