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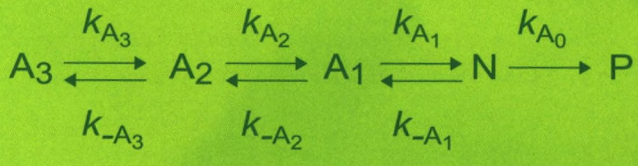
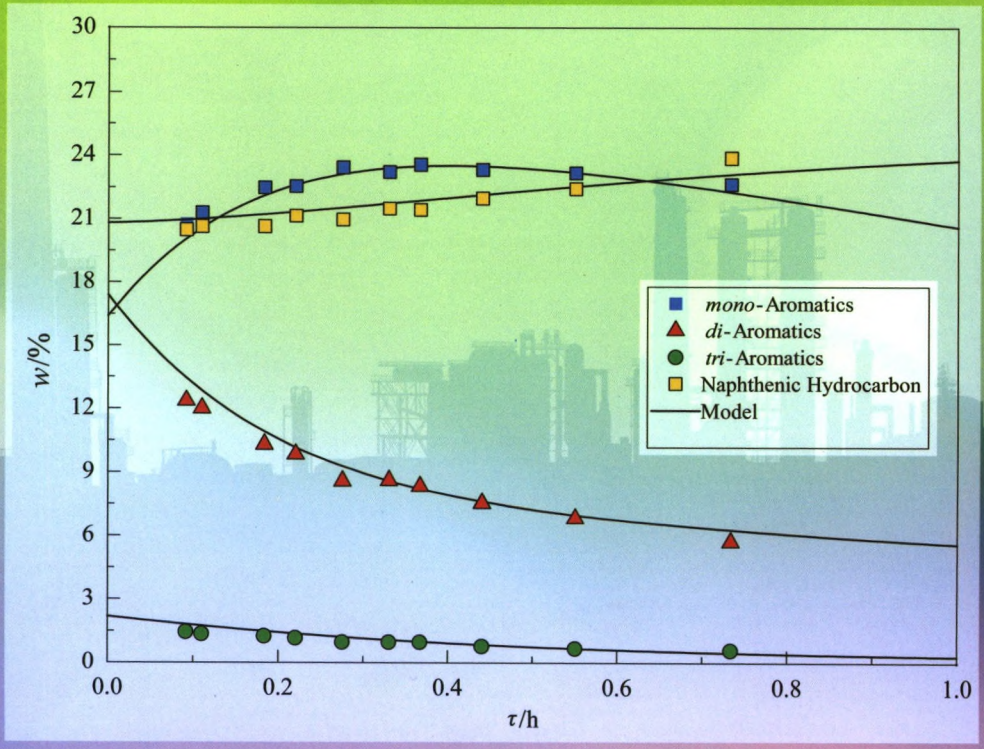
石油学报(石油加工)

ACTA PETROLEI SINICA
(PETROLEUM PROCESSING SECTION)





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（石油加工）

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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。

ACTA PETROLEI SINICA

(PETROLEUM PROCESSING SECTION)

Vol. 35 No. 3 May 2019

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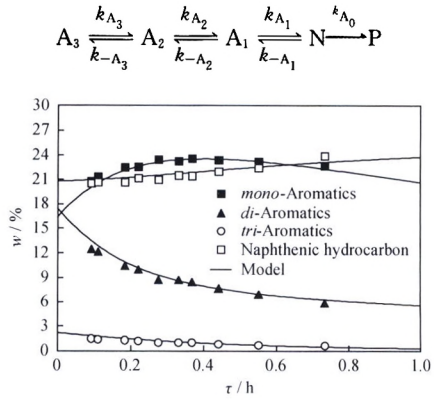
Lumped Kinetic Model for Diesel Hydrodearomatization on $CoMo/Al_2O_3$ Catalyst

JIANG Hongbo LÜ Hailong CHEN Wenbin QIN Kang LI Mingfeng NIE Hong

Hydrogenation kinetics of aromatics in diesel with $CoMo/Al_2O_3$ catalyst were investigated in an isothermal high-throughput reactor. A lumped kinetic model considering the influence of competitive adsorption was proposed. This kinetic model can be used to provide technical support for diesel hydrodearomatization process optimization.

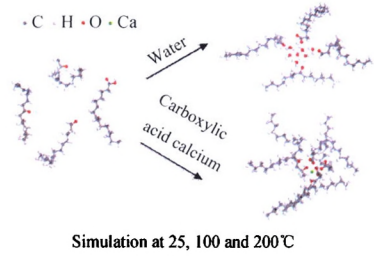


Acta Petrolei Sinica (Petroleum Processing Section), 2019, 35(3): 0440-0448 **doi**: 10.3969/j.issn.1001-8719.2019.03.002

Molecular Dynamics Simulation on the Effect of Water and Carboxylic Acid Calcium on the Aggregation of Lubricant Oxidation Products

XIA Lei LONG Jun ZHAO Yi WU Zhiqiang DAI Zhenyu WANG Lihua

We investigate herein the aggregation of lubricant oxidation products and the effect of water and carboxylic acid calcium on the aggregation by molecular dynamics simulations. The aggregation of lubricant oxidation products becomes less with temperature increase. Water and carboxylic acid calcium could promote the aggregation even at high temperatures.



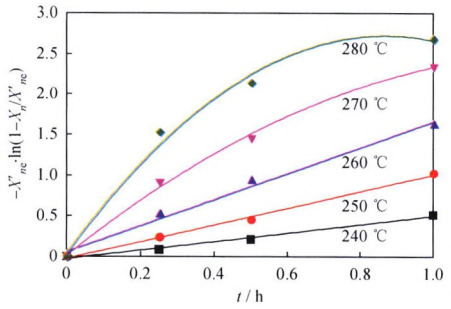
Simulation at 25, 100 and 200℃

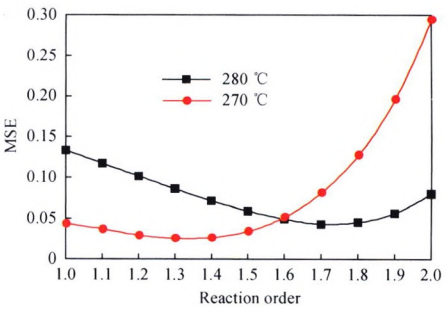
Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0449-0455 **doi**: 10.3969/j.issn.1001-8719.2019.03.003

Kinetics Model of the Hexane Isomerization on a Pt/HBeta Catalyst

ZHANG Kongyuan XIAO Changlin LIU Chenguang

The effects of MHSV on the isomerization of *n*-hexane were investigated under different reaction temperatures. Subsequently, the kinetic model of isomerization reaction was established.



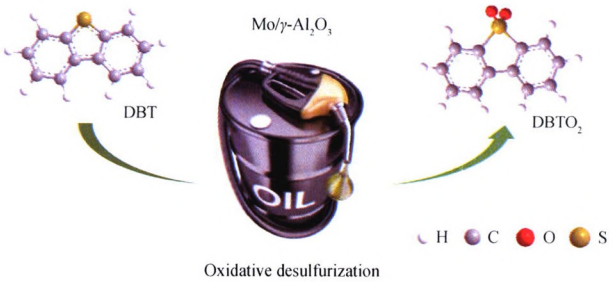


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0456-0462 **doi**: 10.3969/j.issn.1001-8719.2019.03.004

Preparation of Mo/γ-Al_2O_3 Catalyst and Its Catalytic Performance in Oxidative Desulfurization of Marine Fuel Oil

HUANG Xiaoqiao

After oxidative desulfurization (ODS) treatment, the sulfur mass fraction of marine fuel oil reduces from 1.6% to 0.3%. The Mo/γ-Al_2O_3 exhibits excellent catalytic performance for ODS of marine fuel oil and the sulfur removal activity, without any decline after reusing for 10 times.

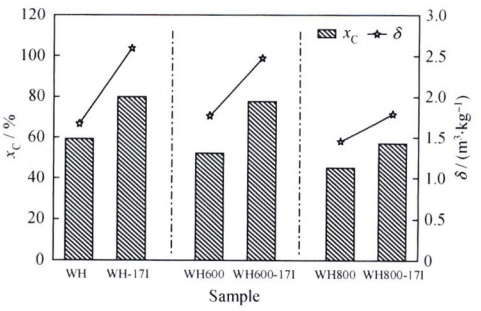


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0463-0472 **doi**: 10.3969/j.issn.1001-8719.2019.03.005

Effects of $Ca(OH)_2$ on Steam Gasification of Weihua Sub-Bituminous Coal and Char

CUI Dianmiao OUYANG Ping ZHANG Ran LIU Yanfang
WANG Dachuan CUI Longpeng

Effects of $Ca(OH)_2$ on steam gasification of Weihua sub-bituminous coal and pyrolysis char were investigated. Experimental results demonstrated that $Ca(OH)_2$ can significantly enhance the gasification reactivity of coal and char. It is also found that it is through electrostatic and hydrogen-bond interactions for $Ca(OH)_2$ to disperse into the surface of coal and char.

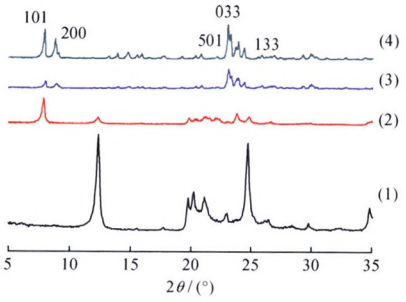


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0473-0478 **doi**: 10.3969/j.issn.1001-8719.2019.03.006

Characterization of ZSM-5 Zeolite Synthesized From Kaolin/Dimethylsulfoxide Intercalation Composite

ZHANG Peiqing LIU Sicheng HE Lijun ZHENG Shuqin REN Shao

The ZSM-5 zeolite composites were synthesized from Kaolin/dimethylsulfoxide intercalation composite by an in-situ hydrothermal crystallization method. When the mass fraction of Kaolin/dimethylsulfoxide intercalation composite is 6%, the highest crystallinity and the best thermal stability of ZSM-5 zeolite are obtained, with particle diameter of 5 μm.



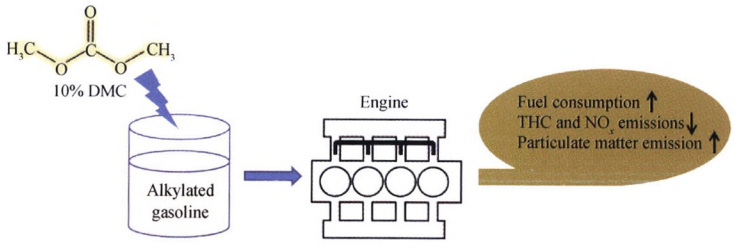
(1) K; (2) KDC; (3) CZ-6; (4) RZ

Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0479-0485 **doi**: 10.3969/j.issn.1001-8719.2019.03.007

Effect of Dimethyl Carbonate on Combustion Performance of Gasoline From Alkylation Unit

YANG He WANG Pengfei WANG Jun XU Chen HAN Yongqiang ZHANG Jianrong

Adding 10% volume fraction dimethyl carbonate (DMC) in alkylated gasoline has some typical impacts on the performance of a direct-injection gasoline engine. In general, compared with blank alkylated gasoline, DMC addition will increase fuel consumption and particulate matter emission, but can reduce THC and NO_x emission.

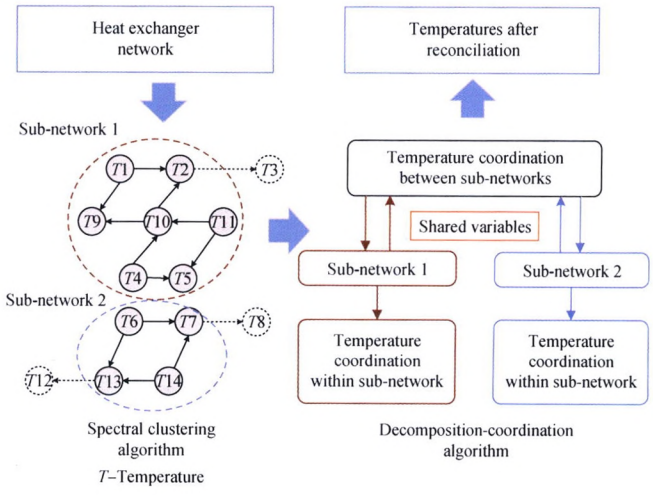


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0486-0492 **doi**: 10.3969/j.issn.1001-8719.2019.03.008

Temperature Reconciliation of Large-Scale Heat Exchanger Networks Based on Network Partitioning

KANG Lixia ZHU Tianhong LIU Yongzhong

For a given heat exchanger network (HEN), a weighted directed graph can be constructed on the basis of the energy balances of the HEN as the first step. Then, the spectral clustering algorithm is used to generate the sub-networks of the HENs. The feasible reconciliation results can be finally obtained by decomposition and coordination algorithm.

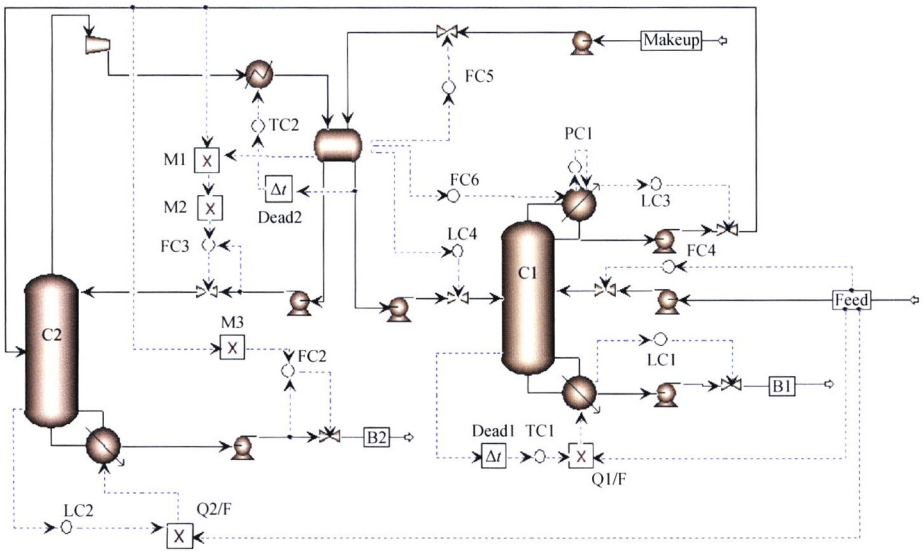


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0493-0501 **doi**: 10.3969/j.issn.1001-8719.2019.03.009

Design and Dynamic Control of Energy Efficient Azeotropic Distillation for Dehydration of *n*-Propanol

WANG Xiaohong LI Minggao LI Wenkui ZHANG Yuanpeng

Two energy-saving processes of *n*-propanol dehydration, azeotropic distillation under reduced pressure (ADRP) and azeotropic dividing-wall column (ADWC), are designed and compared. It is found that ADWC can save 25.65% energy than that of ADRP, however, its control effect is inferior to that of ADRP.

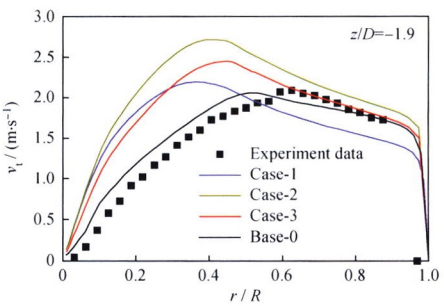


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0502-0508 **doi**: 10.3969/j.issn.1001-8719.2019.03.010

Effect of Grid Generation on Simulation Accuracy of Spray Granulation Tower

FENG Liuhai BU Yifeng ZHU Yanqing MAO Yu
LI Xi MEN Zhuowu

The simplified geometric model and mesh generation strategy have great impact on the simulation accuracy. Therefore, the jet direction and physical dissipation should be considered when building the mesh system.



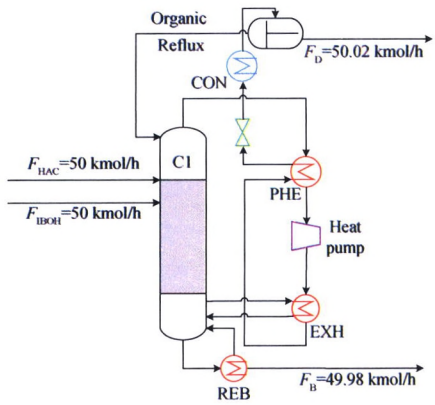
Case-1—Variation on orifice area; Case-2—Variation on jet velocity;
Case-3—Non-simplified grid (vertical mapping); Base-0—Non-simplified grid (fine)

Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0509-0517 **doi**: 10.3969/j.issn.1001-8719.2019.03.011

Design and Control of Isobutyl Acetate Synthesis by Inter-Reboiler Heat Pump Reactive Distillation

ZHANG Qingrui LI Haiying YAN Sen LIU Yan

The IR-HPRD-2 process reduces the energy consumption and TAC significantly. Compared with the CRD process, the results show that the TUC of IR-HPRD-2 decreases by 47.55% and TAC decreases by 19.13%.



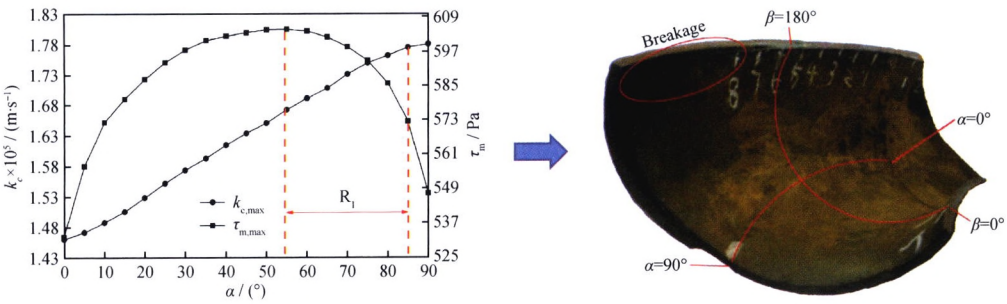
CON—The condenser; EXH—The heat exchanger; F_B—The flow of the bottom; F_D—The flow of the top; F_{HAC}—The HAC feed flow; F_{IBOH}—The IBOH feed flow; PHE—The preheater; REB—The reboiler

Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0518-0526 **doi**: 10.3969/j.issn.1001-8719.2019.03.012

Characteristics and Numerical Prediction Method of Elbow Erosion in the Air Coolers Outlet Piping System of Hydrogenation Reaction Effluents

JIN Haozhe XU Xiaofeng OU Guofu LIU Xiaofei YANG Tao

To study the pipeline failure caused by erosion, based on the numerical simulation of REAC outlet piping, an erosion prediction method combined with the characterization parameters of mass transfer coefficient and maximum shear stress is proposed. The predicted high risk area of erosion obtained by analysis of elbows is the same area where the elbow erosion leakage actually failed.

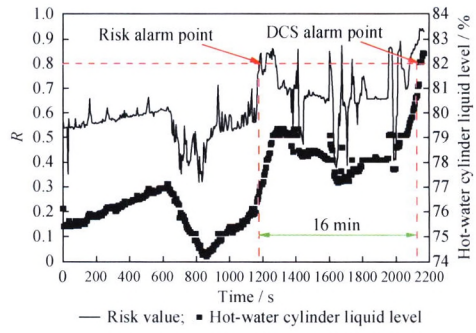


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0527-0533 **doi**: 10.3969/j.issn.1001-8719.2019.03.013

Precise Risk-Ultra-Early-Warning Method for Long Period Running Petrochemical Devices

HU Jinqiu ZHANG Liqiang ZHANG Laibin

The expected loss and occurrence probability of abnormal situation were first calculated by Loss Function and Remaining Time Model, and thus obtained the risk value for risk warning. Test results show that this method can achieve early warning about ten minutes earlier than that from DCS.

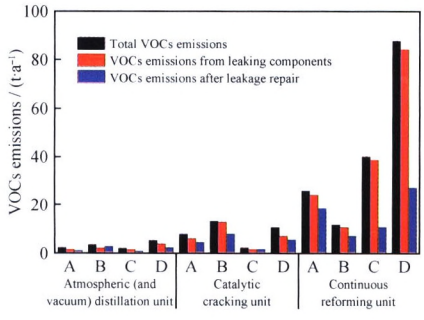


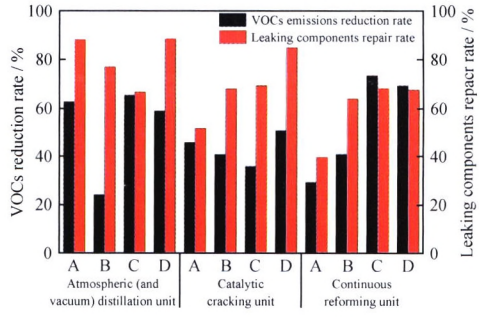
Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0534-0539 **doi**: 10.3969/j.issn.1001-8719.2019.03.014

VOCs Emissions From Several Typical Units in Different Refineries With LDAR Technology

KE Jia SUN Hui ZHAO Dongfeng LI Shi SUN Longzhu TIAN Xiaoying

Based on the implementation of leak detection and repair (LDAR) technology, the LDAR records and volatile organic compounds (VOCs) emissions of three typical units, it was found that leaking components contribute to about 80% of total VOCs emissions. 73% reduction in VOCs emissions has been achieved after repairing 70% leaking components. Reforming unit has the highest leaking percentage and VOCs emissions.





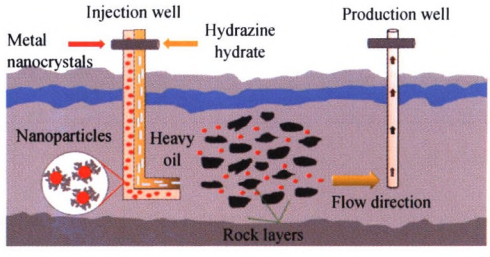
Research Notes

Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0540-0547 **doi**: 10.3969/j.issn.1001-8719.2019.03.015

In-Situ Viscosity Reduction for Heavy Oil Through Catalytic Hydrocracking With Bifunctional Metal Nanocrystals/Hydrazine Hydrate System

LI Yanping ZHANG Hui CUI Yingxian LI Chenyu LI Jianhu WU Xi

Bifunctional Ni, Pd and Ni-Pd alloy nanocrystals/hydrazine hydrate system was used in the viscosity reduction and upgrading process of Nanpu heavy oil by in-situ catalytic cracking. Metal nanocrystals have dual functions, i.e. promoting macromolecule catalytic cracking reactions in heavy oil and help hydrogen donor to release hydrogen through catalytical reactions. Pd nanocrystals/hydrazine hydrate system exhibited the best viscosity reduction performance for heavy oil. The mass fraction of heavy components of the upgraded oil could decrease 8.34%, and the viscosity reduction rate could be up to 91.3%. The proposed bifunctional system can be used for heavy oil enhanced oil recovery development.

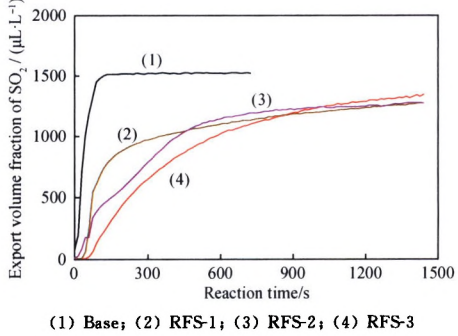


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0548-0554 **doi**: 10.3969/j.issn.1001-8719.2019.03.016

Physicochemical Characterization and Desulfurization Properties of Sulfur-Transfer Catalysts With Different Preparation Methods

ZHANG Jiexiao ZHANG Wanhong SONG Haitao TIAN Huiping LI Jiaxing

The sulfur-transfer catalyst RFS-1 prepared by conventional method has low performance in regeneration flue gas desulfurization. The cerium modified sulfur-transfer catalysts RFS-2 and RFS-3, with different cerium compounds adding, ensure excellent intensive index and high MgO content, as well as promising desulfurization performance. RFS-3 shows the most excellent flue gas desulfurization performance, of ultra-low SO_2 volume fraction in flue gas within 500 s, and long flue gas desulfurization lifetime.



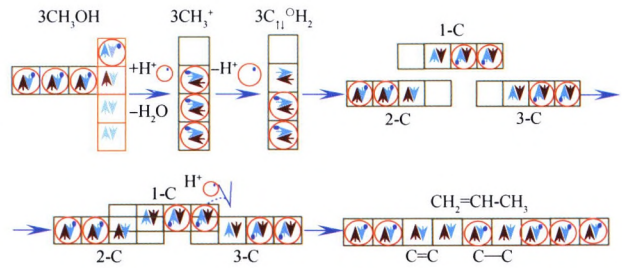
(1) Base; (2) RFS-1; (3) RFS-2; (4) RFS-3

Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0555-0560 **doi**: 10.3969/j.issn.1001-8719.2019.03.017

Reaction Mechanisms of Methanol to Propylene

HE Zhenfu

B-acid center releases H^+ to attack the C—O bond in the methanol molecule, and the C—O bond cleaves to form the methyl carbon cation (CH_3^+). The outer layer of the carbon atom of the CH_3^+ has an empty orbit, and the B-acid center after the release of H^+ loses its activity. The inactivated B-acid center obtains H^+ from CH_3^+, and the CH_3^+ produces a new intermediate H-form. The H-form has a pair of lone pairs of electrons (e^-) and one empty orbital, and the structural formula can be expressed as $C_{\uparrow\downarrow}{}^{\circ}H_2$. The inactivated B-acid center can recover activity after obtaining H^+. For carbon atoms of the three H-form structures, the first carbon atom and the second carbon atom share two pairs e^- to form a C=C bond; the first carbon atom also shares a pair e^- with the third carbon atom to form C—C bond. As a result, the three carbon atoms of H-form structure can form a C=C—C structure, which is propylene.

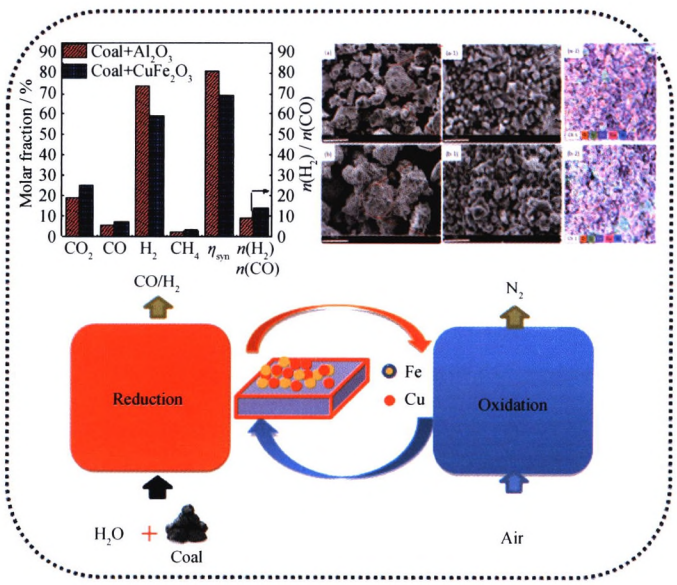


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0561-0568 **doi**: 10.3969/j.issn.1001-8719.2019.03.018

Chemical Looping Gasification of Yangchang Coal With $CuFe_2O_4$ as Oxygen Carrier

AN Mei MA Jingjing WU Wei REN Tian HU Xiude GUO Qingjie

Comprehensive studies of reaction products from $CuFe_2O_4$ with YC and oxygen transfer mechanism of $CuFe_2O_4$ oxygen carrier were performed. $CuFe_2O_4$ is a good oxygen carrier for coal chemical looping gasification. $CuFe_2O_4$ oxygen carrier is dual functional. It can provide both lattice oxygen and catalyzing decomposition of CO_2.

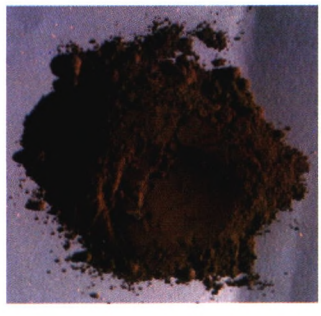


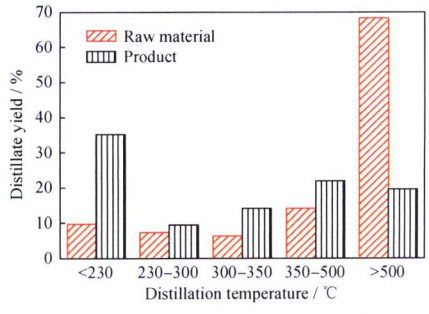
Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0569-0574 **doi**: 10.3969/j.issn.1001-8719.2019.03.019

Product Characteristics of the Co-Hydrogenation of Coal-Derived Oil and Low Rank Coal Under Solid Acid Catalysts

HU Fating LI Junfang MAO Xuefeng

The co-processing test of coal-derived oil and low rank coal was carried out using solid acid catalyst. The distillation characteristics, element content, group composition and compounds structure of co-processing products were studied by using real boiling point distillation, elemental analysis, and gas chromatography-mass spectrometer (GC-MS) methods.



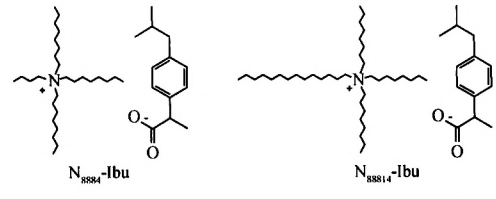


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0575-0580 **doi**: 10.3969/j.issn.1001-8719.2019.03.020

Tribological Properties of Lubricating Grease Adding Quaternary Ammonium Ionic Liquids

CHANG Jun WANG Zeyun

Two kinds of environmental-friendly quaternary ammonium ionic liquids were prepared by using ibuprofen as anions and quaternary ammoniums as cations. The tribological properties of ionic liquids for PAO10 complex lithium grease additives were investigated on a four-ball friction tester. The results show that the ionic liquids exhibit excellent friction reducing and anti-wear properties.

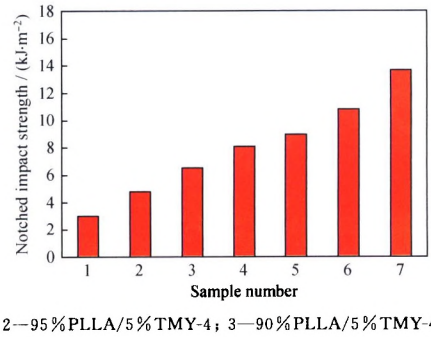


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0581-0588 **doi**: 10.3969/j.issn.1001-8719.2019.03.021

Effects of TMY-4 and TMY-4/TPEE Combination on Crystallization and Mechanic Properties of PLLA

SHI Mengmeng LUO Faliang LUO Chunhui

When TPEE mass fraction was 40% and TMY-4 mass fraction was 5%, the impact strength of PLLA/TMY-4/TPEE ternary blend system could reach 13.68 kJ/m^2, which was 3.5 times higher than that of PLLA.



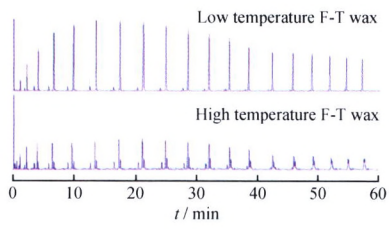
1—PLLA; 2—95%PLLA/5%TMY-4; 3—90%PLLA/5%TMY-4/5%TPEE; 4—85%PLLA/5%TMY-4/10%TPEE; 5—75%PLLA/5%TMY-4/20%TPEE; 6—65%PLLA/5%TMY-4/30%TPEE; 7—55%PLLA+5%TMY-4+40%TPEE

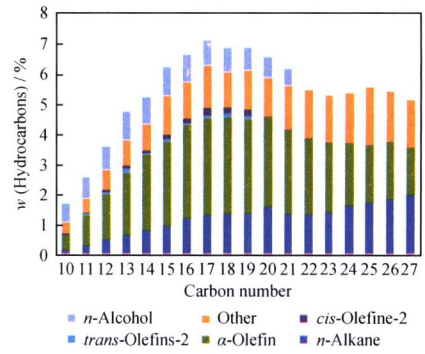
Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0589-0593 **doi**: 10.3969/j.issn.1001-8719.2019.03.022

Compositional Analysis of Fischer-Tropsch Wax by Gas Chromatography

WU Mei XU Run ZHANG Ran

A gas chromatographic method was developed for the determination of hydrocarbon composition in Fischer-Tropsch (F-T) wax, which enables detailed hydrocarbon analysis of ＜400 ℃ fractions. Compared to low-temperature F-T wax, there are more *α*-olefins, *n*-paraffins and *n*-alkanol in high-temperature F-T wax. Higher reaction temperature led to more *i*so-alkanes but less *α*-olefins, *n*-paraffins and *n*-alkanes produced.



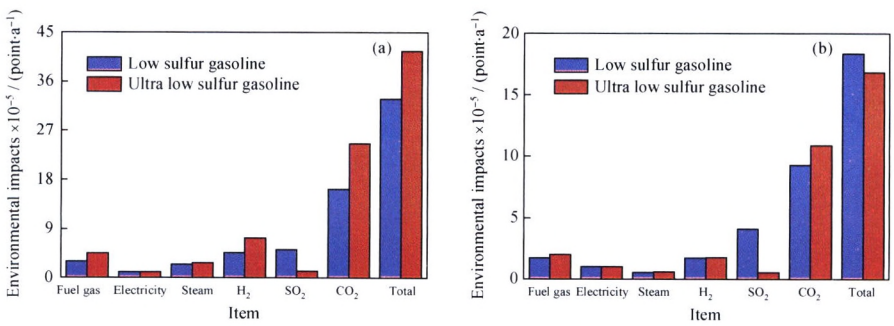


Acta Petrolei Sinica (*Petroleum Processing Section*), 2019, 35(3): 0594-0602 **doi**: 10.3969/j.issn.1001-8719.2019.03.023

Environmental Impact Analysis and Comparison for Different Gasoline Production Refining Processes

SHI Meirong WU Le ZHAO Xin

When gasoline quality is upgraded from low sulfur to ultra-low sulfur, the total environmental impact of a hydrodesulfurization unit will increase when considering environmental impact due to utility consumption during production process. However, the total environmental impact of S-Zorb unit is less compared with HDS process.



(a) A gasoline hydrotreating unit; (b) An S-Zorb unit

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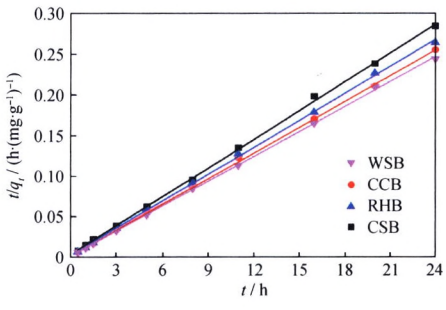
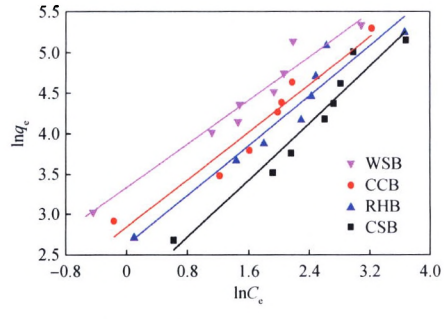
Adsorption of Petroleum Pollutants Released From Soil by Biochar

WANG Beibei LIU Qi ZHANG Shengnan YOU Hanyang MA Yanfei AN Jiutao

Different sources of biochar were used as adsorbents to study the adsorption properties of petroleum hydrocarbons. Batch experiments were conducted to investigate effects of process conditions on the adsorption capacity, and the kinetic and isothermal adsorption fitting were performed.





Review

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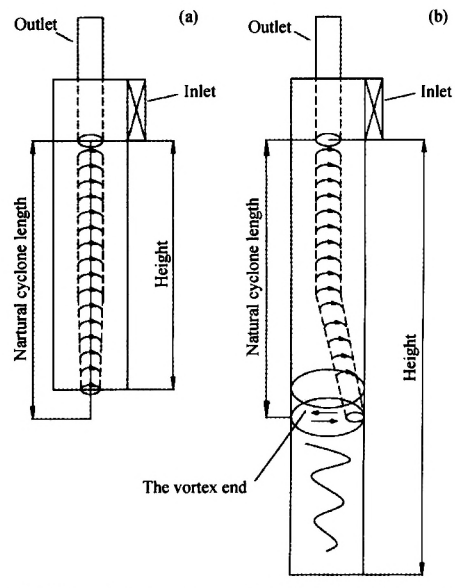
Influence Factors of the Natural Cyclone Length in Cyclone Separators

GAO Zhuwei WANG Juan WANG Jiangyun MAO Yu

Natural cyclone length is the axial distance between the vortex end and the bottom section of vortex finder, which has an important impact on flow field in the cyclone separator. For the calculation model of natural cyclone length, not only the influence of inlet area but also the influence of other geometric parameters (e.g. cylindrical height, etc.), operating parameters (e.g. inlet velocity, etc.) and the inlet concentration should be considered.



(a) The short cylinder structure; (b) The long cylinder structure

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