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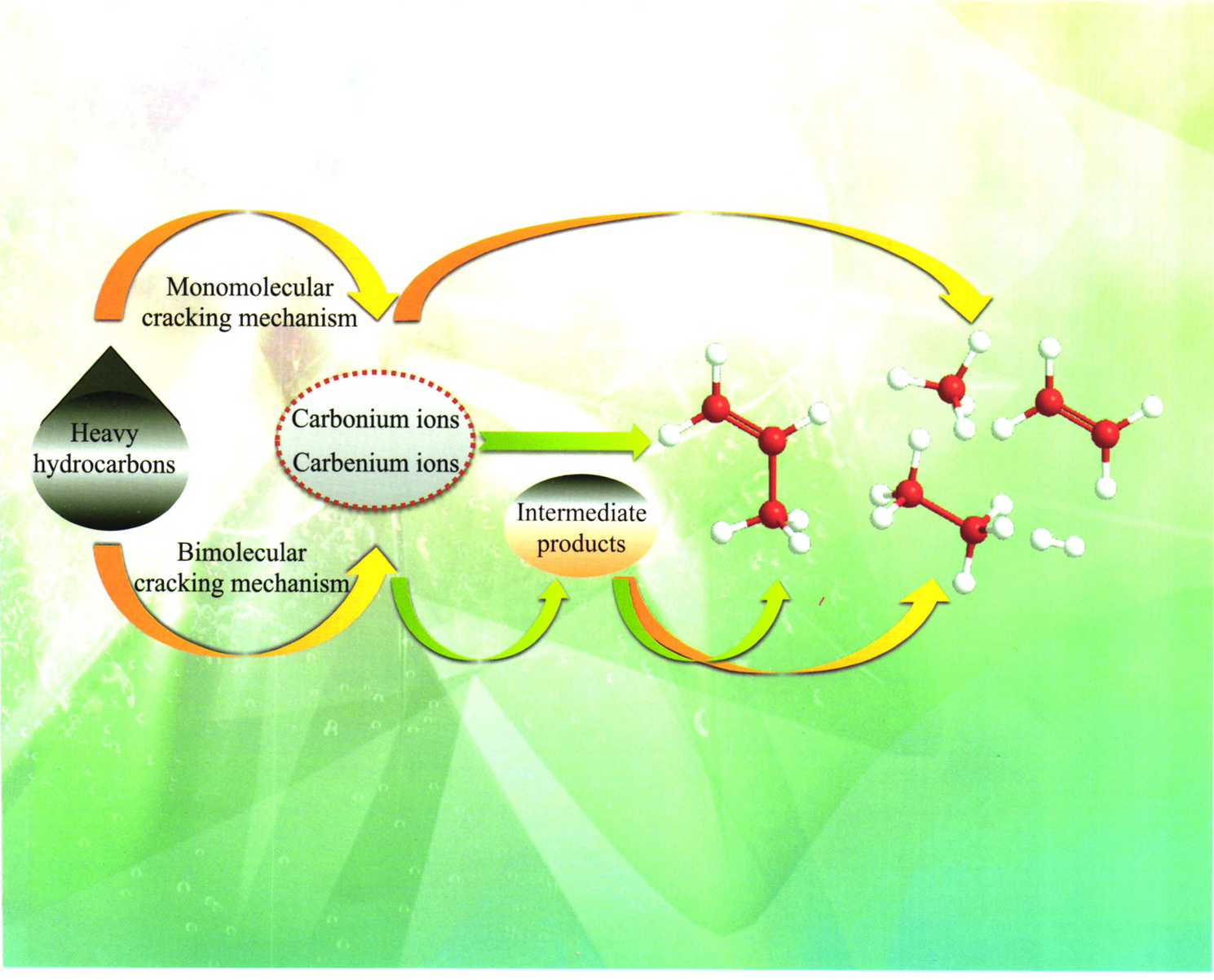
ISSN 1001-8719
CN 11-2129/TE
CODEN SXSHEY

石油学报(石油加工)

ACTA PETROLEI SINICA
(PETROLEUM PROCESSING SECTION)



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中国石油学会主办
石油化工科学研究院 承办

2014
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Vol.30

石 油 学 报

（石油加工）

第 30 卷　第 1 期　2014 年 2 月

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* 封面文章

期刊基本参数： CN11－2129/TE * 1985 * b * A4 * 188 * zh＋en * P * ￥20.00 * 1200 * 29 * 2014－02　**本期责任编辑：** 白雪

ACTA PETROLEI SINICA

(PETROLEUM PROCESSING SECTION)

Vol. 30 No. 1 Feb. 2014

CONTENTS

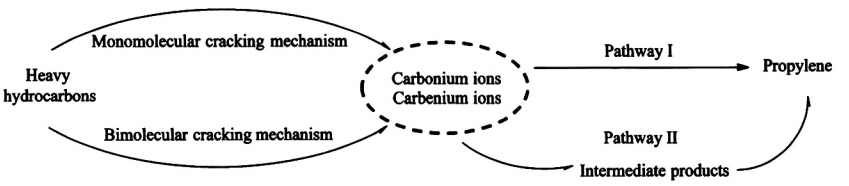
Research Articles

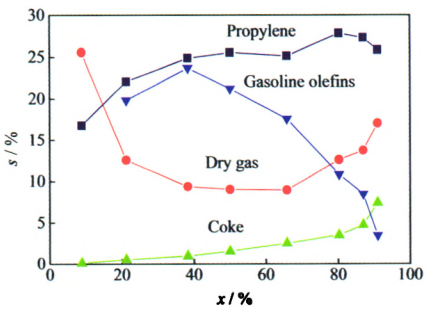
Acta Petrolei Sinica (Petroleum Processing Section), 2014, 30(1): 1-6 **doi**: 10.3969/j.issn.1001-8719.2014.01.001

Formation Mechanism of Propylene and Dry Gas During Deep Catalytic Cracking of Heavy Oil

YUAN Qimin LONG Jun XIE Chaogang

Based on analyzing the change of product distribution with conversion, the formation mechanisms of propylene and dry gas during deep catalytic cracking of heavy oil were discussed. The results suggested that propylene was formed both by primary cracking reaction of heavy hydrocarbons and by secondary cracking reaction of gasoline fractions.



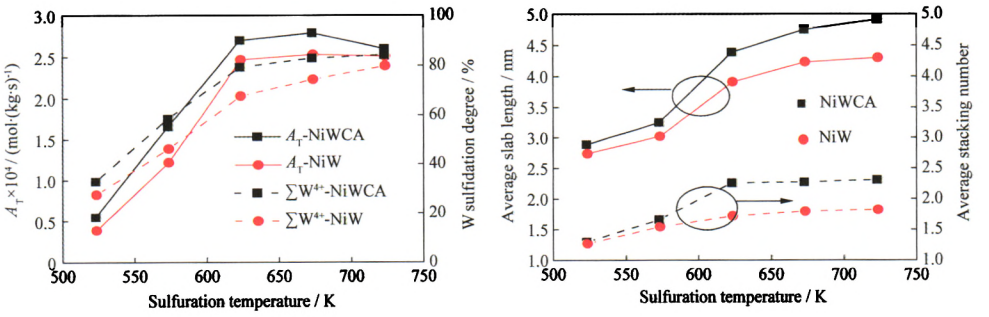


Acta Petrolei Sinica (Petroleum Processing Section), 2014, 30(1): 7-14 **doi**: 10.3969/j.issn.1001-8719.2014.01.002

Effect of Sulfuration Temperature on Hydrodesulfurization Performance of NiW/Al_2O_3 Catalyst

NI Xuehua LONG Xiangyun NIE Hong CHEN Wenbin LIU Qinghe

The HDS activity of citric acid containing NiW/Al_2O_3 (NiWCA) displayed a similar variation trend to that of NiW/Al_2O_3 without citric acid (NiW) with the increase of sulfuration temperature, and reached its highest value at the sulfuration temperature around 673 K. A good correlation was found between the catalyst HDS activity and W sulfuration degree and WS_2 morphology.

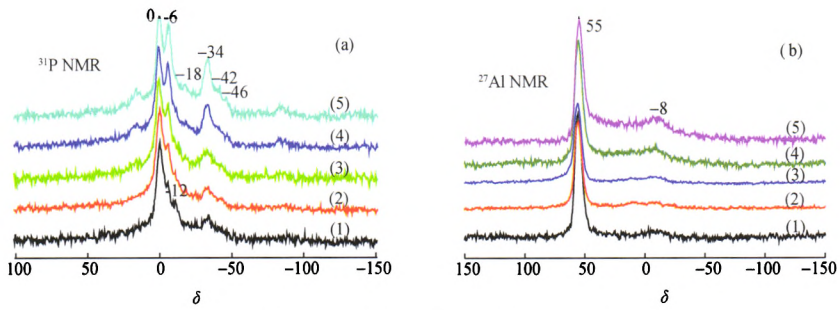


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 15-23 **doi**: 10.3969/j.issn.1001-8719.2014.01.003

Effect of Phosphorus Modification on ZSM-5 Molecular Sieves

SONG Shouqiang LI Minggang LI Lisheng WANG Dianzhong ZHANG Fengmei SHU Xingtian

The $n(SiO_2)/n(Al_2O_3)$ of P-modified ZSM-5 determined existence and effect of phosphorus oxides. P-modified ZSM-5 with low $n(SiO_2)/n(Al_2O_3)$ lost more tetrahedral framework Al as $Al(OSi)_4$, which transformed into several sorts of $Al_{dis\text{-}f}$ and $Al_{non\text{-}f}$ by coordinated with phosphorus oxides mainly as polyphosphates due to strong interaction of the zeolite framework with phosphorus loading rising, and also lost more acid strength and capacity and more specific surface area and pore volume, because those phosphorus oxides not only distributed on the outer surface but also penetrated into the depth of channels of zeolite. While P-modified ZSM-5 with high $n(SiO_2)/n(Al_2O_3)$ lost less tetrahedral framework Al as $Al(OSi)_4$ and lost less acid strength and capacity and less specific surface area and pore volume owing to weak interaction of phosphorus oxides with the zeolite framework, majority of which as free orthophosphate or diphosphate mainly exposed on the outer surface of zeolite with the phosphorus loading rising.



(a) ^{31}P NMR of P-Z 150; (b) ^{27}Al NMR of P-Z 150

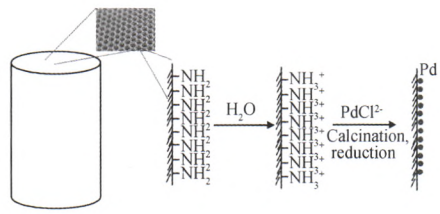
$n(P)/n(Al)$: (1) 0.59; (2) 1.11; (3) 1.24; (4) 1.44; (5) 1.70

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 24-31 **doi**: 10.3969/j.issn.1001-8719.2014.01.004

Preparation of Pd/Cordierite Monolithic Catalyst via Surface Modification of Cordierite by Amino Groups

ZHOU Fang ZHU Yuchao ZHOU Yonghua YE Hongqi JIN Yisu

A simple method to achieve high Pd dispersion as well as increased Pd loading on cordierite monolith without washcoat layer was reported. The cordierite monolith was functionalized with aminesilanes, and then Pd was loaded.

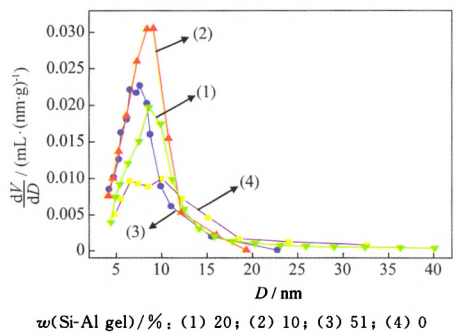


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 32-37 **doi**: 10.3969/j.issn.1001-8719.2014.01.005

Synthesis of Hierarchical Catalytic Materials From Si-Al Gel and Kaolin by Hydrothermal Crystallization

ZHENG Shuqin GAN Jie REN Shao LIU Zhigang YAO Hua

The amount of Si-Al gel added to Kaolin slurry affecting the crystallinity, silica to alumina ratio and pore size distribution of synthesized catalytic materials had been investigated. The results showed that after adding the gel, the crystallized product of pore volume and surface area in the mesoporous range were more substantial rise in referral, the pore size distribution more concentrated.



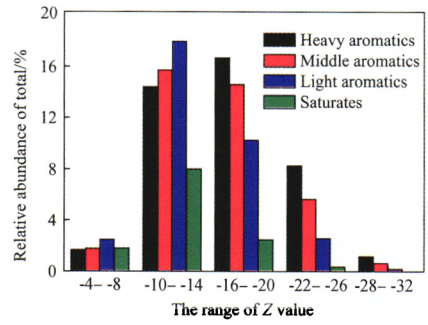
w(Si-Al gel)/%: (1) 20; (2) 10; (3) 51; (4) 0

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 38-46 **doi**: 10.3969/j.issn.1001-8719.2014.01.006

Extraction Separation and Sulfur Distribution in VGO of Saudi Middle Crude Oil

GUAN Cuishi WANG Yuzhang DING Luo LIU Yingrong
WANG Zijun

VGO of Saudi Arabia Middle crude oil could be separated into four fractions by three-stage solvent extraction. The extraction efficiency of aromatics with more rings was higher than that of aromatics with less rings and saturates. Aromatics or thiophenes with three or more rings were mainly in heavy aromatics and middle aromatics fractions.

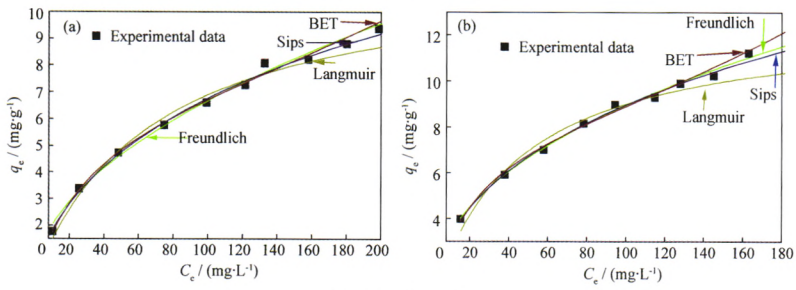


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 47-52 **doi**: 10.3969/j.issn.1001-8719.2014.01.007

Adsorption of Benzothiophene in Simulated Gasoline on Nitric Acid Modified Activated Carbon

ZHANG Zhigang MA Yanyan FAN Jungang SUN Xiangle LI Wenxiu

Nitric acid modified activated carbon showed higher adsorptive capacity and longer adsorptive time to reach equilibrium for benzothiophene than activated carbon. The degree of heterogeneity of activated carbon surface was the main factor to determine its adsorptive capacity, and the density of oxygen containing functional groups was the main factor to determine the equilibrium time.



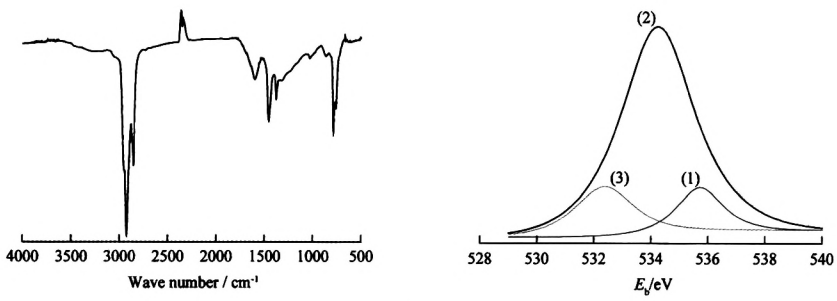
(a) AC; (b) ACN

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 53-59 **doi**: 10.3969/j.issn.1001-8719.2014.01.008

Distribution of the Functional Oxygen Content in Heavy Oils

XU Yanyan ZHANG Hongxiao LI Juqiang ZHOU Yulu XIANG Yuzhi YANG Chaohe XIA Daohong

The analysis of FT-IR and XPS indicated that >C=O, —COOH, —COO—, —OH existed in heavy oils, and the analysis results were consistent with the distribution result of functional oxygen content determined by potentiometric titration method. The analysis of XPS showed that there was a good deal of C—O on the surface of WNRL heptane asphaltene, which was in line with the result of FT-IR.



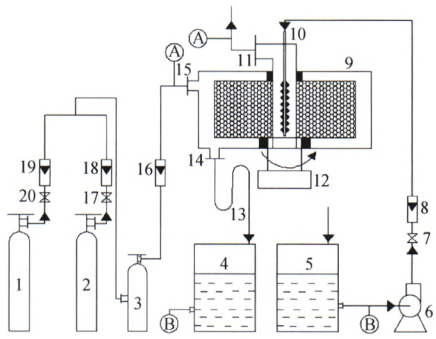
(1)—(3) are the different peak position of O_{1s}.

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 60-65 **doi**: 10.3969/j.issn.1001-8719.2014.01.009

Selective Removal of H_2S From Acid Gas by Chelated Iron Method in a Rotating Packed Bed

YU Yong LIU Youzhi QI Guisheng WANG Jianwei

Selective removal of H_2S from acid gas with chelated iron was investigated in a rotating packed bed. Experimental results indicated that over 98% of H_2S removal efficiency and 90 of selectivity were acquired, which fulfilled the goal of high selectivity, rapid and high efficiency when removing H_2S from acid gas.



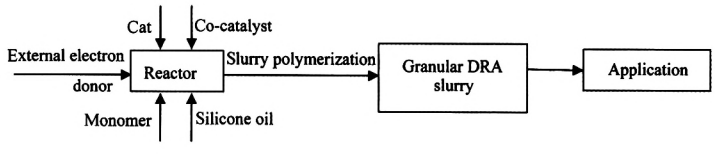
1—H_2S steel container; 2—Mixed gas of N_2 and CO_2 steel container; 3—Feed gas buffer tank; 4—Sulfur-rich solution tank; 5—Sulfur-lean solution tank; 6—Sulfur-lean solution pump; 7,17,20—Valve; 8—Liquid flow meter; 9—Counter-current rotating packed bed; 10—Liquid inlet; 11—Gas outlet; 12—Motor; 13—Liquid seal; 14—Liquid outlet; 15—Gas inlet; 16,18,19—Gas flow meter; A—Gas detection sampling point; B—Liquid detection sampling point

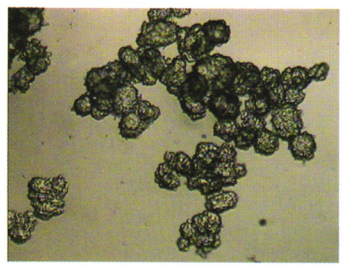
Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 66-70 **doi**: 10.3969/j.issn.1001-8719.2014.01.010

Oil-Soluble Drag Reducing Agent Synthesized by Slurry Polymerization

XIE Jingxin RONG Junfeng WANG Zhenyu LI Feng

By using Ziegler-Natta catalyst to polymerize long chain α-olefin by slurry polymerization under atmosphere pressure, the high efficiency oil-solvent drag reducing agent (DRA) was directly synthesized, which could be applied directly in pipeline transportation without complex handling process. The effects of some factors on polymerization were discussed. The results showed that the slurry polymerization process was simple, by which drag reducing efficiency of the product DRA could reach 58.7% with the intrinsic viscosity[η] of 17.3 dL/g.



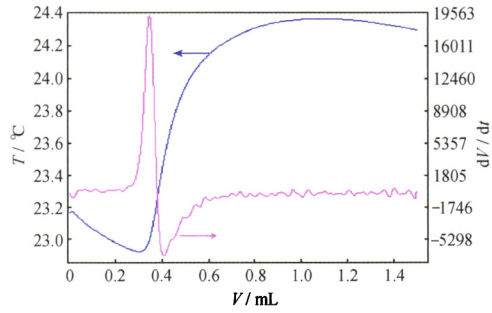


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 71-75 **doi**: 10.3969/j.issn.1001-8719.2014.01.011

Rapid Determination for Acidity of Aviation Oils by Thermometric Titration

YANG Shizhao HU Jianqiang GUO Li HAO Jingtuan
LIU Guanglong

By adding a kind of thermometric titration indicator in aviation oil sample to indicate the temperature changes during the titration, the titration curve of temperature-titration volume could be drawn and then the acidity value of the sample was obtained. The whole measuring process lasted only 3 — 5 min. This method provided a good way to determine the acidity of colored or additive-containing petroleum oils.

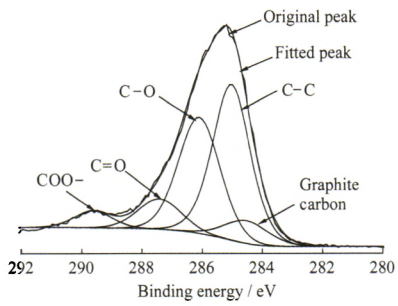


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 76-82 **doi**: 10.3969/j.issn.1001-8719.2014.01.012

Property and Composition Analysis of Toluene Insoluble Materials in Coal Tar

LI Dong LIU Xin SUN Zhihui LI Wenhong MA Wei

The XPS C1*s* results of TIM showed that graphite carbon, C—C, C—O, C═O, and COO— were the five forms of carbon present on the surface of the samples, and C—C was the main form of carbon element.

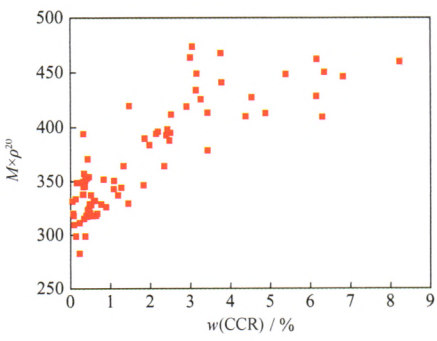


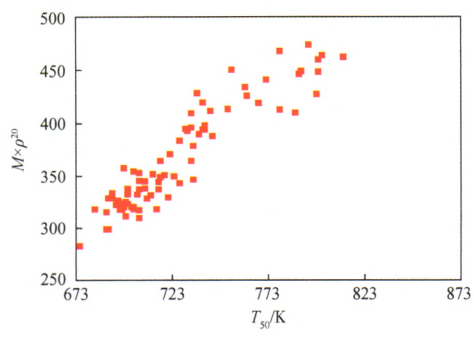
Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 83-86 **doi**: 10.3969/j.issn.1001-8719.2014.01.013

Calculation of Average Relative Molecular Mass of FCC Feedstocks

CHENG Congli

It was found through the data analysis of 79 FCC feedstocks that there was no clear relationship between the average relative molecular mass and density of FCC feedstock, while there was a certain increasing linear relationship among the average relative molecular mass, carbon residue value and the boiling point of distillation cut. A correlation of the average relative molecular mass with density, carbon residue value and distillation temperature at 50% of FCC feedstock was established.



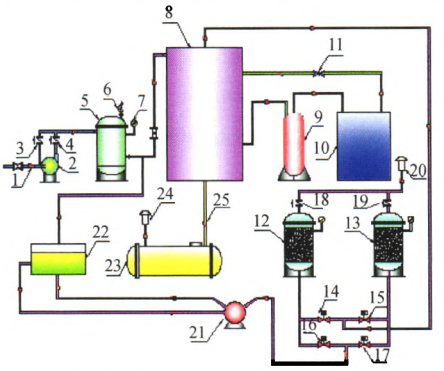


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 87-93 **doi**: 10.3969/j.issn.1001-8719.2014.01.014

Study on Integrated Process of Condensation and Adsorption for Gasoline Vapor Recovery

SHI Li HUANG Weiqiu HU Zhilun CAI Daofei WANG Hongning

A gasoline vapor recovery technology of the integrated condensation and adsorption with higher safety and economic benefit was developed. The total vapor recovery efficiency of the integrated unit was up to 99% with the outlet vapor concentration of below 7.7 g/m^3.



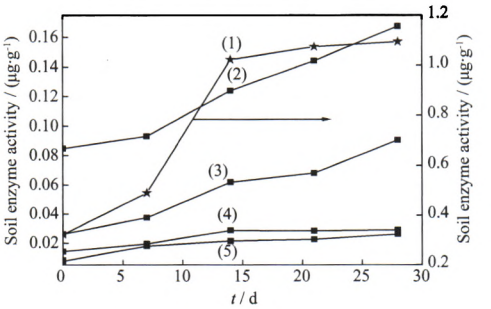
1—Gasoline vapor-air collecting pipeline; 2—Induced fan; 3,4,18,19—Check valve; 5—Buffer tank; 6—Safety valve; 7—Pressure gauge; 8—Evaporator; 9—Compressor; 10—Condenser; 11—Expansion valve; 12,13—Adsorption tank; 14-17—Electric valve; 20, 24—Spark arrestor; 21—Vacuum pump; 22—Gas-liquid separator; 23—Gasoline tank; 25—Gasoline collecting pipeline

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 94-99 **doi**: 10.3969/j.issn.1001-8719.2014.01.015

Relationship Between Microorganism Population Quantity, Soil Enzyme Activity and Oil Degradation Rate in Soil Bioremediation

ZHANG Xiuxia WU Haijie BAI Xuejing GUO Yunxia ZHANG Shoujuan

Under optimized degradation conditions, dosing highly efficient petroleum-degrading bacteria to oil contaminated soil, through change of microorganism population quantity, soil enzyme activity and oil degradation rate in remediation, the data were statistically analyzed with SPSS18.0 to study the correlations between microorganism population quantity, soil enzyme activity and oil degradation rate.



(1)Polyphenol oxidase; (2)Catalase; (3)Urease; (4)Protease; (5)Dehydrogenase

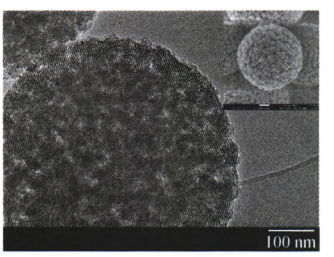
The 17th Chinese Zeolite Conference

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 100-109 **doi**: 10.3969/j.issn.1001-8719.2014.01.016

Brief Introduction of Hierarchically Porous Materials Synthesis With Polyelectrolyte-Surfactant Complex as Template

SHI Chengxiang SUN Pingchuan CHEN Tiehong

Hierarchically mesoporous silica single-crystal particles with different morphologies and structures were synthesized by employing organic mesomorphous complex of polyelectrolyte-surfactant as template to guide the assembly of inorganic silicon source precursor, which possessed both crystal-like regularity and hierarchical pores of high diffusion efficiency.

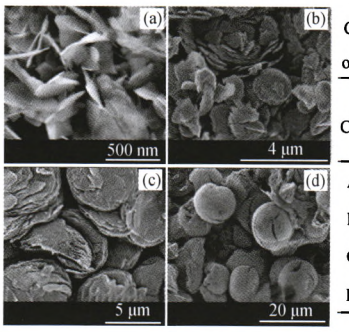


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 110-114 **doi**: 10.3969/j.issn.1001-8719.2014.01.017

Synthesis and Catalytic Properties of MCM-22 Zeolites With Different Morphologies

WANG Zhendong ZHANG Yunxian ZHANG Bin SUN Hongmin YANG Weimin

MCM-22 zeolites with different morphologies were synthesized under different rotational or static conditions and with different Si sources. Alkylation reaction of benzene with ethylene and dealkylation of 1,3,5-triisopropylbenzene were carried out to test the catalytic performance of synthesized MCM-22 samples, which showed that the catalytic performance of MCM-22 zeolite was affected by its morphology.



Catalytic properties of MCM-22 zeolites

Cat.	$x(C_2^=)$/%	x(TIPB)/%
A	92.4	49.4
B	73.2	43.5
C	65.3	44.3
D	32.9	34.5

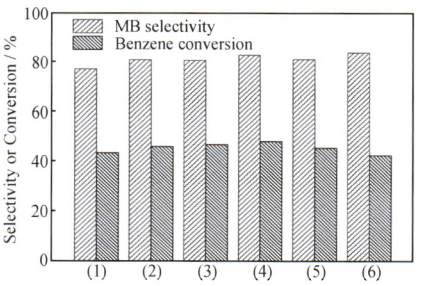
(a) A; (b) B; (c) C; (d) D

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 115-120 **doi**: 10.3969/j.issn.1001-8719.2014.01.018

Aluminophosphate Bound Zn/HZSM-11 Catalyst for Benzene Alkylation With Dimethyl Ether

LIU Hui WEI Huijuan XIN Wenjie LIU Shenglin XIE Sujuan XU Longya

Compared to the ZnZAl catalyst with pure Al_2O_3 binder, ZnZPAlO-x ($x = n(P)/n(Al)$) with aluminophosphate binder showed higher benzene conversion and selectivity of benzene methylation products in benzene alkylation with dimethyl ether.



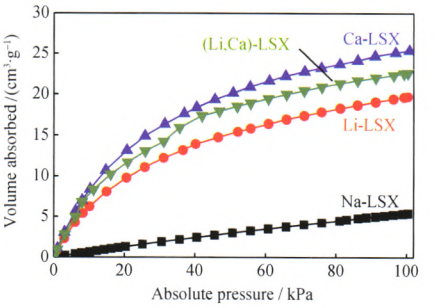
(1) ZnZAl; (2) ZnZPAlO-0.4; (3) ZnZPAlO-0.6; (4) ZnZPAlO-0.8; (5) ZnZPAlO-1.0; (6) ZnZPAlO-1.2

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 121-125 **doi**: 10.3969/j.issn.1001-8719.2014.01.019

Preparation of (Li,Ca)-LSX From Low Silica X Zeolite and Their N_2 Adsorption Capacity

FAN Minghui REN Bo BAI Shiyang SUN Jihong

The hybrid (Li, Ca)-LSX zeolites were prepared via ion exchange method with Na-LSX zeolite as starting material. The N_2 adsorption performances were characterized in detail. The results showed that the N_2 adsorption increased in the order of Na-LSX, Li-LSX, (Li, Ca)-LSX, Ca-LSX. Moreover, (Li,Ca)-LSX might play an important role on reducing the consumption of lithium salt, overcoming the difficult exchange of individual Na^+ and enhancing the N_2 adsorption ability.

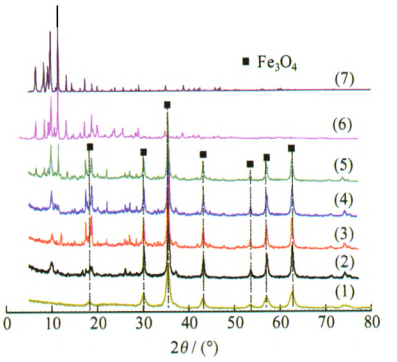


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 126-133 **doi**: 10.3969/j.issn.1001-8719.2014.01.020

Synthesis of Magnetic Zn-BTC @ SiO_2 @ Fe_3O_4 Catalysts and Their Catalytic Performance for Toluene Acylation With *p*-Toluoyl Chloride

LI Qingyuan MUHAMMAD Ammar JI Shengfu
WANG Jingyan LIU Xiang

A series of novel magnetic Zn-BTC@SiO_2@Fe_3O_4 catalysts were synthesized by using magnetic SiO_2@Fe_3O_4 nano-particle as the core and Zn-BTC metal-organic framework material as the coating. These magnetic catalysts exhibited good superparamagnetic properties and catalytic activity for toluene acylation with *p*-toluoyl chloride, and could be reused through the treatment of external magnetic field after reaction.



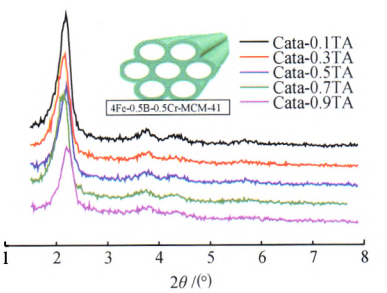
(1) SiO_2@Fe_3O_4; (2) 12.6%Zn-BTC@SiO_2@Fe_3O_4;
(3) 22.5%Zn-BTC@SiO_2@Fe_3O_4;
(4) 36.7%Zn-BTC@SiO_2@Fe_3O_4;
(5) 53.7%Zn-BTC@SiO_2@Fe_3O_4;
(6) As-synthesized Zn-BTC; (7) Simulated Zn-BTC

Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 134-139 **doi**: 10.3969/j.issn.1001-8719.2014.01.021

Synthesis and Modification of Mesoporous Molecular Sieve Catalyst Used for Phenol Hydroxylation

CHEN Qiang MA Honglei KONG Qinghu GAO Shuying
KONG Yan

The Fe-incorporated MCM-41 with dual additives doping were synthesized by replacing the expensive co-template of tetramethyl ammonium hydroxide with low-cost tartaric acid, while the catalytic activity in the phenol hydroxylation was higher than that of industrial TS-1.

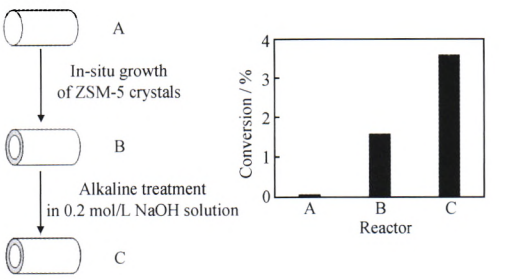


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 140-144 **doi**: 10.3969/j.issn.1001-8719.2014.01.022

Influence of Alkali Treatment on Structure and Catalytic Performance of ZSM-5 Films

YUAN Fang LI Gang HU Shenlin

The influence of alkali treatment on structure and catalytic performance of ZSM-5 films was studied. The treatment of ZSM-5 films in 0.2 mol/L NaOH solution with long time or high temperature would cause formation of cracks in the film and thus affected the adhesion strength between the film and the substrate. Under appropriate conditions for alkali treatment, the generation of cracks in the film could be avoided and the catalytic performance of the film could be improved.

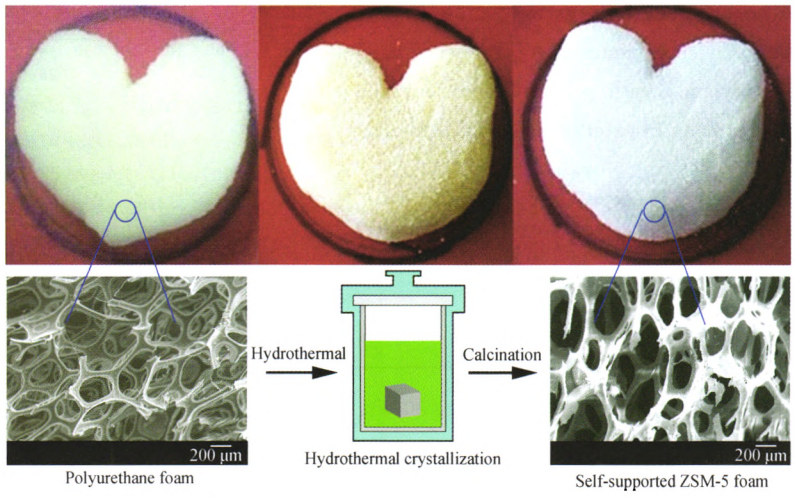


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 145-150 **doi**: 10.3969/j.issn.1001-8719.2014.01.023

Preparation and Characterization of Hierarchical ZSM-5 Foam

YAO Junkang CHEN Minggao YUE Xianglong ZHAO Bo WANG Zheng

Commercial polyurethane foam was used as hard template for the synthesis of hierarchical ZSM-5 foam in the in-situ hydrothermal method at 100℃ for 48 h. Self-supported ZSM-5 monolithic foam with average thickness around 1 μm was finally obtained after removing polyurethane foam and structural direct agent by calcination process.

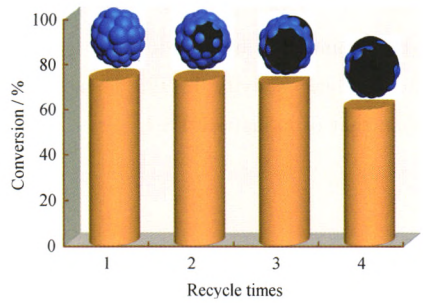


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 151-157 **doi**: 10.3969/j.issn.1001-8719.2014.01.024

Deactivation of Bimodal Mesoporous SiO_2 Supported Phosphotungstic Acid in Esterification of Waste Oil

BAI Shiyang DAI Qunhe SUN Jihong CHEN Dong REN Bo
ZHUANG Shengli WU Xia

The reusability and deactivation of HPW/BMMs catalyst during esterification of waste oil with methanol were emphatically investigated. The results presented that both the coke deposit on catalyst surface and the leaching of HPW might be the main reasons for the deactivation of HPW/BMMs catalyst during waste oil esterification.

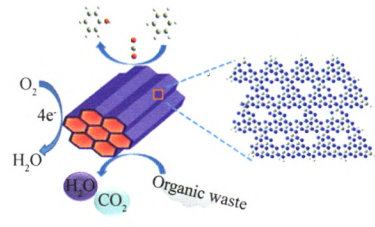


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 158-168 **doi**: 10.3969/j.issn.1001-8719.2014.01.025

Synthesis and Application of High-Surface-Area Graphitic Carbon Nitride

LI Min LI Haiyan SUN Famin LI Jie ZHANG Lingfeng YUAN Zhongyong

High-surface-area graphitic carbon nitrides with controllable pore structure and morphology were synthesized by hard- and soft templating methods, which exhibited their application potential in the adsorption of gas and organic pollutant, photocatalysis, photoelectrochemistry, base catalysis and other heterogeneous catalysis.

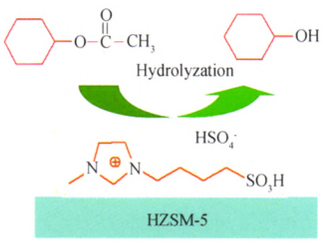


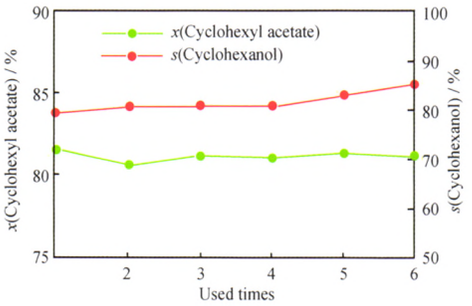
Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 169-174 **doi**: 10.3969/j.issn.1001-8719.2014.01.026

Hydrolyzation of Cyclohexyl Acetate Over HZSM-5 Catalyst

JIN Jingjing LI Fang YANG Lihong ZHANG Dongsheng XUE Wei WANG Yanji

The acidic ionic liquid [HSO_3bmim]HSO_4 increased the selectivity to cyclohexanol in the hydrolyzation of cyclohexyl acetate over HZSM-5 catalyst. And it also restricted the formation of deposited coke on HZSM-5 and then increased its stability for repeated use.



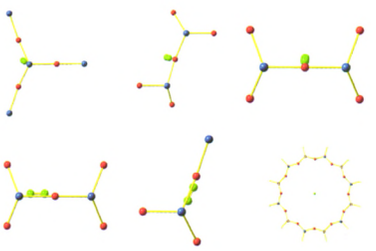


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 175-180 **doi**: 10.3969/j.issn.1001-8719.2014.01.027

Density Functional Theory Studies of H_2 Adsorbed in AFI Zeolite

WU Yuhua SU Weiguang MA Xiaoqin ZHAO Tiansheng
JI Yongqiang BAI Hongcun LIANG Bin

H_2 adsorption in AFI zeolite with different adsorption models were studied based on DFT calculations. The adsorptions exhibited the characteristics of physical adsorption. The frontier orbitals of the hybrid systems were all derived from the zeolite, and no distribution was found in the adsorbed H_2 molecules.

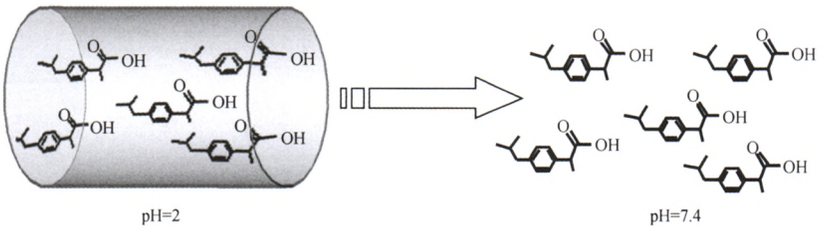


Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 181-186 **doi**: 10.3969/j.issn.1001-8719.2014.01.028

Preparation of pH-Responsive Bimodal Mesoporous Silicas and Their Performances in Controlled Ibuprofen Delivery

GUO Yueyue BAI Shiyang SUN Jihong

The pH-responsive bimodal mesoporous SiO_2 nanocomposite (D-P/BMMs) was prepared by combining of pH-responsive Dex-PAA polymer with the bimodal mesoporous silica (BMMs). The drug-controlled delivery was systematically investigated with ibuprofen as a model drug, and the results showed that the yield of ibuprofen released at pH=7.4 was more than that at pH=2.0. Therefore it was suggested that the D-P/BMMs nanocomposite had an excellent performance in the pH-responsive drug delivery.



Acta Petrolei Sinica (*Petroleum Processing Section*), 2014, 30(1): 187-188 **doi**: 10.3969/j.issn.1001-8719.2014.01.029

How to Write a Manuscript for Scientific Journal

ZHU Jianhua

In this short paper, experience on writing a manuscript for scientific journal was introduced, including the principles, the matters needing attention and the writing skill as well as some advice, in order to give a hand to those students who want to write a paper but require assistance.

石油学报(石油加工)

SHIYOU XUEBAO (SHIYOU JIAGONG)

主 编 汪燮卿

双 月 刊

(1985 年 3 月创刊)

第 30 卷 第 1 期 2014 年 2 月 25 日

ACTA PETROLEI SINICA

(PETROLEUM PROCESSING SECTION)

Editor in Chief Wang Xieqing

Bimonthly

(Started in March 1985)

Vol. 30 No. 1 Feb. 25, 2014

主 管：中国科学技术协会

主 办：中国石油学会

编辑、出版：《石油学报(石油加工)》编辑部

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印 刷：北京科信印刷有限公司

发 行：

国 内：北京市报刊发行局

国 外：中国国际图书贸易总公司

(中国国际书店)

北京市 399 信箱

国内订阅处：全国各地邮局

报刊登记证：(BJ)第 1404 号

Responsible Institution: China Association for Science and Technology

Sponsored by: China Petroleum Society

Edited and Published by: Editorial Office of Acta Petrolei Sinica

(Petroleum Processing Section)

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Executive Chief Editor: Li Caiying

Deputy Editor in Chief: Feng Weisun Hu Xiaochun

Printed by: Beijing Kexin Printing Co., Ltd.

Distributed by:

Domestic: The Bureau of Periodical Distribution, Post Office of Beijing

Abroad: China International Book Trading Corporation (Guoji Shudian), P. O. Box 399, Beijing

(Code No. BM845)

Subscripted by: Local Post Offices in China

Periodical Registration: (BJ) No. 1404

ISSN 1001-8719

CN 11-2129/TE

国内邮发代号：82-332

国外发行代号：BM845

定价：20.00 元/期

120.00 元/年