

甲醇燃料车尾气净化催化剂的研究(Ⅱ)

——多组分催化剂对甲醇的深度氧化

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摘要 利用色谱-微反联用技术研究多种多元催化剂对甲醇深度氧化的活性,并借助于 XRDBET 等手段考察焙烧温度对活性的影响。结果表明,不同的催化剂对甲醇氧化时均有甲醛及甲酸甲酯伴生,其伴生温度区间及最大伴生浓度随不同催化剂而变化;32—37 号催化剂的活性明显高于双组分催化剂;添加少量稀土金属氧化物 CeO_2 和贵金属 Pd 对活性均有一定的改善作用;提高焙烧温度,催化剂表面发生烧结,对活性有不良影响。

关键词 甲醇, 甲醛, 甲酸甲酯, 深度氧化, 催化剂, 甲醇燃料。

目前甲醇燃料作为汽油代用品已经在国外市场上大量销售^[1]。尽管甲醇燃料被誉为“清洁燃料”,但是,其燃烧尾气中仍含有相当成分的污染物,如未完全燃烧的甲醇以及部分氧化产物甲醛及甲酸甲酯等^[2],这些都给汽车尾气净化的研究带来了新课题。近几年来,本所致力于开发新型催化剂以适应市场的迫切需要,取得了一定进展。本文报道有关二元,三元以及多元组分非贵金属氧化物催化剂对甲醇的深度氧化情况。

1 实验部分

1.1 催化剂制备

将一定量的催化剂活性组分前体物质如硝酸盐按要求配成溶液,用 20—40 目载体 $\text{r-Al}_2\text{O}_3$ (比表面积 $195\text{m}^2/\text{g}$,孔容为 0.76ml/g)浸渍该溶液,在 110°C 干燥 5h,在 200°C 焙烧 2h,升温至 500°C 焙烧 3h,制成成品催化剂。其中 Ce-O 是利用 $\text{Ce}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ 溶液在已制备好的催化剂上再次浸渍,采用同样的焙烧条件负载的。

1.2 催化剂的活性评价

采用色谱-微反联用技术,催化剂填充量为 0.5g ,空速 12000h^{-1} ,甲醇浓度 3000×10^{-6} ,氧的浓度 5%。尾气分析采用沪产 GC-102 色谱仪氢焰离子检测器测定,规定甲醇等转化率为 50%,95% 时对应的床层温度为 T_{50}, T_{95} ,甲醇氧化生成甲醛、甲酸甲酯的初始温度为 $T_{\text{生成}}$,甲醛

及甲酸甲酯消失时温度为 $T_{\text{消失}}$,最大浓度对应的温度为 $T_{\text{峰值}} (\text{ }^\circ\text{C})$;该最大浓度为 $c_{\text{峰值}} (10^{-6})$ 。

1.3 X-射线衍射分析(XRD)

采用日本松下公司 D/max II 型衍射仪,以 Cu Ka 为辐射线源,工作条件为 $40\text{kV} \times 40\text{mA}$ 。

1.4 催化剂比表面积测定(BET)

测定仪是 ST-03 型,称样为 0.2g ,在 120°C 干燥 2h,采用常压流动法在液氮温度下吸附,在室温下脱附。采用 BET 方程计算表面积。

2 结果与讨论

2.1 二元组分催化剂对甲醇的氧化活性

单组分催化剂的研究表明: $\text{Cu-O/r-Al}_2\text{O}_3$, $\text{Co-O/r-Al}_2\text{O}_3$ 以及 $\text{Ag-O/r-Al}_2\text{O}_3$ 是优良的甲醇深度氧化催化剂^[3]; Mn-O 中 Mn 元素易变价并且该物质传递氧的性能较好^[4],故选择以上 4 种物质作为二元组分催化剂的活性组分。表 1 是 $\text{Cu-Co-O/r-Al}_2\text{O}_3$, $\text{Cu-Mn-O/r-Al}_2\text{O}_3$ 以及 $\text{Cu-Ag-O/r-Al}_2\text{O}_3$ 等多种催化剂的活性测试结果。由此可知:当 $\text{Cu : Co} = 3 : 1$ (原子比)时,催化剂的活性较好; $\text{Cu : Mn} = 1 : 1$ (原子比)时活性也较优;而 Cu-Ag-O 中,随 Ag 的含量渐次提高,其催化剂的活性相应地提高,双元组分的 $\text{Cu-Ag-O/r-Al}_2\text{O}_3$ 比 $\text{Cu-O/r-Al}_2\text{O}_3$ 活性好,但仍逊于 $\text{Ag-O/r-Al}_2\text{O}_3$ 。

表 1 不同催化剂的活性比较

序号	19	20	21	22	23	25	26	27	28	29	30	
催化剂	组成	Cu-O	Cu-Co-O	Cu-Co-O	Cu-Co-O	Co-O	Cu-Mn-O	Cu-Mn-O	Cu-Mn-O	Cu-Ag-O	Cu-Ag-O	Cu-Ag-O
甲醇	原子比		3:1	1:1	1:3		3:1	1:1	1:3	20:1	15:1	10:1
	T ₅₀	185	165	170	185	200	175	170	185	155	150	145
甲醛	T ₉₅	255	240	250	260	290	240	230	250	250	240	205
	T _{生成}	150	145	145	150	150	140	150	140	120	110	110
甲酸甲酯	T _{峰值}	240	230	240	250	230	240	240	240	200	210	200
	T _{消失}	310	300	300	310	320	320	300	300	280	285	260
	c _{峰值}	180	190	190	170	250	160	160	140	130	120	
	T _{生成}	100	100	100	110	130	100	100	100	100	110	100
	T _{峰值}	180	180	180	170	200	200	180	170	170	150	150
	T _{消失}	265	265	270	260	265	285	260	260	250	240	220
	c _{峰值}	300	200	210	220	350	240	200	210	160	150	140

r-Al₂O₃,但考虑到Ag是贵金属,其含量不宜太高,一般应低于总活性组分的5%,由于含量太低的单组分Ag-O/r-Al₂O₃氧化活性会降低,因此采用多组分催化剂是比较合适的。表1数据说明:副产物甲醛及甲酸甲酯的伴生浓度与催化剂组成也有一定联系。其中活性较好的Cu-Co-O/r-Al₂O₃、Cu-Co-O/r-Al₂O₃副产物伴生浓度相应较低;Cu-Ag-O/r-Al₂O₃的氧化活性尽管没有Ag-O/r-Al₂O₃活性高^[3],但其副产物伴生浓度却

明显地低于后者,甲醛和甲酸甲酯的最大伴生浓度仅为Ag-O/r-Al₂O₃的48%和47%。

2.2 三元组分催化剂对甲醇的氧化活性

32—37号催化剂是Cu、Mn、Ag按照一定的配比制成的3元组分催化剂,其中32—34号催化剂中Cu:Ag的原子比保持不变,Mn的含量依次增加;35—37号催化剂中Cu:Ag原子比不变但小于32号,Mn的含量依次增加。表2是这6种催化剂的活性测试结果。

表 2 3元组分催化剂的活性比较

序号	催化剂组成	甲 醇		甲 醛				甲酸甲酯			
		Cu:Ag:Mn	T ₅₀	T ₉₅	T _{生成}	T _{峰值}	T _{消失}	c _{峰值}	T _{生成}	T _{峰值}	T _{消失}
32	Cu:Ag不变	150	195	140	155	315	80	110	130	210	110
33	Mn的含量	145	185	130	150	310	80	110	130	200	100
34	依次增加	140	170	100	140	300	<50	105	120	200	100
35	Cu:Ag不变,但	135	160	110	140	300	<50	105	120	190	80
36	小于32号;Mn	130	145	110	140	300	<50	100	120	180	<50
37	的含量依次升高	125	145	110	140	300	<50	100	120	180	<50

表2结果表明:①Cu-Ag-Mn-O/r-Al₂O₃对甲醇的氧化活性比2元组分有明显提高;②催化剂的活性随Mn、Ag的含量增加而提高。其中37号催化剂的T₅₀、T₉₅低达120℃和145℃。该催化剂中Cu:Ag:Mn的比例基本上与2元催化剂Cu:Ag、Cu:Mn相一致。由此可知3者的合理匹配可以产生良好的协同效应。③甲醛和甲酸甲酯的伴生浓度明显地低于2元催化剂。37号催

化剂上,2者的最大伴生浓度均小于50×10⁻⁶。

2.3 添加稀土氧化物CeO₂对活性的影响

添加Ce的目的是希望改善Cu-Ag-Mn-O/r-Al₂O₃催化剂的贮氧性能,以便达到提高活性的目的。以37号Cu-Ag-Mn-O/r-Al₂O₃催化剂的配比为基础配方,再分别浸渍2%、5%、8%的CeO₂,制成38—39A3个催化剂。考虑到CeO₂对甲醇的氧化活性较差,含量太高可能不利于提高

活性,因此未进一步对更高含铈的催化剂加以研究。实验结果如表 3 所示。结果表明:加入铈之后,催化剂的活性与未加入时相比有一定的提高,38 号与 37 号相比,甲醇氧化的 T_{50} 、 T_{95} 分别

降低了 5℃,尽管幅度不大,但对高活性催化剂,其活性进一步增加比较困难。铈的含量以 5% 为宜。

2.4 添加贵金属 Pd 的影响

表 3 添加稀土铈对催化剂活性的影响

催化剂		甲 醇		甲 醛				甲酸甲酯			
序号	组 成	T_{50}	T_{95}	$T_{\text{生成}}$	$T_{\text{峰值}}$	$T_{\text{消失}}$	$c_{\text{峰值}}$	$T_{\text{生成}}$	$T_{\text{峰值}}$	$T_{\text{消失}}$	$c_{\text{峰值}}$
38	Cu-Ag-Mn+2%Ce	120	140	105	140	300	<50	100	120	180	<50
39	Cu-Ag-Mn+5%Ce	120	140	100	140	295	<50	95	110	180	<50
39A	Cu-Ag-Mn+8%Ce	120	145	110	140	300	<50	90	110	180	<50

把微量的金属钯引入 37 号 Cu-Mn-Ag-O/r-Al₂O₃ 和 39 号的 Cu-Ag-Mn-Ce-O/r-Al₂O₃ 催化剂之中,制得 40—43 4 种催化剂,其中 Pd 的含量依次增加,实验结果列入表 4。由表 4 中数据可知:引入 Pd 之后催化剂的活性有一定的变化。40—41 号催化剂的活性有一定提高。但随 Pd 的相对值增加,42、43 号 2 个催化剂活性反而降

低,而且甲醛及甲酸甲酯的伴生浓度也增加。已知 Pd-O 的甲醇氧化活性较低,由于加入 Pd 之后主要是以 Pd-O 的形式存在而未加还原处理,低活性 Pd-O 占据了一定的表面活性位,以致于高活性的表面分率下降,造成了总活性下降,故 Pd 的含量不宜过高。

2.5 培烧温度对催化剂活性的影响

表 4 添加贵金属 Pd 对催化剂活性的影响

序 号	催化剂组成			甲 醇		甲 醛				甲酸甲酯			
	Cu : Ag : Mn	Ce %	Pd 的相对值	T_{50}	T_{95}	$T_{\text{生成}}$	$T_{\text{峰值}}$	$T_{\text{消失}}$	$c_{\text{峰值}}$	$T_{\text{生成}}$	$T_{\text{峰值}}$	$T_{\text{消失}}$	$c_{\text{峰值}}$
39	同	5		120	140	110	140	295	<50	95	110	180	<50
40	37		1	120	145	105	140	290	<50	95	110	180	<50
41	号	5	1	120	135	100	130	290	<50	90	105	175	<50
42	一	5	5	130	170	95	135	310	120	90	110	180	100
43	样	5	10	165	185	95	140	340	250	90	120	180	180

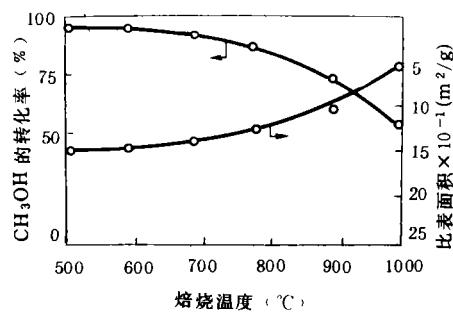


图 1 甲醇转化率、催化剂比表面积与焙烧温度的关系

取 37 号催化剂在空气和 600℃、700℃、800℃、900℃、1000℃ 条件下分别焙烧 4h,然后在相同条件下进行活性评价。结果如图 1 所示。可以看出,甲醇转化率随催化剂的焙烧温度的提高而呈下降趋势。由此表面数据可知,随温度升

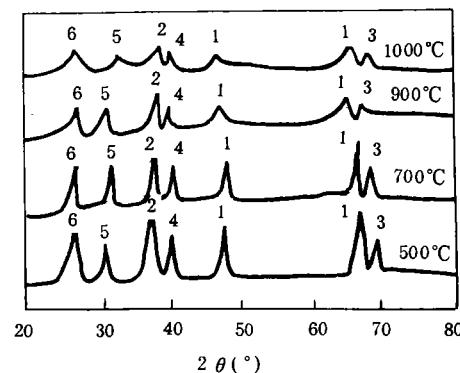


图 2 催化剂在不同焙烧温度的 XRD 谱图

1. r-Al₂O₃ 2. CuO 3. MnO 4. MnO₂
5. Cu₂MnO₄ 6. Ag₂MnO₂

高,催化剂的比表面积下降,活性下降与比表面积下降有明显的对应关系。除此之外,高温引起

催化剂化学结构的变化也可能是活性下降的原因。图2为不同温度下的XRD谱图,随温度增加,催化剂晶粒发生变化,结晶度下降,1000℃时呈弥散状态,说明催化剂表面活性组分发生了烧结,这与比表面数据相一致。

2.6 不同催化剂对应的副产物伴生温度区间及峰值浓度曲线

在甲醇氧化时,几乎所有催化剂上均产生一定量的甲醛及甲酸甲酯,但不同的催化剂,二者的生成温度和消失温度不同,其峰值浓度也各

异。笔者将本研究所涉及的单组分,双组分,3组分以及多组分催化剂按序号自左至右排列,把甲醇氧化时甲醛及甲酸甲酯的生成温度,消失温度,峰值温度以及峰值浓度对催化剂序号绘图(图3—4)。由于催化剂的活性基本上符合由单组分、双组分到多组分的递增顺序,故可以近似地认为,催化剂的序号顺序就代表了活性递增顺序。称不同催化剂的甲醛及甲酸甲酯的生成温度和消失温度所联成的曲线为生成温度曲线和消失温度曲线,二者之间的区域为伴生区间。

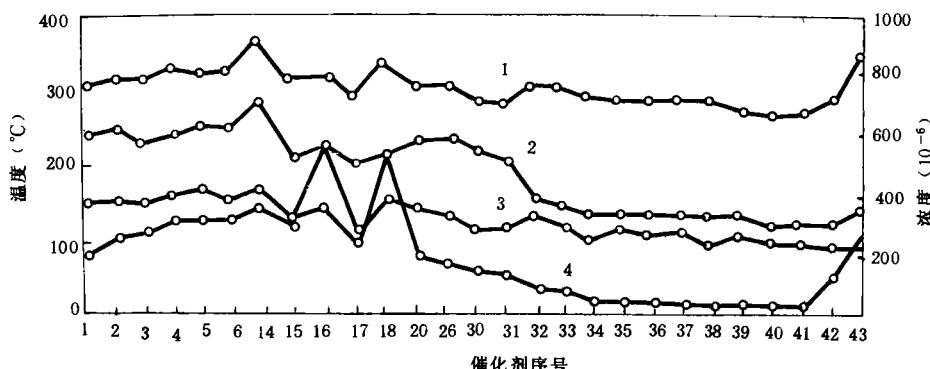


图3 甲醛存在的温度范围以及最大浓度与催化剂的关系

1. 消失温度曲线 2. 峰值温度曲线 3. 生成温度曲线 4. 峰值浓度曲线

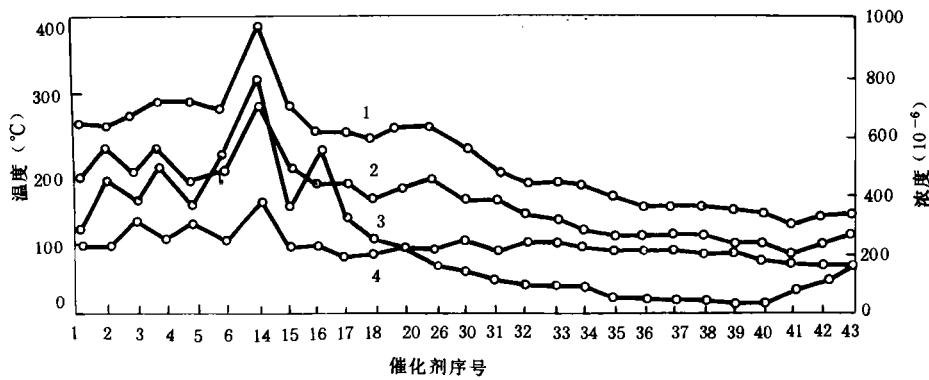


图4 甲酸甲酯存在的温度范围、最大浓度与催化剂的关系

1—18号催化剂见参考文献[3] 1. 消失温度曲线 2. 峰值温度曲线 3. 生成温度曲线 4. 峰值浓度曲线

由图3和图4可以得出如下重要结果:

(1)从峰值温度曲线上看,自左至右随催化剂活性的增加向低温方向移动,其中14号催化剂Ce-O/r-Al₂O₃甲醛和甲酸甲酯峰值温度高达290℃和295℃,而40号Cu-Ag-Mn-Pd-O/r-Al₂O₃只有140℃和110℃。

(2)从峰值浓度曲线来看,总趋势也是自左至右呈下降趋势。其中14号Ce-O/r-Al₂O₃,16号Pd-O/r-Al₂O₃和18号Pd/r-Al₂O₃3种催化剂产生的甲醛、甲酸甲酯浓度明显较高。但36—41号多元组分催化剂,2者的伴生浓度都低于50×10⁻⁶,说明活性越高,副产物的(下转第60页)

理；

特点；

(3)没有复杂的积分计算；

(5)可以进行一条公路上有不同源强路段情

(4)虚拟线源比虚拟点源更接近实际线源的况下的计算；

表 2 京顺公路示踪剂浓度实测值与计算值(mg/m^3)

时间	计算与实测值	10m	50m	100m	150m	200m	R	S_{xy}/\bar{X}
1988-12-24	HIGHWAY- I 计算值	4.92	1.76	1.27	1.05	0.096	0.88	0.30
	计算值	3.97	2.13	1.86	1.15	1.03	0.85	0.25
	实测值	3.81	1.82	1.94	0.09	2.15		
1989-07-19	HIGHWAY- I 计算值	3.74	0.97	0.54	0.39	0.03	0.99	1.55
	计算值	4.37	2.26	1.09	0.58	0.21	0.98	0.62
	实测值	6.90	2.40	1.30	0.12			

表 3 沪嘉高速公路 CO 分布计算值与实测值(mg/m^3)

样本号	计算与实测值	15m	25m	55m	75m	95m	R	S_{xy}/\bar{X}
116 (45°)	CLINE2 计算值	1.94	1.97	1.98	1.97	1.96	0.87	0.62
	计算值	1.65	2.62	3.25	1.86	1.75	0.89	0.11
	实测值	1.30	2.90	3.20	1.53	2.35		
117 (0°)	CLINE2 计算值	0.051	0.085	0.086	0.075	0.069	无相关性	
	计算值	0.95	0.83	0.70	0.69	0.59	0.95	0.022
	实测值	0.87	0.77	0.74	0.59	0.69		
118 (90°)	CLINE2 计算值	1.91	1.96	1.98	1.97	1.96	0.51	1.64
	计算值	1.93	3.02	3.58	2.03	1.91	0.82	0.21
	实测值	1.71	3.93	3.99	1.95	1.87		
210 (67°)	CLINE2 计算值	1.60	1.69	1.69	1.68	1.66	0.88	0.18
	计算值	1.35	1.42	1.52	1.79	1.63	0.85	0.25
	实测值	2.46	1.40	1.49	1.86	1.65		

(6)对路堑的情况,仍可按本方法计算,但平面上初期扩散混合区的源强与实际源强有一定的稀释度。

参考文献

(上接第 37 页)浓度越低。

(3)甲酸甲酯的生成温度曲线和消失温度曲线出现了明显变化, $\text{Ce}-\text{O}/\text{r}-\text{Al}_2\text{O}_3$ 的 2 值较大,故出现了 1 个峰,但总趋势自左至右渐次降低,32 号催化剂以后的两温度曲线都分别低于 130°C 和 180°C 。而且 2 者之间的距离越来越接近,最窄时只有 70°C 左右。故甲酸甲酯的伴生区间随催化剂活性增加而变窄。

(4)对于 32—41 号催化剂对应的甲醛及甲酸甲酯的峰值温度曲线和生成温度曲线,发现 2

1 Petersen W B. User's Guide for Highway- I —— A Highway Air Pollution Model. EPA-600/8-80-018

2 David P Choc. Atmospheric Environment. 1978, 12(1):823

3 孙锡平等. 交通环保. 1986, 6;2

4 曹文俊等. 南京气象学院学报. 1991, 14(2):203

者靠的很近,大约相差只有 $20\text{--}30^\circ\text{C}$ 左右,并且远离消失温度曲线,这说明 32—41 号催化剂在对甲醇氧化时,在一个比较窄的温度区间内,甲醛和甲酸甲酯的伴生浓度达到最大,然后迅速降低到 50×10^{-6} 以下,如果把 50×10^{-6} 以下的甲酸甲酯或甲醛完全氧化,则需要更高的温度。

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Abstracts

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a waterborne salt movement was found to be 120 cm water column pressure. However, a 30 cm thick clay layer artificially covered on the top surface of the original sediment shows a strong suppression against the waterborne salt movement even if the suction head is over 800 cm water column pressure. No salt content was found to be accumulated on the surface during a 3 month period of simulated evaporation.

Key words: oxidative pond sediment, waterborne salt transport, simulation.

Application of GKS in National Water Quality Management Information System. Jiang Yong, Fu Guowei (Department of Environmental Engineering, Tsinghua University, Beijing 100084); *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 22—25

GKS (Graphics Kernel System), the first ISO international standard for computer graphics, was used to construct a graphic application system with a higher efficiency of development and a stronger implantability of programs. This paper also deals briefly with the position of GKS in various applications, major functions and the principles of developing such a graphic system. The reasonable functions of graphics were arranged to closely meet the requirements of the national information system on water quality management. The software structures of the graphic system, and the schemes of designing a general graphics and a geographic graphics, were also described along with a general evaluation on the effectiveness of GKS application in developing graphic systems.

Key words: water quality management, graphics kernel system, National Water Quality Management Information System.

Research of the Separation and Recovery of PET Plastic Wastes. Zhang Zhongyan, Zhao Genmei et al. (Department of Chemistry and Chemical Engineering, Shanghai University of Technology, Shanghai 200072); *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 26—29

The recycles of PET and high density polyethylene (HDPE) from the used plastic drinking bottles made of them were carried out by using a process comprising steps of: smashing the used bottles into pieces, air separation, cleaning, and floating. With this process, PET, HDPE and other plastic wastes were effectively separated and recovered at a rate of 97% for PET and a rate of 95% for HDPE. The recovered PET had a purity of above 95% and could be recycled as a raw material of plastics having a high quality.

Key words: PET, HDPE, separation and recovery of plastic wastes.

Use of Polymer Composite Materials for Vibration Damping and Noise Reduction. Zou Zongbai, Li Jun et al. (Southeast University, Nanjing 210018); *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 30—33

A polymer composite material has been prepared by using an epoxy resin as binder, a low molecular weight polyamide as curing agent, and a mixture of powdered stone, quartz sand and glass fiber as filler, based on an optimized formulation designed to meet the requirements for the performance of material. The tests show that the composite material has a hardness of about 240 HB and an impact resistance of about $30\text{kg}\cdot\text{cm}/\text{cm}^2$, both of which are close to those for some metal materials. This material is also easy to shape and is cost-effective. All of these make the material having a value of wide application, particularly use as alternatives to replace those metal parts which may undergo a heavier impact on shuttled textile machines in textile factories, in order to minimize the vibration and noise.

Key words: polymer composite material, epoxy resin, vibration damping, noise reduction.

Method for Treating Exhaust Gases from Methanol Fueled Internal Combustion Engine (II): A Deep Oxidation of Methanol over Multicomponent Catalysts. Wang Jin'an, Wang Ren (Institute of Industrial Catalysts, East China University of Science and Technology, Shanghai 200237); *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 34—37

Several kinds of multicomponent catalysts for a deep oxidation of methanol were studied for their activities and surface features by means of GC-MR, XRD, SEM, BET etc. The studies were also conducted on the effects of calcination temperature, oxygen level in the atmosphere and space-velocity on the activities of catalysts. The results show that the oxidation of methanol over all the catalysts studied produced formaldehyde (HCHO) and methyl formate (HCOOCH_3), and both the temperature ranges in which they could be produced and the maximum concentrations at which they could be produced varied for different catalysts. Catalysts No. 32—37 were found to have a significantly high activity than the bicomponent catalysts. The addition of a rare earth metal oxide (CeO_2) and a noble metal (Pd) in a small amount to such catalysts could improve their activities to an extent. Increased calcination temperatures would cause the catalyst surfaces to be sintered, making the activities reduced. Increased space-velocities could give a slightly higher rate of methanol conversion. The oxygen level was found to be preferably at 5% and a level of over 10% would have only a small effect on methanol conversion.

Key words: methanol, formaldehyde, methyl

Abstracts

Chinese Journal of Environmental Science

formate, deep oxidation, catalyst.

Study on the Recovery of Carbon Monoxide (CO) from Industrial Exhaust Gases by a Chemical Absorption Method. Su Chunhui, Che Yinchang et al. (Dept. of Nonferrous Metal., Northeastern University, Shenyang 110006): *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 38—41

An aqueous CuCl-MgCl₂ system has been found to be a preferred, highly selective CO absorbent. A relationship between the maximum capacity of the absorbent to absorb CO and temperature was determined. The effects of a change in exhaust gas composition on CO recovery was also studied. The CO recovery with this absorption process was found to be up to 93%, and the recovered CO has a purity of 98% as determined by gas chromatography (GC). The CO gas can be desorbed from the CO absorbed absorbent liquor at temperatures in the range of 120—140°C. In addition, the mechanism of the absorption reaction between CO and the aqueous CuCl-MgCl₂ absorbent system was preliminarily studied. The new process can be used to separate and recover CO gas from industrial exhaust gases, such as the off-gas from steelmaking converters.

Key words: carbon monoxide, absorbent, chemical absorption

Atmospheric Dispersion Parameters for High Overhead Pollution Sources Fitted with the Monitored Data from Various Parts of China. Gu Yongrui, Zhang Tong, Wang Dongpu (Inner Mongolian Central Monitoring Station for Environmental Protection, Huhehaote 010010): *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 42—46

In a calculation of the atmospheric dispersion of emissions from a high overhead source, the atmospheric dispersion parameters given in the National Standards GB3840-91 and the Briggs parameters were found to be no longer suitable. By using the general expression for the Briggs atmospheric dispersion parameters ($\sigma = \alpha x (1 + \beta x)^{-1/2}$) to fit the atmospheric dispersion parameters which were actually measured in various parts of China, the fitted parameters were obtained and were found more reasonable as compared with the GB3840-91 and Briggs parameters, and thus have a practical value in use for calculating other atmospheric dispersion parameters.

Key words: atmospheric dispersion, fitting, high overhead sources.

Determination of the Source Intensity of the Gases Released from Municipal Solid Wastes Dumping sites and Their Environmental Impact Assessment. Zhou Zhongping, Zhang Jun (Dept. of Environ. Eng.,

Tsinghua University, Beijing 100084): *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 47—52

After taking samples of the gases released from the Beishenshu Municipal Solid Wastes Dumping Site in Beijing and making the qualitative and quantitative analyses of the samples, two methods were used to study the determination of the intensity of the gases releasing sources, by which an assessment was made on the environmental impact of the gases emitted from the dumped garbage. Some countermeasures feasible to control such a pollution were suggested.

Key words: gases release, garbage dumping site, source intensity, EIA.

Forms and Transformation of Chromium Species in Soils. Chen Yingxu, He Zengyao et al. (Dept. of Environmental Protection, Zhejiang University of Agriculture, Hangzhou 310029): *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 53—56

By developing a method for the fractional extraction of chromium species in various binding states in soil, it was found that the extractants of 1 mol/L NH₄Ac, 2 mol/L HCl and 5% H₂O₂-2mol/L HCl in use for a sequential extraction of chromium species from soil can give the exchangeable Cr species, precipitated Cr species, and organics-bound Cr species, respectively. The results show that in the natural soil the Cr species are present dominantly in a precipitated or residual state. Under the reducing conditions, the Cr species in soil tend to be transformed into those in an organics-bound state. As the soil pH value was lowered, the levels of water soluble Cr species and exchangeable Cr species raised while the levels of Cr species in precipitated or residual state being reduced. The soil pH value can be lowered by adding Cr(Ⅲ) species and raised by adding Cr(Ⅵ) species.

Key words: chromium, soil, fractional extraction, species transformation.

Mathematical Modelling on the Dispersion of Line Sources of Air Pollution. Cheng Zirun, Fu Dafang (Institute of Environmental Engineering, Southeast University, Nanjing 210018): *Chin. J. Environ. Sci.*, 15(3), 1994, pp. 57—60

Based on the traditional Gaussian dispersion theory, a method has been proposed to calculate the dispersion of line sources of air pollution caused by vehicles running on road. In this method, a road line source is divided into several elements in which an initial dispersion exists; each of the elements is considered to be a proximate short line source which is passing through the midpoint of the element and is rectangular to the direction of wind, and can be calculated for its dispersion based on the Gaussian Model for rectangular wing, with the concentration