表 4 洗脱剂体积及洗脱时间的选择*

编号	洗脱剂体积 (ml)	洗脱时间 (min)	铜回收率 (%)
1	500	10	79
2	500	15	93
3	500	30	94
4	500	60	88
5	500	120	80
6	500	180	68
7	400	30	97.7
8	400	30	98.4
9	200	30	98.8
10	200	30	98.4
11	100	30	91.6

* 洗脱剂为 H_2SO_4，浓度 0.5mol/L.

表 5 再生活性炭吸附效果*

编号	活性炭量 (g/L 废水)**	出水 pH	出水 Cu (mg/L)	吸附率 (%)
1	20	6.05	0.88	97.8
2	20	6.07	0.84	97.9
3	20	6.08	0.88	97.8
4	20	6.05	0.87	97.8

* 吸附条件： pH = 6，时间 30min
** 每次实验补充 0.4g 新鲜活性炭

三、结 论

1. 采用简单的化学沉淀法处理 Cu-EDTA 废水不能使排放水中铜达标，而只要严格控制 pH 在 5—6 和一定的活性炭量条件下，利用铜络合物特性和活性炭的表面电荷形式进行活性炭吸附法处理，可以使铜的吸附率为 98%，同时使出水残铜稳定达标和处理水回用，因此是一种处理络合铜废水较理想的工艺.

2. 对荷铜的活性炭采用 0.5mol/L H_2SO_4 洗脱再生，可以回收铜，且回收率为 97—98%，同时可做到活性炭再生使用. 经估算，处理一吨废水可以盈利 0.08 元，因此具有较高的环境效益和一定的经济意义.

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粉煤灰资源化利用趋势灰色预测

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摘要 运用灰色系统原理，对上海地区粉煤灰的排放及各项利用进行了分析，提出该地区粉煤灰综合利用趋势的预测模型；在此基础上对 1990 年、1995 年和 2000 年该地区粉煤灰综合利用状况进行了各项预测分析；为电厂规划和管理及粉煤灰资源开发利用提供了必要的理论依据.

关键词：灰色系统；粉煤灰利用；预测.

灰色系统[1,2] (Grey Systems) 理论自提出后已较广泛地应用于各个领域[3]，灰色系统在建模、控制、预测等方面的思路和方法有其明显的优点. 本文应用灰系理论，对粉煤灰资源利用进行预测探讨.

电厂粉煤灰排放及资源化利用趋势预测是电力规划及环境治理中不可缺少的重要部分，其排灰及利用总量是一个综合性环境统计指标，它与当地的经济发展水平，技术水平、管理措施等诸因素有关，要准确定量地描

述这些因素与煤灰利用状况的相关动态模式是极其困难的. 因此，煤灰排放及利用系统是本征性灰色系统，煤灰排放及利用总量是系统的灰色量，这样对粉煤灰资源的综合利用趋势进行长期动态预测，便是灰系预测内容. 笔者根据上海地区 1980—1988 年粉煤灰排放及利用总量的时间动态数据系列，建立年粉煤灰综合利用趋向的灰系预测模型，为今后能源发展及粉煤灰深度利用提供必要的科学理论依据.

一、灰色预测方法

1. 建模原理

对于给定的原始时间数据序列

$\{X_i^{(0)}(t)\}, i = 1,2,\cdots\cdots,n; t = 1, 2,\cdots\cdots,m.$

一般不直接用于建模，因为时间数据多为随机的,无规律的,无法用一个数学模型来近似表示. 若对原始数据序列经过生成处理，则将原始数据序列的随机性加以弱化，为建模提供中间信息,从而对系统进行预测,建立长期预测模型. 为了简便，我们只采用一阶单变量线性动态模型 GM(1,1).

2. 预测方法

GM(1,1) 的一般形式表示为:

$$\frac{dx^{(1)}}{dt} + ax^{(1)} = u \qquad (1)$$

式中，a, u 为参数

微分方程 (1) 解即时间响应模型解为:

$$\hat{x}^{(1)}(t+1) = \left(x^{(1)}(0) - \frac{u}{a}\right)e^{-at} + \frac{u}{a} \qquad (2)$$

令 $x^{(1)}(0) = x^{(0)}(1)$

则:

$$\hat{x}^{(1)}(t+1) = \left(x^{(0)}(1) - \frac{u}{a}\right)\cdot e^{-at} + \frac{u}{a} \qquad (3)$$

记方程的参数向量 $\hat{a} = [a, u]^T$, 用最小二乘法求解,可得参数 a 及 u:

$$\hat{a} = [a,u]^T = \begin{bmatrix} a \\ u \end{bmatrix} = [B^T \cdot B]^{-1} \cdot B^T \cdot y_m \qquad (4)$$

式中，B 为累加生成矩阵，y_m 为向量. 二者构造为:

$$B = \begin{bmatrix} -\frac{1}{2}(x^{(1)}(2) + x^{(1)}(1)), & 1 \\ -\frac{1}{2}(x^{(1)}(3) + x^{(1)}(2)), & 1 \\ -\frac{1}{2}(x^{(1)}(4) + x^{(1)}(3)), & 1 \\ \vdots & \vdots \\ -\frac{1}{2}(x^{(1)}(m) + x^{(1)}(m-1)), & 1 \end{bmatrix} \qquad (5)$$

$$y_m = [x^{(0)}(2), x^{(0)}(3), \cdots\cdots, x^{(0)}(m)]^T \qquad (6)$$

式中 $x^{(0)}(t)$ 为第 t 年的原始数据，$x^{(1)}(t)$为第 t 年的一次累加生成值，$t = 1,2,\cdots\cdots, m$.

由此可建立时间响应模型. 然后令 $t = 1,2,\cdots\cdots,m-1$. 用模型(3)求出生成数的回代计算值 $\hat{x}^{(1)}(t+1)$:

$\hat{x}^{(1)}(2), \hat{x}^{(1)}(3), \cdots\cdots, \hat{x}^{(1)}(m)$，即有序列 $\{\hat{x}^{(1)}(t+1)\}$.

$\hat{x}^{(1)}(t+1)$ 是一次累加量，必须求还原值 $\hat{x}^{(0)}(t+1)$:

$$\hat{x}^{(0)}(t+1) = \hat{x}^{(1)}(t+1) - \hat{x}^{(1)}(t) \qquad (7)$$

这样就建立了时间响应模型. 然后对模型精度进行检验. 检验方法主要有关联度检验和后验差检验. 关联度 S 大于 0.5 时，模型精度合格;如果 S 越大,模型精度越高 (关联度 S 的具体求法见参考文献[1])，本文主要采用后验差检验,其步骤是:

(1) 求原始数据序列的均值

$$\bar{x}^{(0)} = \frac{1}{n}\sum_{m=1}^{n} x^{(0)}(m) \qquad (8)$$

式中，n 为数据个数，m 为年份，$m = 1, 2, \cdots\cdots, n$.

(2) 求原始数据列的方差与均方差

$$S_2^2 = \sum_{m=1}^{n} (x^{(0)}(m) - \bar{x}^{(0)})^2 \qquad (9)$$

$$S_2 = \sqrt{\frac{S_2^2}{n-1}} \qquad (10)$$

(3) 求残差 $\varepsilon^{(0)}$ 的均值

$$\bar{\varepsilon}^{(0)} = \frac{1}{n}\sum_{m=1}^{n} \varepsilon^{(0)}(m) \qquad (11)$$

式中，$\varepsilon^{(0)}(m) = x^{(0)}(m) - \hat{x}^{(0)}(m)$

(4) 求残差的方差与均方差

$$S_1^2 = \sum_{m=1}^{n} (\varepsilon^{(0)}(m) - \bar{\varepsilon}^{(0)})^2 \qquad (12)$$

$$S_1 = \sqrt{\frac{S_1^2}{n-1}}. \qquad (13)$$

(5) 计算方差比 c 和小误差概率 P

$$c = S_1/S_2. \qquad (14)$$

$$P = \{|\varepsilon^{(0)}(m) - \bar{\varepsilon}^{(0)}| < 0.6745 S_2\} \qquad (15)$$

根据经验，一般可按表 1 精度等级，如果检验合格，模型(4)就可以用于预测．如果模型精度不符合要求，可通过残差辨识，提高模型精度，合格后再进行预测．预测时，还要将回代计算值 $\hat{x}^{(1)}(i)$ 还原成真正需要的预测值 $\hat{x}^{(0)}(i)$.

表 1 精度等级划分

预测精度	P	c	等级
好	>0.95	<0.35	I
合格	>0.80	<0.50	II
勉强	>0.70	<0.65	III
不合格	<=0.70	>=0.65	IIII

二、年粉煤灰综合预测系统预测模型

已知上海地区 1981—1986 年的年粉煤灰综合利用状况，构成一时间数据序列(见表 2).

将该原始数据序列进行一次累加生成处理，如年排灰量:

表 2 1981—1986 年粉煤灰排放、利用总量及主要利用途径(×10⁴t)

年 份	1981	1982	1983	1984	1985	1986
排放总量	80.1	97.6	102.4	124.4	132.9	156.9
利用总量	53.5	65.5	64.9	84.1	95.8	116.9
墙体材料用量	24.0	23.8	20.3	22.9	21.4	22.9
水泥混合材料用量	15.9	17.8	14.8	17.4	21.9	21.9
混凝土和砂浆用量	1.3	3.0	5.9	6.8	9.1	11.4
筑路(三渣基层)用量	7.5	16.4	17.6	22.3	34.3	36.6

$$x^{(1)}(m) = \sum_{i=1}^{m} x^{(0)}(i),\ i = 1,2,3,4,5,6$$

故: $x^{(1)}(1) = 80.1$, $x^{(1)}(2) = 177.7$

$x^{(1)}(3) = 280.1$, $x^{(1)}(4) = 404.5$

$x^{(1)}(5) = 537.4$, $x^{(1)}(6) = 694.3$

由(5)及(6)式有:

$$B = \begin{bmatrix} -\frac{1}{2}(x^{(1)}(2) + x^{(1)}(1)), & 1 \\ -\frac{1}{2}(x^{(1)}(3) + x^{(1)}(2)), & 1 \\ -\frac{1}{2}(x^{(1)}(4) + x^{(1)}(3)), & 1 \\ -\frac{1}{2}(x^{(1)}(5) + x^{(1)}(4)), & 1 \\ -\frac{1}{2}(x^{(1)}(6) + x^{(1)}(5)), & 1 \end{bmatrix}$$

$$= \begin{bmatrix} -128.9, & 1 \\ -228.9, & 1 \\ -342.3, & 1 \\ -470.95, & 1 \\ -615.85, & 1 \end{bmatrix}$$

$$y_6 = [97.6, 102.4, 124.4, 132.9, 156.9]^T$$

参数向量:

$$\hat{a} = [B^T \cdot B]^{-1} \cdot B^T \cdot y_6 = [a, u]^T$$

$$= [-0.1232183, 78.8042]^T$$

则该年排灰量模型的两个参数 a，u 为

$a = -0.1232183$, $u = 78.8042$

$u/a = -639.5492$

令 $x^{(1)}(0) = x^{(0)}(1) = 80.1$ 则由 (3)式可得时间响应模型:

表 3　各项预测模型（$\times 10^4$t）

预测项目		模型编号	模型数学表达式
年灰排放量		I	$\hat{x}^{(1)}(t+1)=719.6495e^{0.1232183t}-639.5495$
年灰利用量		II	$\hat{x}^{(1)}(t+1)=341.5824e^{0.1616827t}-288.0824$
利用途径	墙体材料	III	$\hat{x}^{(1)}(t+1)=-3757.058e^{-0.005997896t}+3781.058$
	水泥混合材料	IV	$\hat{x}^{(1)}(t+1)=177.6785e^{0.02468819t}-161.7785$
	混凝土和砂浆	V	$\hat{x}^{(1)}(t+1)=12.6602e^{0.2705507t}-11.36022$
	筑、 三渣基层）	VI	$\hat{x}^{(1)}(t+1)=59.57404e^{0.2276428t}-52.07404$

$$\hat{x}^{(1)}(t+1)=719.6495e^{0.1232183t}-639.5495 \tag{16}$$

上式即为该地区煤灰排放总量的预测模型．其余各项预测模型见表 3．

表 4　年排灰量模拟值 $\hat{x}^{(0)}(t+1)$ 与实际值 $x^{(0)}(t+1)$ 比较

年份	1982	1983	1984	1985	1986
$\hat{x}^{(0)}(t+1)$	94.37	106.74	120.74	136.57	154.48
$x^{(0)}(t+1)$	97.6	102.4	124.4	132.9	156.9
$Q(\%)$	3.31	−4.24	2.942	−2.764	1.541

用模型可以求出 1981—1986 年的回代计算值 $\hat{x}^{(1)}(t+1)$，再根据(7)式求取还原值(模拟值)$\hat{x}^{(0)}(t+1)$，与原始数据 $x^{(0)}(t+1)$ 比较，求出相对误差 Q

$$Q=\frac{x^{(0)}(t+1)-\hat{x}^{(0)}(t+1)}{x^{(0)}(t+1)}\times 100\% \tag{17}$$

这里列出年排灰量预测值的相对误差（见表 4）．

从表 4 看出，模型精度是好的，另由后验差检验，$c=0.032$，$P=1$，精度为一级；用关联度检验法得关联度 $S=0.70987$ (>0.5)，故表明模型(16)符合要求．其余各项模型检验见表 5．

表 5　各模型检验结果

检验结果 \ 模型编号	I	II	III	IV	V	VI
后验差检验	$c=0.032$ $P=1.0$	$c=0.062$ $P=1.0$	$c=0.316$ $P=1.0$	$c=0.2053$ $P=1.0$	$c=0.0574$ $P=1.0$	$c=0.0684$ $P=1.0$
关联度	$S=0.7099$	$S=0.83$	$S=0.804$	$S=0.808$	$S=0.587$	$S=0.7025$

表 6　1987 年粉煤灰统计指标预测分析结果（$\times 10^4$t）

类别 \ 预测项目	灰排放量	总利用量	墙体材料量	水泥混合材料	混凝土砂浆	筑路用量
实际统计量	174.7	134.9	23.0	23.7	14.1	33.9
模拟预测值	174.74	134.5335	21.8035	23.9815	15.2145	37.5335
误差(%)	−0.023	0.273	5.2	−1.19	−7.9	−10.7

表 7 1990 年、1995 年和 2000 年粉煤灰资源化利用状况预测($\times 10^4 t$)

预测项目 / 年份	粉煤灰排放量	粉煤灰部分利用途径			
		墙体材料利用量	水泥混合材料利用量	混凝土和砂浆利用量	筑路(三渣基层)利用量
1990	250.8899	21.4143	30.9182	34.2573	94.1006
1995	468.2705	20.7815	47.2185	132.5093	293.7057
2000	867.0845	20.1677	72.1124	512.5539	916.7095

从表 5 中看出,各个模型精度均为一级,表明均符合要求,因此,不再需要进行残差辨识,可用来进行各项预测.

表 6 列出了1987年粉煤灰统计指标预测分析结果,结果表明预测效果相当好. 这样,我们就建立了该地区年粉煤灰利用趋势的灰系预测模型. 本文用该模型进行 1990 年, 1995 年, 2000 年各项指标预测,预测结果见表 7.

三、结 果 分 析

1. 常规的预测是通过历年的电厂装机容量、燃煤种类与灰排放量的数据序列,进行回归分析建立. 但是,粉煤灰利用系统实质上是一种灰色系统,每个统计指标(例如第一项电厂排灰量)我们无法完全确知它与其它诸多因素的复杂关系. 环境预测本是一种灰色预测. 灰色系统预测与常规的多元回归分析方法相比,所需数据少(一般五个以上就可以了),数据也不需特殊分布,且计算简单,精度较高,这是一般回归分析法无法达到的.

2. 从表 7 的预测结果可知: (1) 用于墙体材料的粉煤灰量趋于平稳, 若要增加这方面的量,需增加材料生产厂,在现有基础上很难扩大其用灰量. (2) 水泥混合材料行业还有潜力可挖,在今后的发展规划中不容忽视. (3) 混凝土和砂浆及筑路是粉煤灰的使用大户. 二十世纪末, 用于筑路的粉煤灰将大大增加,甚至有超过排放量的趋势,这主要与交通事业的大力发展有关.

3. 从本文预测过程中发现, 灰色系统预测用于短期预测效果较长期预测更好些, 故通常用于短期规划, 如针对下一年度或阶段的粉煤灰管理、利用对策、科技开发计划的制定及近期效益分析等.

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The Transport and Fate of ^{14}C-cypermethrin in A Microcosm under the Laboratory Conditions. Zhou Zhenhui (Institute of Entomology, Academia Sinica, Shanghai): *Chin. J. Environ. Sci.*, **11**(5), 1990, pp.2—6

The aim of the experiments is to study mass balance of ^{14}C-cypermethrin in a close ecosystem by observing metabolism, degradation and distribution of the pesticide. The microcosm was set up in a 30 cm-desiccator with 15 one-week-old maize plants and 15 earthworms (*Eiscnia foctida*) in the sandy loam soil containing 5.5ppm pure ^{14}C-cypermethrin.

The results indicated that cypermethrin residues was absorbed in the maize roots, but very little was to be migrated to the leaves. After two weeks, the major product in the maize plants was the bound compounds which contained 81.81%; the armount of metabolic products in the earthworms was 72.40%; parent of cypermethrin in soil 68.74%. In soil main product 3-phenoxybenzaldehyde was degraded by splitting of chain easter and 4′-methoxy-compound was formed by hydroxylation and methoxylation at 4′-carbon atom.
Key Words: ^{14}C-cypermethrin, fate, transport, soil, plant.

Persistence and Movement of Tricyclazole in the Rice-Water-Soil System of Rice Fields. Xiao Yunxiang, Chen Hexin, Fan Defang (Institute of Environmental Toxicology of(Pesticides, Zhejiang Agricultural University, Hanzhou):*Chin. J. Environ. Sci.*, **11**(5), 1990, pp. 6—12

Reported in this paper is the residues and variations of tricyclazole in the rice-water-soil system of rice fields in Zhejiang Province by means of field tests and simulation. The results showed that the adsorption curves of three kinds of soil comformed to Freudliche adsorption equation. Xiaoshan loamy silt had less adsorption ability of tricyclazole than the other two soils. In the pot tests, there existed obvious differences of its leaching ability between loamy silt and silty loam with same eluting water volume. In practically applied dosages, tricyclazole was able to leach down to ground water. Its leaching ability in the soils followed this order: loamy silt > silty loam > clay loam. It could move laterally to the ponds around by flowing water. Rice plants adsorbed tricyclazole from soil-water system, and a very remarkable relationship appeared between its amount taken up by rice plants and its concentrations in water (at 0.01 level). In this research, the tricyclazole residues were determined by using GC-FPD (S-Mode) after the samples of soils and rice plants had been purified by coagulation.
Key Words: tricyclazole, soil persistence, residue.

Preliminary Study of the Kinetics of Photodecomposition of Benzamide, 2-chlora-N(((4 chlorophenyl) amino) carbonyl) under Simulated Atmospheric Conditions. Liu Guoguang, Jin Zuliang, Xu xiao-bai (Research Center for Eco-Environmental Sciences, Academia Sinica, Beijing): *Chin. J. Environ. Sci.*, **11**(5),1990,pp. 12—16

The kinetics of photodecomposition of benzamide, 2-chloro-N(((4-chorophenyl)amino)carbony) under simulated atmospheric conditions has been preliminarily studied in theis paper. The rate constants and half-lives of this compound in nitrogen, oxygen and air have been determined. The statistical treatment of experimental results indicates that the photoreaction in nitrogen and air is of the first order, while in oxygen is closer to that of the second order.
Key Words: kinetics of photoreaction, benzamide.

Activated Carbon Process for Treatment of Wastewater Containing Cu(II) and EDTA. Zhang Zhongyan, Hu Longxing, Yuan Yan, Liu Zhilong (Shanghai University of Technology): *Chin. J. Environ. Sci.*, **11**(5), 1990, pp. 16—20

In this paper the treatment of wastewater containing Cu(II) and EDTA with activated carbon adsorption has been examined. The characteristics of unstability of Cu(II) chelate of EDTA in acid medium and the surface charge of activated carbon were utilized in the process. It was found that, after 30 minutes of mixing wastewater containing Cu 40 mg/L and complexing agent EDTA at pH 5—6, 98% of Cu(II) was adsorbed by the activated carbon and remainder Cu(II) concentration in the treated wastewater was less than lmg/L. It was also found that the adsorbed Cu(II) could be eluted from the activated carbon with 0.5 mol H_2SO_4 solution, and the recovery of Cu was 98% and the spent activated carbon could well be regenerated, The experimental results demonstrated that this treatment process was an economical and effective process.
Key Words: activated carbon adsorption, copper, copper chelate of EDTA, wastewater treatment.

Grey Prediction for Utilization of Fly-Ash Resources in Shanghai Area. Xu Zhong(Institute of Environmental Protection for Electric Power,

Nanjing): *Chin. J. Environ. Sci.*, **11**(5), 1990, pp. 20—24

This paper presents a prediction on discharge and utilization of fly-ash in Shanghai area with Grey System, by which a predictable model has been set up. Based on this System, utilization of fly-ash in the area in 1990, 1995 and 2000 has been predicated and its tendency analysed. This work will provide for management of power plants and their development.
Key Words: Grey System, prediction, fly-ash resources, utilization.

A New Decolorizing Flocculant for Dyeing Wastewater. Zhang Xuexin, You Reisheng, Li Zhuomei, He Weiguang (Institute of Polymer Science, Zhongshan University, Guanzhou): *Chin. J. Environ. Sci.*, **11**(5), 1990, pp. 25—29

MG has been prepared by condensation polymerization of dicyanodiamide-HCHO modified with a modifying agent. Its molecular weight and charge density can be adjusted by the reaction condition and the amount of modifying agent. MG is a cationic polyelectroyte whose characterization has been studied. The factors influencing decoloration have also been studied. The results show that Mg can be used as an effective decolorizing agent in treatment of wastewater containing hydrophilic dyes, particularly for active dyes.
Key Words: decolorizing flocculant, wastewater. ter.

The Steady State Control of Anaerobic Treatment for Monosodium Glutamate Processing Wastewater. Shen Yaoliang, Le Yanran (Dept. of Environmental Protection, Suzhou Institute of Urban Construction and Environmental Protection, Suzhou): *Chin. J. Environ Sci.*, **11**(5), 1990, pp. 30—34

Anaerobic treatment of high concentrated monosodium glutamate proce sing wastewater (COD 60000—80000mg/L), which is so far very difficuls to be treated biologically, was conducted and the steady state control of the treatment process for the optimal efficiency under different operating parameters (COD loading rate, hydraulic retention time and pH) were demonstrated in this paper. The experimental results showed that COD removal could reach more than 70%, biogas production rate was as high as $10.5\,m^3/m^3\cdot d$ with more than 58% of methane content under the controlled conditions of hydraulic retention time of 84 hours, COD loading rate of 6—8%, pH of 6.5—7.5 and medium temperature.
Key Words: anaerobic treatment, monosodium glutamate processing wastewater.

Industrial Wastewater Treatment Using the Catalytic Wet Oxidation Process. Jiang Yi, Yu Chunyin, Liu Huiqing et al. (Dalian Institute of Chemical Physics, Academia Sinica, Dalian): *Chin. J Environ. Sci.*, **11**(5), 1990, pp. 34—37

The aim of this work is to explore application of the catalytic wet oxidation process to wastewater treatment in the coke-oven plants and the coal-gas producers. A series of catalysts, noble metals/semiconductor oxides, were prepared and tested in a high pressure vessel under 250°C liquid phase conditions. It was found that different catalysts demonstrated their own selectivity to different pollutants. The catalyst WT-501 showed high activity toward both ammonia anf organic components. Wastewater from the coke-oven plants originally contained COD 9302 mg/L and NH_3 5230 mg/L, but they were removed into 619 mg/L and 47 mg/L respectively by using the catalyst WT-501 with COD removing rate of 93.2% and NH_3 of 99%.
Key Words: wastewater treatment, catalytic wet oxidation process, noble metals/semiconductor oxides.

Preparation of A New Flocculant, Polysilicate Containing Aluminium Ions. Gao Baoyu, Yue Qinyan, Wang Shuren (Center of Environmental Science, Shandong University, Jinan): *Chin. J. Environ. Sci.*, **11**(5), 1990, pp. 37—41

Polysilicic acid containing aluminium ions (PSAA), a new flocculant, has been prepared by using sodium silicate, sulfuric acid and aluminium sulfate as raw materials. The properties of PSAA and the factors affecting treatment of wastewater were studied experimentally. The flocculating effect of PSAA was compared with that of polyaluminium chloride (PAC). The experimental results showed that the flocculating properties of PSAA was greatly influenced by the content of aluminium ion in PSAA. When the molar ratio of A to SiO_2 was equal to ane. the flocculating effect of PSAA was best. Compared with PAC, PSAA is a low cost, highperformance water-reating agent.
Key Words: polysilicic acid containing aluminium ion, inorganic polymer flocculant, wastewater treatment.

A Cheap Entrapping Agent for Wastewater Treatment. Li Tong, Yu Yuxin, Hu Jicu (Dept. of Environmental Engineering, Tsinghua Unive rsity, Beijing): *Chin. J. Environ. Sci.*, **11** (5), 1990, pp. 41—44