# 松花江鱼类汞污染现状研究

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**摘要**　松花江主要工业汞源根治后，该江吉林市至三岔河口和三岔河口至同江江段总汞与甲基汞已分别降到轻、中度污染水平。各江段鱼类总汞与甲基汞污染水平均表现出：肉食性鱼类＞杂食性鱼类＞植物食性鱼类；底层鱼类＞中、上层鱼类；无鳞鱼类＞有鳞鱼类。各江段每种鱼类肌肉中甲基汞含量与总汞含量之间呈明显的正相关关系，与脲酶、乳酸脱氢酶活力之间呈明显的负相关关系。鱼类肌肉中总汞含量与江水中总汞含量之间呈明显的多元直线、多元对数和多元指数回归关系；鱼类肌肉中甲基汞含量与江水中甲基汞含量之间呈明显的多元对数回归关系。

**关键词**　松花江，总汞，甲基汞，污染，鱼类。

70 年代，汞污染是松花江突出的环境问题之一。1982 年 9 月该江主要工业汞源——吉林化学工业公司电石厂醋酸车间乙醛工段得到根治，结束了向松花江排汞的历史。本文报道该汞源根治 8 年后的 90 年代初，该江鱼类总汞与甲基汞的污染水平和污染规律。

## 1　材料与方法

### 1.1　材料

1990—1992 年春、秋季在松花江的土城子、松花江村、扶余、肇源、涝州、白石、富锦 7 个江段（图 1）采集鱼类 15 种 2600 余尾。同时在海龙水库、二龙山水库、兴凯湖、五大连池等非汞污染水域采集鱼类 9 种 200 余尾。现场测量每尾鱼类的生物学指标，取出背部肌肉，用塑料布包好，立即放入自带低温冰柜冻实，运回实验室 测定总汞与甲基汞含量。在采集鱼样的同时采集水样，测定江水中总汞与甲基汞含量。此外，将非汞污染鲤鱼分成 4 组，分别放入 0.036mg/L HgCl₂ 溶液中、腹腔注射 0.036mg/kg HgCl₂、腹 腔 注 射 0.009mg/kg CH₃HgCl₂ 和对照组。定期取样测定背部肌肉中甲基汞含量和脲酶、乳酸脱氢酶活力。

### 1.2　方法

总汞采用硝酸硫酸硝解，冷原子吸收法测

定[1]。甲基汞采用盐酸浸提，气相色谱法测定[2]。脲酶[3]和乳 酸 脱 氢 酶[4]活力采用分光光度法测定。



图1　1990—1992 年松花江鱼类采样江段示意图

## 2　结果与讨论

### 2.1　鱼类总汞与甲基汞污染水平

#### 2.1.1　不同年度鱼类总汞与甲基汞污染水平

从松花江吉林市至三岔河口江段各种鱼类总汞与甲基汞平均含量的年度变化曲线（图2）看，1973—1976 年该江段鱼类总汞污染相当严重，各种鱼类总汞平均含量均高于日本水俣湾 1972 年测定结果（0.73mg/kg），超过我国食品卫生标准（0.3mg/kg）1.5 倍以上；1977—1982 年则下降到 0.5mg/kg 左右，仍然超标近 1 倍左右；

1984 年以后又降到我国食品卫生标准以下,仍高于背景含量 0.5 倍以上。同样,该江段各种鱼类甲基汞平均含量,也是 70 年代最高,1975—1978 年为 0.45mg/kg 左右,超过我国食品卫生标准(0.2mg/kg)1.3 倍左右;80 年代下降到 0.3 mg/kg 以下,仍然超标;90 年代又降到 0.1mg/kg 以下,仍高于背景平均含量(0.034mg/kg)1 倍左右,也高于轻度污染的起始值 0.05mg/kg。随着主要工业汞源的治理和根治,总汞与甲基汞的排放量及其输入速率逐渐降低,从而使该江鱼类总汞与甲基汞污染水平也逐年下降。但历年累计已经输入江中的汞尚未消除,所以目前鱼类的汞污染水平仍高于背景含量。
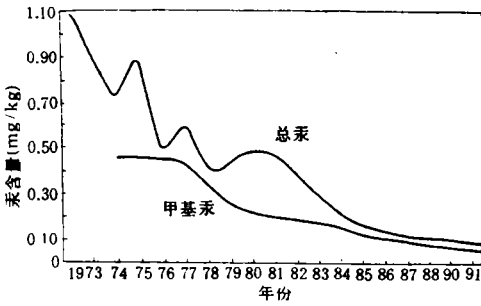


图 2　松花江鱼类总汞与甲基汞历年变化趋势

**2.1.2　不同江段鱼类总汞与甲基汞污染水平**

从各江段中各种鱼类总汞与甲基汞平均含量(图 3)看,三岔河口以下明显高于以上各江段,总汞最高值出现在涝州江段,比土城子江段高 1.7 倍;甲基汞最高值出现在肇源江段,比土城子江段高 2.3 倍。随着距原主要工业汞源距离的增加,各种鱼类总汞与甲基汞平均含量呈递增趋势,至涝州和肇源江段以下又有所下降。t 检验后,土城子、松花江村、扶余各江段之间的差异不显著,肇源、涝州、白石、富锦各江段之间的差异也不显著,而前 3 个江段和后 4 个江段之间的差异极显著,而且每种鱼类总汞与甲基汞在各江段的分布规律和总的趋势基本一致。表明原主要工业汞源已输入江中的汞随着沉积物、悬浮物、江水等逐渐往下游迁移,该江目前鱼类总汞与甲基汞污染水平主要受沉积汞影响。而三岔河口以

下江段的鱼类除受上述沉积汞影响外,还受嫩江及其沿岸汞源的影响。此外,在三岔河口以下采到的鱼类比其以上采到的同种鱼类重 2—6 倍,也是造成三岔河口以下各江段鱼类总汞与甲基汞污染水平高的原因之一。
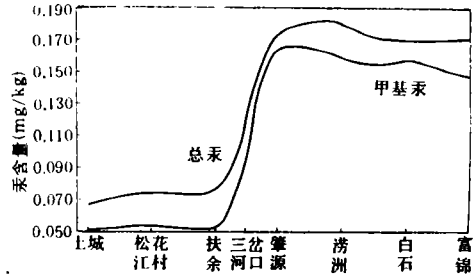


图 3　1990—1992 年松花江不同江段各种鱼类平均汞含量

**2.1.3　不同种鱼类总汞与甲基汞污染水平**

由表 1 可见,生活在同一江段的不同种鱼类总汞与甲基汞平均含量均不相同。根据显著性检验结果,将三岔河口以上江段鱼类按汞含量从高到低的顺序划分 4 个类群:雷氏七鳃鳗 > 鲶鱼、花鳅、青鲌、黄鳝 > 鳘条、鲤鱼、银鲫、犬首鮈 > 银鲴。将三岔河口以下鱼类划分为 3 个类群:鲶鱼、乌苏里鮠、黄鳝 > 鲤鱼、银鲫 > 白鲢。由此可见,生活在同一水环境中,雷氏七鳃鳗总汞与甲基汞平均含量最高,主要是该种鱼类营寄生生活,食物链最长,而且体表无鳞,头部有 7 个鳃孔,也可能通过皮肤和鳃孔直接吸收环境中的汞。鲶鱼、乌苏里鮠、黄鳝均为底层肉食性鱼类,由于原主要工业汞源排入江中的汞主要沉积于江底,加之这些鱼类的食物链都很长,体表又无鳞,使其体内积累了较多的总汞与甲基汞。鲤鱼和鲫鱼为底层杂食性鱼类,食物链较上述鱼类短,体表有鳞,所以体内积累的汞较上述鱼类少些。银鲴栖息于有水流的河道中,产卵后的成体有相当数量在岸边河湾索食,以浮游植物和碎屑为主,体表有鳞,体内积累的汞较少。白鲢为上层浮游植物食性鱼类,食物链最短,体内总汞与甲基汞含量最低。由此得出:不同种鱼类总汞与甲基汞污染水平为:肉食性鱼类 > 杂食性鱼类 > 植物食性鱼类;底层鱼类 > 中、上层鱼类;无鳞鱼类 > 有鳞鱼类。主要

是鱼类的食性、习性等生态学特征及其生活环境 中汞水平等多种因素综合作用的结果。

表1 1990—1992年松花江不同种鱼类汞污染水平（mg/kg鲜重）

| 鱼类 | 吉林市—三岔河口江段 | | 三岔河口—同江江段 | |
|---|---|---|---|---|
| | 总 汞 | 甲基汞 | 总 汞 | 甲基汞 |
| 银鲫 Carassus auratus gibelio | 0.075±0.039 | 0.061±0.036 | 0.125±0.068 | 0.138±0.057 |
| 黄颡 Pseudobagrus fulvidraco | 0.096±0.036 | 0.069±0.035 | 0.195±0.079 | 0.180±0.063 |
| 鲤鱼 Cyprinus carpio haematopterus | 0.082±0.039 | 0.059±0.027 | 0.156±0.064 | 0.138±0.050 |
| 鲶鱼 Parasilurus asotus | 0.124±0.073 | 0.065±0.049 | 0.239±0.092 | 0.216±0.064 |

**2.1.4 松花江鱼类总汞与甲基汞污染水平同我国食品卫生标准的比较**

我国食品卫生标准规定，鱼体内总汞和甲基汞含量不得超过0.3mg/kg和0.2mg/kg。由图3可见，松花江各种鱼类总汞与甲基汞的平均含量均未超标。由表1可见，除三岔河口—同江江段鲶鱼甲基汞平均含量超标外，其余鱼类均未超标。但松花江各江段鲶鱼；三岔河口以下各江段乌苏里鳕、黄颡、鲤鱼、银鲫；松花江村江段雷氏七鳃鳗、青鳉体内总汞与甲基汞含量及松花江村江段银鲫体内总汞含量均有部分个体超标。

**2.1.5 松花江鱼类总汞与甲基汞污染水平同背景含量的比较**

将海龙水库等14处基本未受汞污染水域中13种662尾鱼类总汞平均含量（0.053mg/kg）和7处水域中8种154尾鱼类甲基汞平均含量（0.034mg/kg）作为背景含量。研究结果表明，除吉林市—三岔河口江段中银鲴总汞平均含量之外，其余各江段每种鱼类总汞与甲基汞平均含量均超过背景含量。$t$检验后，土城子、松花江村、扶余江段鱼类总汞与甲基汞平均含量与背景含量之间差异显著，属轻度污染水平；肇源、涝州、白石、富锦江段鱼类与背景含量之间差异极显著，属中度污染水平。

**2.2 鱼类肌肉中甲基汞含量与总汞含量的关系**

以三岔河口为界，将松花江分为2大江段（表1），以每江段中同种鱼类肌肉中甲基汞（$y$）与总汞（$x$）含量为对应数据，采用直线回归方程拟合两者之间的关系（表2）。相关系数检验结果表明，除青鳉肌肉中甲基汞与总汞含量之间为显著相关外，其余各江段每种鱼类甲基汞与总汞含量之间均为极显著相关。虽然鱼类的食性和习性不同，鱼体内及其生活环境中甲基汞与总汞的污染水平不同，但鱼类肌肉中甲基汞与总汞含量之间均呈明显的正相关关系：$y=a+bx$。

**2.3 鱼类肌肉中甲基汞与酶活力的关系**

表2 1990—1992年松花江鱼类肌肉中甲基汞与总汞含量的相关分析

| | 吉林市—三岔河口江段 | | | | | | 三岔河口—同江江段 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 银鲫 | 银鲴 | 鲤鱼 | 青鳉 | 犬首鮈 | 鲶鱼 | 白鲢 | 鲤鱼 | 乌苏里鳕 | 黄颡 | 银鲫 | 鲶鱼 |
| $a$ | 0.0183 | 0.0043 | 0.0163 | 0.0365 | 0.0154 | 0.0105 | 0.0153 | 0.0199 | 0.0430 | 0.0274 | 0.0178 | 0.0632 |
| $b$ | 0.3905 | 0.6450 | 0.5208 | 0.8117 | 0.4139 | 0.4376 | 0.6261 | 0.7558 | 0.7034 | 0.7707 | 0.7941 | 0.6400 |
| $r$ | 0.5892[1] | 0.8356[1] | 0.7553[1] | 0.7127[2] | 0.5585[1] | 0.6555[1] | 0.9118[1] | 0.9650[1] | 0.9340[1] | 0.9515[1] | 0.9581[1] | 0.9191[1] |

1）差异极显著 2）差异显著

以鲤鱼为例，用上述方法对肌肉中甲基汞含量（$y$）与脲酶（$x_1$）、乳酸脱氢酶（$x_2$）活力进行相关分析。结果表明，鲤鱼肌肉中甲基汞含量与脲酶、乳酸脱氢酶活力之间均呈极显著的负相关关系：

$$y=6.55127-7.18287x_1$$
$$y=7.93298-7.01049x_2$$

相关系数分别为$-0.606496$和$-0.6196498$。$y$

与 $x$ 之间之所以呈极显著的负相关关系,主要是甲基汞抑制了脲酶和乳酸脱氢酶活力所致,其抑制程度与甲基汞含量呈正相关关系。

## 2.4 鱼类肌肉中甲基汞、总汞与江水中甲基汞、总汞含量的关系

### 2.4.1 鱼类肌肉中总汞与江水中总汞含量关系

以松花江九站($x_1$)、哨口($x_2$)、白旗($x_3$)3个断面不同时间江水中总汞含量为自变量 $x$,鱼类肌肉中总汞含量为因变量 $y$,分析二者之间的关系。经计算得出以下3个回归方程:

多元直线回归方程(超平面方程):

$$y = -0.196 + 0.064x_1 + 0.215x_2 + 0.479x_3 \tag{1}$$

$$U = 0.1305 \quad Q = 0.03065 \quad F = 5.6791$$
$$S = 0.0875 \quad R = 0.8999$$

多元指数回归方程:

$$y = 0.759x_1^{0.5507} \cdot x_2^{0.7659} \cdot x_3^{0.2311} \quad R = 0.879 \tag{2}$$

多元对数回归方程:

$$y = 0.1697 + 0.6261\lg x_1 + 0.3366\lg x_2 + 0.1517\lg x_3 \tag{3}$$

$$F = 5.0959 \quad R = 0.8903$$

因 $R_{0.05} = 0.839$,所以上述3个回归方程的复相关系数均为显著水平,而且各复相关系数的绝对值相差甚小,可见,采用任一方程均能显著反映实测值。

### 2.4.2 鱼类肌肉中甲基汞与江水甲基汞含量的关系

以哨口($x_1$)、扶余($x_2$)2个断面不同时间江水中甲基汞含量为自变量 $x$,鱼类肌肉中甲基汞含量为因变量 $y$,对随时间变化的8个对应值进行拟合,结果表明,只有多元对数回归方程的复相关系数为显著水平,用该方程拟合的关系最好:

$$y = 0.2081 + 0.2112\lg x_1 - 0.07632\lg x_2 \tag{4}$$

$$F = 6.2457 \quad R = 0.8451 > R_{0.05} = 0.795$$

## 3 结论

(1)松花江主要工业汞源根治8年后,该江鱼类总汞与甲基汞已下降到轻、中度污染水平。根据显著性检验结果,将轻度污染水平的吉林市—三岔河口江段鱼类划分为4个类群:雷氏七鳃鳗>鲶鱼、青鳉、黄鳠、花鳅>鳌条、鲤鱼、银鲫、犬首鮈>银鲴;将中度污染水平的三岔河口—同江江段鱼类划分为3个类群:鲶鱼、乌苏里鲹、黄鳠、>鲤鱼、银鲫>白鲢。各江段鱼类总汞与甲基汞污染水平均表现出:肉食性>杂食性>植物食性;底层>中、上层;无鳞>有鳞。该江吉林市—三岔河口江段各种鱼类总汞与甲基汞平均含量,历年来呈下降趋势,70年代超标1.2倍以上,80年代仍然超标,90年代均下降到我国食品卫生标准以下,但明显高于背景含量,而且部分个体仍然超标。

(2)大量样本统计分析结果表明,每种鱼类肌肉中甲基汞与总汞含量之间呈明显的正相关关系,与脲酶、乳酸脱氢酶活力之间呈明显的负相关关系。

(3)多元回归分析结果表明,鱼类肌肉中总汞与江水中总汞含量之间呈明显的多元直线、多元对数和多元指数回归关系。鱼类肌肉中甲基汞与江水中甲基汞含量之间呈明显的多元对数回归关系。

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The optimum conditions for polyaluminum species, CF-1 and PC85-3 to remove fluorides from drinking water, such as pH value, ageing and agitation, were compared in detail and activated alumina, bone carbon and UR-3700 chelate resin were tested for their equilibrium capacity of fluoride removal, the effect of water hardness, etc. The results show that polyaluminum species, CF-1 and PC85-3 removed the excessive fluorides from drinking water to an acceptable level for drinking use but had limited applications. Activated alumina and bone carbon were more effective filters for removing fluorides from drinking water. The optimum pH values for the fluoride removal by polyaluminum species were 6—7. The eficiency of fluoride removal was the same at water temperatures ranged from 10— 30℃. The stirring time of 1—3min and agitation time of 10—15 min were satisfatory for fluoride removal from drinking water. The equilibrium capacity of fluoride removal for activated alumina was 0.89—1.75mg/g. The eficiency of fluoride removal was related to pH, concentration of fluoride, salinity and hardness.

Key words: fluoride removal, polyaluminum, activated alumina, bone carbon, drinking water.

**Selection of the Methods for Extraction and Determination of Extracellular Polymers from Anaerobic Sludge.** Liu Zhijie et al. ( Dept. of Environ. Eng., Tsinghua University, Beijing 100084); *Chin. J. Environ. Sci.*, 15(4), 1994, pp. 23—26

Extracellular polymers (ECPs) were extracted from 4 kinds of anaerobic sludge by using 6 different ECPs extracting processes, i. e., sulfuric acid process, sodium hydroxide process, ethylenediaminetetraacetic acid (EDTA) process, boiling benzene process, distilled water process and steaming process, which have been used to extract ECPs from activated sludge. The concentrations of polysaccharides in the extracts were determined by both the phenol-sulfuric acid method and the anthrone-sulfuric acid method, and the concentrations of nucleic acid were also measured to examine the degree of cells damaged. The results show that the sulfuric acid process can extract more ECPs from anaerobic sludges, with a less degree of damage to cells, than other processes. The phenol-sulfuric acid method was found more suitable to measure the concentration of polysaccharide. The level and composition of ECPs in anaerobic sludges were also discussed.

Key words: anaerobic sludge, extracellular polymer, extraction method, sulfuric acid process for ECP

**Levels of Mercury in Soil and Their Geographical Distribution in Tibet.** Zhang Xiaoping et al. ( Changchun Institute of Geography, Chinese Academy of Sciences, Changchun 130021); *Chin. J. Environ. Sci.*, 15(4), 1994, pp. 27—30

205 Samples of soil were taken from different sites in Tibet and analysed for their levels of mercury in soil. The data obtained were processed by using a method for mathematical programming statistics on a microcomputer and making some related computations. The results show that the average level of mercury in soils from Tibet was 0.021 mg/kg and significantly lower than the average national level of 0.04 mg/kg. The level of mercury in soil was distributed in Tibet with a total trend of gradually decreasing from the southeast to the northwest that was consistent with the direction of changes in the zonal successions of vegetation and soil in Tibet. The level of mercury was closely related to the basic attributes of soil and mercury tends to be concentrated upto the organic matter and glutinous grains of soil.

Key words: mercury, soil, Tibet.

**Study on the Treatment of Dye-stuff Wastewater with an Anaerobic/Aerobic Process.** Zhu Jianrong et al. (Dept. of Environ. Eng., Tsinghua University, Beijing 100084); *Chin. J. Environ. Sci.*, 15 (4), 1994, pp. 31—34

The results were reported from a study on the treatment of dye-stuff wastewater by using an anaerobic/aerobic process, wherein the anaerobic stage was carried out in a UASB reactor and the aerobic stage was using a conventional activated sludge process. The results show that with a raw dye-stuff wastewater of 1150— 1300 mg COD/L and 500 fold colourity (a colour scale meant by the number of dilution times leading to a colour that seems to be the colour of tap water) under the condition of HRT 6— 10 h at the anaerobic stage, the COD removal was more than 60% and the colourity was reduced to 50—100 folds. If followed by an additional 6 h aeration treatment, the total COD removal was up to 85%— 90% and the colourity was further reduced to about 20 folds. The spectrometric analyses of influent and effluent revealed that the decolouration of dye-stuff wastewater mainly took place at the anaerobic stage and was achieved through bilogical degradation. It was concluded that the anaerobic/aerobic process was a cost-effective way to treat a dye-stuff wastewater and was of a great value of practical application.

Key words: dye-stuff wastewater, UASB reactor, activated sludge process, COD removal, decolouration.

**Study on the Total Mercury and Methyl Mercury Contaminations in Fish from the Songhuajiang**

River. Yu Changrong et al. (Jilin Provincial Institute of Environmental Protection, Changchun 130012): *Chin. J. Environ. Sci.*, **15**(4), 1994, pp. 35—38

Since the main industrial sources of mercury discharged into the Songhuajiang River were eliminated eight years ago, the total mercury and methylmercury contaminations in fish from the reaches of the river from Jilin City to Sanchahekou and from Sanchahekou to Tongjiang have been reduced to a light level of contamination and a medium level of contamination, respectively. The average levels of total mercury and methylmercury contaminations in fish from both reaches of the river exhibited: the highest in carnivorous fish, lower in omnivorous fish, and the lowest in herbivorous fish; higher in the underlayer fish than in the medium and upper layer fish; and higher in the scaleless fish than in the scaled fish. In the muscle of each species of fish from both reaches of the river, the level of methylmercury was in a significantly positive correlation with the level of total mercury while being in a significantly negative correlation with the activities of urease and lactate dehydrogenase (LDH). The level of total mercury in the muscle of fish was in a significantly multiple linear, multiple logarithmic or multiple exponential correlation with the level of total mercury in river water. The level of methylmercury in the muscle of fish was in a significantly multiple logarithmic correlation with the level of methylmercury in river water.

Key words: the Songhuajiang River, total mercury, methylmercury, contamination, fish.

**Study on the Level of Mercury in Fishmen's Hair Since the Elimination of Major Sources of Mercury Pollution in the Songhuajiang River.** Wu Shi'an et al. (Jilin Provincial Station of Sanitation and Antiepidemics, Changchun 130021): *Chin. J. Environ. Sci.*, **15**(4), 1994, pp. 39—40

Since the major sources of mercury pollution in the Songhuajiang River were eliminated 8 years ago, the level of mercury in the hairs of fishmen living along the river has reduced by 78. 30% — 82. 5% as compared with that in the 1970s, and by 71. 48% as compared with that in the early 1980s, showing that obvious health benefit and environmental benefit have been obtained. However, it was found that so far the fishmen living along the river still have a significantly higher level of hair mercury than those living in a non-mercury polluted area, and 1. 92% of them have a level of hair mercury exceeding the national diagnostic standards. They were found to be mainly distributed along the first Songhuajiang reaches of the river downstream Sanchahekou. Extremely less number of cases for the fishmen living along the second Songhuajiang reaches of the river were found to have a level of hair mercury exceeding the national diagnostic standards, and the causes for this were discussed also.

Key words: mercury poisoning, water pollution, biological monitoring, Songhuajiang River.

**Determination of Phthalic Esters in Aqueous Extracts from Solid Wastes.** Dai Tianyou, Wang Shufang (China National Environmental Monitoring Center, Beijing 100012): *Chin. J. Environ. Sci.*, **15**(4), 1994, pp. 41—43

The HPLC determination of phthalic esters in aqueous extracts from solid wastes were reported. In this study, a HPLC system equipped with a Zorbax-CN column and a 224 nm UV detector and using a n-hexane mixed with 0. 1% isopropanol as eluting agent was established and used to determine the phthalic esters in aqueous extracts from municipal refuses in Beijing. The system was effective to separate phthalic esters from non-polar organics in the extracts and to eliminate the interference likely resulted from some organic compounds which had a polarity similar to phthalic esters. Having been extracted with n-hexane and then concentrated, the extracts in organic phase could be directly analysed with the HPLC system without a further purification (e. g. , column chromatography). Water samples fortified with phthalic esters at a level in the range of 1—500 ppb were analysed, with a linear response in the range of 0. 1— 450 ppb, a recovery for phthalic esters of 70% —110%, and the detectable limits of 1. 0 ng for dimethyl phthalate (DMP), 0. 4 ng for diethyl phthalate (DEP), and 0. 2 ng for each of di-n-butyl phthalate(DBP), di-n-octyl phthalate (DOP) and di(2-ethylhexyl) phthalate (DEHP), at 224 nm. The phthalic esters in aqueous extracts from several solid waste samples were found by using this system to be at a level of 5 ppb. The variation coefficient for 7 parallel tests on the extracts from solid wastes was within 10%.

Key words: phthalic esters, extracts, HPLC.

**Study on the removal of Arsenic in Different States of Valence from Acidic Wastewater.** He Shaoxian et al. (Dept. of Environmental Engineering and Chemical Engineering, Kunming Institute of Technology, Kunming 650093): *Chin. J. Environ. Sci.*, **15**(4), 1994, pp. 44—46

Based on the process of iron salts neutralization to remove arsenic from wastewater, theoretical analysis and experiments indicated that, at a ratio of Fe/As $= 0. 5—0. 6$, As ($\mathrm{I\!I\!I}$) was removed at a rate of about 60% lower than that of As (V), demonstrating that As($\mathrm{I\!I\!I}$) was more difficult to be removed from wastewater than As(V). In a further study, it was found that it was most suitable to oxidize As ($\mathrm{I\!I\!I}$) in acidic wastewater containing a high level of arsenic by using a bleaching powder, Ca(ClO)$_2$. For an acidic wastewater containing 782. 5 mg/L of As at pH $= 1$, the oxidation/iron salts neutralization process used in a primary treatment produced an effluent containing less than 8 mg/L of As, with an arsenic removal of more than 99%. If followed by a further secondary treatment, the level of arsenic in the effluent produced would be lower