

表 1 浓硫酸中的 BaP 在不同 $\Delta\lambda$ 时的同步荧光强度

$\Delta\lambda(\text{nm})$	峰高(nm)	$\Delta\lambda(\text{nm})$	峰高(nm)
5	21.2	40	25.5
10	29.5	50	30.5
15	31.2	60	29.5
18	31.5	70	24.5
20	32.2	80	22.8 ¹⁾
23	31.2	90	17.2 ²⁾
25	30.7	100	14.3 ³⁾
30	29.0		

1)峰高移至 550nm 2)峰高移至 560nm 3)峰高移至 565nm

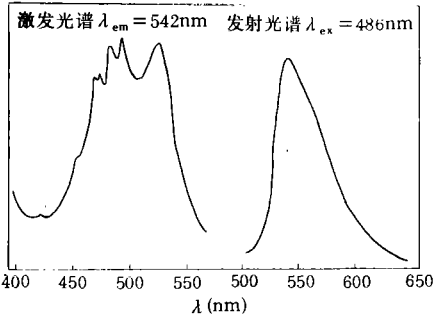


图 1 浓硫酸中 BaP 的荧光光谱(0.02 $\mu\text{g}/\text{ml}$)

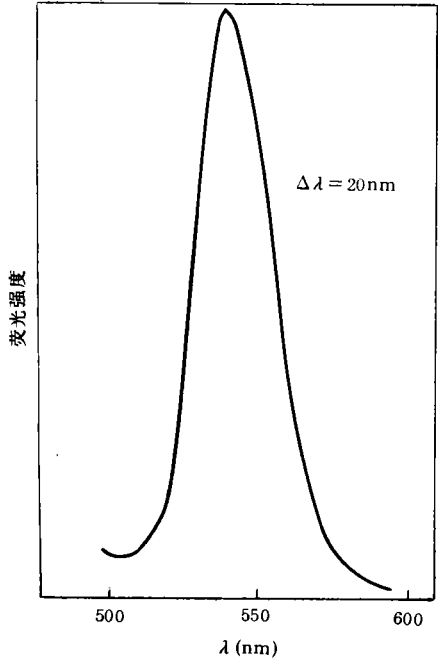


图 2 浓硫酸中 BaP 的同步荧光光谱(0.02 $\mu\text{g}/\text{ml}$)

于 5ml 环己烷中加入 0.1 μg BaP,用 5ml 浓硫酸萃取,手摇时间与萃取率的关系如图 3 所示。由图 3 可以看出,手摇 1min 即可定量萃取,

结果与文献[5]基本一致。只是手摇 10min 时,本实验的萃取率反而出现下降现象,这可能是由于手摇时间过长,促使浓硫酸与 BaP 的碳化作用所致(见 2.3)

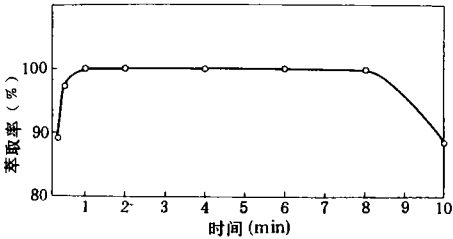


图 3 手摇时间与萃取率的关系

2.3 苯并(a)芘在浓硫酸中的稳定性

分别在 5ml 浓硫酸中加入 0.05、0.10 和 0.15 μg 的 BaP,摇匀,静置至溶液清亮后,每隔一定时间作同步荧光光谱,测量其峰高并与初始峰高比较,结果列于表 2 中。

表 2 浓硫酸中 BaP 的同步荧光强度与存在时间关系

存在时间 (h)	苯并(a)芘(%)		
	0.05 μg	0.10 μg	0.15 μg
0	100	100	100
0.5	96.0	95.0	95.0
1	94.0	93.4	95.0
2	94.0	84.3	85.8
4	84.2	75.8	75.8
5	71.8	67.0	68.3
6	66.8	58.7	60.8
25	4.9	15.4	15.3
27	4.9	12.5	13.0
28	4.9	11.2	11.7
30	3.9	10.6	8.8
71	0	6.4	3.7
75		2.7	2.5

由表 2 可知浓硫酸中 BaP 在 1h 内基本上是稳定的,但萃取后的测定最好在 1/2h 内完成。另外从测定中发现,随着时间的延长,溶液也从无色透明逐渐变为淡茶色。这可能是因浓硫酸碳化 BaP 形成的杂质所致。且亦因此而使 BaP 同步荧光光谱的基线逐渐上升,峰高逐渐降低。因此在测定时,必须从 500—600nm 作光谱图,再测量 542nm 处峰高进行计算。而不能从相应的波长处直接读取荧光强度值来计算。

2.4 加入标准溶液的回收试验

取同一大气飘尘样品的环己烷提取液 1(或 2)ml8 份,每 2 个为一组,于其中 3 组中分别加入 BaP0.05、0.10、0.15μg。按前述实验操作分别测定全部样品中 BaP 的量,计算回收率,结果列于表 3 中。由表 3 结果可知,样品中加入 0.05、0.10μg BaP 的回收率分别为 86%和 85%,而加入 0.15μg 的为 76%。因此在测定样品时,必须根据样品溶液颜色的深浅适当取样(1—5ml),使其中 BaP 的含量在 0.1μg 以下为宜。

表 3 样品中加入 BaP 的回收率

样 品	BaP 加入量 (μg)	测得 BaP 量 (μg)	平均值 (μg)	回收率 (%)
样品 I	0	0.012;0.018	0.015	
样品 I +BaP	0.05	0.053;0.063	0.058	86
样品 I +BaP	0.10	0.095;0.105	0.100	85
样品 I +BaP	0.15	0.126;0.131	0.129	76

2.5 某些其他多环芳烃对测定的影响

于 5ml 浓硫酸中加入总量为 37μg 的苈、茛、苯并(ghi)茛、晕苯、二苯并(ah)茛、茛并(1,2,3-cd)茛和 10μg 茛、0.1μg 茛、0.2μg 茛、20.6μg 茛、6.7μg 茛。以及 0.14μg 的苯并(e)茛。将这些混合溶液按上述方法在 500—600nm 范围内进行同步荧光光谱扫描测定,结果如图 4 所示。图 4 中曲线 a 表明多环芳烃的混合溶液在 530—600nm 范围内无荧光峰出现,对 BaP 的测定基本无影响。但当苈、茛、苯并(ghi)茛、晕苯、二苯并(ah)茛、茛并(1,2,3-cd)茛混合液的浓度增至 74μg,茛增至 50μg 后,所得同步荧光光谱如图 4 中的 b 所示,说明在此情况下对 BaP 的测定产生干扰。但一般说来,在实际样品的测定溶液中,上述物质的含量很少能达到这种水平。另外 Sawiki,E 等也曾报道过^[5-7],在浓硫酸中可以消除许多荧光物质的干扰,特别是能够消除在一般有机溶剂的荧光测定中极易干扰 BaP 测定的苯并(k)萤茛的干扰。

2.6 实际样品的测定

大气飘尘样品经环己烷萃取后,取 1 或 2ml 提取液,按实验方法进行同步荧光光谱的测定。同时于 5ml 环己烷中加入 0.05 或 0.1μg 的 BaP,

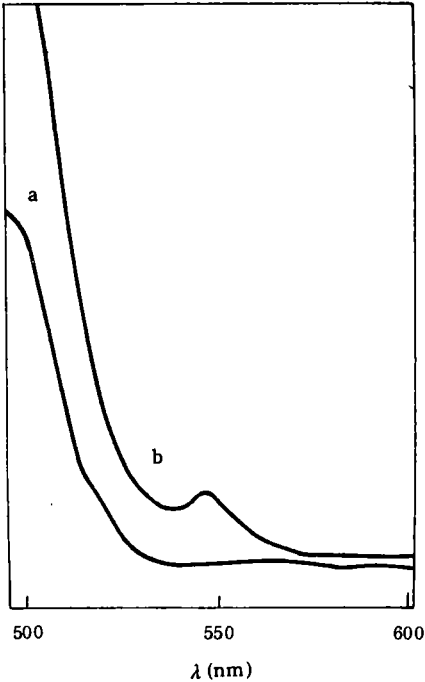


图 4 混合多环芳烃在浓硫酸中的同步荧光光谱
a. 低浓度 b. 高浓度

在相同条件下测定,以对照计算含量。

表 4 2 种方法对大气飘尘样品测定结果的比较

样品号	苯并(a)茛含量(μg)		偏差 (%)
	萃取-同步荧光法	纸层析-荧光法	
1-1	0.900	0.870	+3.4
1-2	0.960	0.870	+10.3
1-3	0.882	0.870	+1.4
2-1	0.227	0.217	+4.6
2-2	0.211	0.217	-2.8
2-3	0.215	0.217	-0.9
3-1	0.600	0.699	-10.3
3-2	0.693	0.699	+3.6
4	0.770	0.700	+10.0
5	1.240	1.440	-13.9
6	0.308	0.276	+11.6
7	0.316	0.352	-10.2
8	0.189	0.196	-3.6
9	0.623	0.630	-1.1

计算公式如下:

苯并(a)茛(μg/100m³)= $\frac{W}{h_{\text{标}}} \cdot h_{\text{样}} \cdot \frac{D}{V} \cdot 100$

式中,W:标准 BaP 的加入量(μg)。

$h_{\text{标}}$:标准 BaP 的峰高(mm)。(下转第 87 页)

氯乙烯。美国路易斯安那州大学 Milier^[26]用一个球形硅藻土填充的 75L 固定微生物反应器,床层停留时间为 20.5h,采用连续流的方式处理含二氯乙烯(主要成分)、四氯乙烯和三氯乙烯污染物的混合地下水,当采用黄细菌自养菌株(*Xanthobacter autotrophicus*),废水流速为 1.5L/h,操作 42d 后,平均有 90.2%的二氯乙烯被降解,81.7%的三氯乙烯及 64.0%的四氯乙烯也被降解。

总之,对氯代有毒物质的生物降解一般采用固定膜生物反应器或循环膨胀床生物反应器。这些反应器均以载体附着微生物,使细胞浓度大大提高,增大有毒物质的去除率,同时也便于处理后菌体与废水的分离。另外,载体还能贮存难降解物质,直到微生物驯化而能降解该组分。而且反应器中的生物膜具有保护某些敏感细胞的能力,膜内的各种微生物的存在可为降解有机毒物提供更好的生物体系与微环境,这些都有得于氯代有机毒物的生物降解。然而,在采用固定床生物反应器时,由于载体材料堆集较密,反应器内氧气的传递及液体流动均会受到阻碍,液体滞留量较大,存在较大程度的返混,形成相对静止区和死区,这对于大量处理废水不利。因此,应根据氯代有毒物质降解菌的细胞生长和降解动力学特征,以及工厂含氯废水的实际排放情况设计合适的生物反应器。

综上所述,采用生物法处理含氯代脂肪烃废水这项技术的关键在于驯化出高效氯化物降解菌株,并开发设计出合适的处理工艺。

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(上接第 67 页) $h_{\text{样}}$:样品的峰高(mm)。

D :提取液总体积与用于分析部分的体积比。

V :换算为参比状况下采样的体积(m^3)。

对一些实际的大气飘尘样品用本法和乙酰化滤纸层析-荧光分光光度法进行了对比测定,结果如表 4 所示。测定偏差在 $\pm 15\%$ 以内。

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Abstracts

Chinese Journal of Environmental Science

of pollutants at a measuring site being a sum of the contributions from all the short line sources divided. As compared with other models such as CLINE2, this method is applicable to all the line sources of finite length in an arbitrary wind direction and can be used to calculate for a reach with different intensities of sources on a road. The results of modelling calculations are consistent well with the data from field tracing and really measuring the pollution by vehicles exhausts.

Key words: line source, air pollution, modelling calculation.

Effects of exhaust gas from diesel vehicles on urban air quality. Yao Weixi, Zhang jinchun et al. (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085); *Chin. J. Environ. Sci.*, **15**(3), 1994, pp. 61—64

The changes in the concentration of polycyclic aromatic hydrocarbons (PAHs) in exhaust gas emitted from diesel vehicles under different working conditions and their effects on urban air quality were reported in this paper. The PAHs emissions were found to be related to the types of engine and their conditions, with the lowest emission generated upon an operation load of between about 2%—5%. Cyclopenta (c,d)pyrene was measured respectively in the exhaust gases and urban air, and was found to have a much higher mutagenicity than benzo(a) pyrene.

Key words: diesel vehicles, polycyclic aromatic hydrocarbons, air quality, cyclopenta (c,d)pyrene.

Extraction and Synchronous Fluorescent Spectrometry for the Determination of Benzo (a) pyrene in Airborne Particulates. Lei Shihuan, Zhao Zhenhua (Beijing Municipal Research Institute of Environmental Protection, Beijing 100037); *Chin. J. Environ. Sci.*, **15**(3), 1994, pp. 65—67

A rapid and effective method for detecting benzo(a) pyrene in airborne particulates was developed, in which benzo (a) pyrene was extracted in one minute step with concentrated sulfuric acid from a cyclohexane extracted solution from the airborne particulates, and then determined with a synchronous fluorescent spectrometry. The best results were obtained at $\Delta\lambda$ of 20nm. Benzo(a)pyrene in the concentrated sulfuric acid phase was stable within 1 hour. The recovery was found to be 85% for 0.10 μg of benzo(a)pyrene standard. No interference with other polynuclear aromatic hydrocarbons was found in the range of 530—600 nm of synchronous fluorescent spectra. For a comparison, the samples were also determined by using the unified method of acetylated paper TLC/ fluorescent photospectrometry, with the results in a variance of 15% between

both methods. The analytical cycle for the present method can shorten by 1 hour.

Key words: benzo (a) pyrene, synchronous fluorescent spectrometry, extraction, airborne particulates.

Plasma Decomposition of Sulfur Dioxide (SO₂). Yi Chengwu, Liu Hengquan, Bai Xiyao et al. (Anshan Research & Design Institute of Electrostatic Technology, Anshan 114011); *Chin. J. Environ. Sci.*, **15**(3), 1994, pp. 68—70

The results were reported for the decomposition of the noxious gas SO₂ by using a plasma technique under the conditions of ambient temperature and atmospheric pressure. The effects of SO₂ concentrations, gas flow rates and fume temperatures on the decomposition of SO₂ were examined and a comparison was made for the energy consumption of SO₂ decomposition and the amount of SO₂ decomposed by the plasma generated by pulse-superposed positive or negative DC voltages. The results show that this process has a much lower energy consumption and a higher rate of SO₂ decomposition, with 1.61—1.97 kg of SO₂ decomposed per kW · h of electric power at a decomposition rate of over 80%.

Key words: plasma, decomposition, sulfur dioxide, high voltage pulse.

Study on the Method for Detecting Environmental Toxicants and Its Application; Bacterial Culture/ Head Space Gas Chromatography. Cheng Jinquan et al. (Shenzhen Public Health and Anti-epidemic Station, Shenzhen 518020); *Chin. J. Environ. Sci.*, **15**(3), 1994, pp. 71—74

Aiming to explore a rapid, sensitive method for monitoring environmental toxicants, a head space gas chromatographic technique was used to determine the extent to which the environmental toxicants have inhibited carbon dioxide (CO₂) as a product of the bacteria *E. Coli* metabolism and IC₅₀, a concentration of an environmental toxicant being tested that has an effect of 50% inhibition, was used as a measure of the toxicity of the environmental toxicant. The optimized conditions in this test include, a bacteria concentration of 10⁹/ml, pH 7.2—7.4, a ratio of gas/liquid of 1 : 2.5 in head space tube, a culture time of 4 hours, and the operation conditions of chromatograph suitable for CO₂ determination. This method has been used to test the toxicities of 8 ions, with an order of decreasing toxicity in terms of IC₅₀ value as follows; Hg²⁺ (0.86 ppm), Cu²⁺ (8.00 ppm), Cd²⁺ (8.39 ppm), CN⁻ (10.20 ppm), Pb²⁺ (11.20), Zn²⁺ (15.20 ppm), Sn²⁺ (20.10 ppm), Ni²⁺ (39.70 ppm). The joint toxicities among Cd²⁺, Hg²⁺, Cu²⁺, Zn²⁺ and CN⁻