

2种大气 SO₂ 监测浓度换算的研究

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摘要 分别用常规法和碱片法对大气 SO₂ 进行同步监测, 并用相关分析讨论了 2 者之间的相关性。结果表明, 2 者呈极显著的正相关, 相关系数达 0.794 ($n=11$)。它们的关系可以用方程: $y=0.090x-0.031$ 来表示(其中 y 为大气 SO₂ 浓度 mg/m³, x 为硫酸盐化速率 SO₃mg/(100cm²·d)), 同时还对方程的适用性进行了分析。

关键词 SO₂ 浓度, 硫酸盐化速率, 换算, 碱片法。

SO₂ 监测的常规法受人力、物力、时间等条件的限制。由于所测结果为瞬时值, 与实际情况有一定差距。用碱片法测定的大气硫酸盐化速率, 是 SO₂ 的累积浓度。此法简便易行, 能大范围同时进行测定, 结果可真实反映大气 SO₂ 等硫化物浓度的平均水平, 尤其对多风雨的南方地区更具优越性。但需将硫酸盐化速率的单位 mg/(100cm²·d) 换算为 mg/m³。为解决这一问题, 笔者通过同一地区 2 种测定方法所得的结果与植物叶片含硫量的相关性研究, 求出其换算关系, 为大气 SO₂ 监测工作的普及提供参考。

1 研究方法

在虎门镇范围内布置 10 个采样点, 同步进行大气 SO₂ 浓度常规监测和大气硫酸盐化速率的测定, 前者于 1996-01 和 1996-07 分别连续测定 10d, 每天采样 4 次, 每次采样 0.5h。在同一采样点同步进行大气硫酸盐化速率的测定, 起始时间与常规法一致。碱片放置离地面高 5m 以上, 以避免周围障碍物的阻挡。收样时在采样点附近采摘细叶榕成熟叶带回实验室分析。另选东莞市大朗镇的佛新作为清洁区进行比较。各采样点的分布见图 1。

分析方法: 大气 SO₂ 浓度用盐酸副玫瑰苯

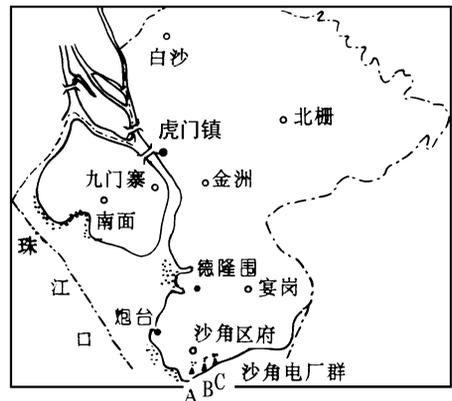


图 1 监测样点分布示意图

胺比色测定^[1]。大气硫酸盐化速率用硫酸钡比浊法测定^[1]。植物叶片含硫量用燃烧法-硫酸钡比浊测定^[2]。

2 结果与讨论

2.1 大气硫酸盐化速率与叶片含硫量的关系

国内外许多资料表明, 植物叶片污染物含量与大气污染物的浓度有密切的相关性^[3-8]。研究结果表明(表 1), 大气硫酸盐化速率与榕树叶片含硫量的相关系数 $r=0.952$, 呈极显著相关。它们之间的关系可以拟合方程:

$$y = 2.674x - 0.239 \quad (1)$$

表1 大气硫酸盐化速率与植物叶片含硫量的关系

地 点	佛新	镇府	宴岗	沙角区府	炮台	金洲	九门寨	南面	德隆围	北栅	白沙
叶 硫/ $\text{mg} \cdot \text{kg}^{-1}$	0.826	1.002	1.020	1.025	1.136	1.209	1.216	1.229	1.314	1.487	1.785
硫酸盐化速率 ¹⁾ /	0.370	0.472	0.510	0.502	0.521	0.525	0.589	0.546	0.527	0.640	0.734
$\text{SO}_3 \text{mg} \cdot (100\text{cm}^2 \cdot \text{d})^{-1}$	0.389	0.464	0.471	0.472	0.514	0.542	0.544	0.549	0.581	0.646	0.757
相对偏差/%	± 3.6	± 0.8	± 4.0	± 1.5	± 0.3	± 1.6	± 2.3	± 0.3	± 4.9	± 0.5	± 1.5
相关系数 r	$r = 0.952 > r_{9(0.01)} = 0.735 (n = 11)$										

1) 第1行为实测值,第2行为理论值

式中, y 为叶硫含量, x 为硫酸盐化速率. 由 r 值可知, x 的变异至少有 90% (r^2) 可以用 y 的变异来说明. 由方程(1) 导出的大气硫酸盐化速率的理论值与实测值, 相对偏差均 < 5%, 说明用叶片含硫量估测大气硫酸盐化速率是可行的.

2.2 大气 SO_2 浓度与叶片含硫量的关系

污染地区植物叶片的含硫量与大气 SO_2 浓度存在着显著的正相关, 这已被许多研究证

实^[3-8]. 研究结果表明, 榕树叶片含硫量与大气 SO_2 浓度呈极显著相关, 相关系数 $r = 0.754$ (表 2), 2 者关系可用方程:

$$y = 0.876 + 18.694x \quad (2)$$

来表示. 式中 y 为叶硫, x 为大气 SO_2 浓度. 由 r 值可知, x 的变异有 56.9% 可以用 y 的变异来说明. 由方程(2) 估测的大气 SO_2 理论值与实测值的偏差较大 (2.9%—38.5%, 表 2), 表明理论与实际情况有一定差距, 但方法本身是可行的.

表2 大气 SO_2 浓度与植物叶片含量的关系¹⁾

地 点	佛新	镇府	宴岗	沙角区府	炮台	金洲	九门寨	南面	德隆围	北栅	白沙
叶 流/ $\text{g} \cdot \text{kg}^{-1}$	0.826	1.002	1.020	1.025	1.136	1.209	1.216	1.229	1.314	1.487	1.785
SO_2 实测值/ $\text{mg} \cdot \text{m}^{-3}$	0.005	0.009	0.012	0.019	0.017	0.007	0.017	0.022	0.014	0.041	0.030
SO_2 理论值/ $\text{mg} \cdot \text{m}^{-3}$	-0.003	0.007	0.008	0.008	0.014	0.018	0.018	0.019	0.023	0.033	0.049
相对偏差/%	± 25	± 12.5	± 20	± 35.7	± 6.3	± 38.5	± 2.9	± 4.8	± 21.1	± 10.8	± 22.5
相关系数 r	$r = 0.754 > r_{9(0.01)} = 0.735 (n = 11)$ 极显著相关										

1) SO_2 浓度为 1 月和 7 月测定结果的平均值

2.3 大气 SO_2 浓度与硫酸盐化速率的关系

大气硫酸盐化作用是指大气中的 SO_2 等硫化物与碳酸钾 (K_2CO_3) 作用生成硫酸钾 (K_2SO_4) 的过程. 据此测得的硫酸盐化速率是气态硫化物 (主要是 SO_2) 的平均浓度, 可反映当地大气 SO_2 的污染水平. 潘如圭等曾用类似的过氧化铅法测定硫酸盐化速率, 与同步测定的大气 SO_2 浓度相比较, 结果趋势非常一致, 但未进一步建立 2 者的相关方程*. 本项研究表明, 2 者同样呈显著的正相关, 相关系数达 0.794 (表 3). 2 者的关系可拟合成方程:

$$y = 0.090x - 0.031 \quad (3)$$

式中, y 为 SO_2 浓度, x 为硫酸盐化速率. 这样, y 的变异至少有 63% 可用 x 的变异来说明, 用

大气硫酸盐化速率来评价大气 SO_2 的污染程度, 大致反映了当地大气 SO_2 的污染水平. 因此, 方程(3) 仍有一定的适用性.

2.4 回归方程的讨论

为避免对 2 个有显著相关的变量彼此间相关程度的夸大解释, 用决定系数 (r^2) 来说明是必要的. 决定系数是表示具线性关系的 2 个变量所占的比例, 比例越大, 相关越显著. 方程(1) 中决定系数 $r^2 = 0.9063$, 表示线性关系的 2 个变量占 90.63%, 方程(2) 和 (3) 仅为 56.85% 和 63.04%. 理论上这 3 个方程都应有较高的决定

* 潘如圭等. 过氧化铅片在监测城市大气 SO_2 污染方面的应用. 江苏植物所: 1985

表 3 大气 SO₂ 浓度与硫酸盐化速率的关系¹⁾

地 点	佛新	镇府	宴岗	沙角区府	炮台	金洲	九门寨	南面	德隆围	北栅	白沙
硫酸盐化速率 /SO ₃ mg·(100cm ² ·d) ⁻¹	0.370	0.472	0.510	0.502	0.521	0.525	0.589	0.546	0.527	0.640	0.734
SO ₂ 浓度实测值 /mg·m ⁻³	0.005	0.009	0.012	0.019	0.017	0.007	0.017	0.022	0.014	0.041	0.030
相对偏差/%	±25	±10	±7.1	±11.8	±3.0	±33	±10	±10	±6.7	±20.6	±6.1
相关系数 r	r = 0.794 > r _{9(0.01)} = 0.735 (n = 11)										

1) SO₂ 浓度实测值为 1 月和 7 月 2 次测定结果的平均值, 括号内数字为 SO₂ 浓度理论值

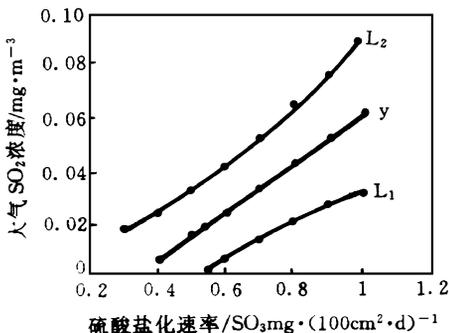
系数 (> 70%)。出现差异的原因可能是大气 SO₂ 浓度监测的位置不合理, 由于是动力取样, 受各种条件的限制, 采样位置均设在靠近动力源, 离地面 1m 高或接近地面的地方, 空气流动性差, 受建筑物、车流的影响大。此外在采样期间受气象因素的影响也较大。所以大气 SO₂ 与另 2 者的相关性较差, 但从统计结果来看, 大气 SO₂ 与叶片含硫量和硫酸盐化速率的相关系数分别为 0.754 和 0.794, 均 > r_{9(0.01)}, 呈极显著相关, 因此, 由方程 (3) 导出的大气 SO₂ 浓度理

论值有一定参考价值。

为在应用上的直观和方便, 也可绘制预测图。在实测的硫酸盐化速率 x 范围内绘若干相等的 x 间距, 分别计算出相对应的 y 值, 估计标准偏差 S_{yx} , 置信限 $S_{yx} \cdot t_{0.05}$ 和 y 的变异区间 (L_1 和 L_2), 结果见表 4。根据表 4 的数据作图, 即得用大气硫酸盐化速率估测大气 SO₂ 浓度的 95% 置信带, 在此带内读出与 x 相对应的任何 y 值, 可靠性均为 95% (图 2)。

表 4 y 估计值的 95% 置信区间

硫酸盐化速率 /SO ₃ mg·(100cm ² ·d) ⁻¹	SO ₂ 浓度 理论值/mg·m ⁻³	估计标准 误差 S_{yx}	误差限 $S_{yx} \cdot t_{0.05}$	y 的变异区间	
				L_1	L_2
0.400	0.005	0.008	0.018	-0.013	0.023
0.500	0.014	0.007	0.017	-0.003	0.031
0.540	0.018	0.007	0.016	0.002	0.033
0.600	0.023	0.007	0.017	0.006	0.040
0.700	0.032	0.008	0.019	0.013	0.051
0.800	0.041	0.009	0.022	0.019	0.063
0.900	0.050	0.011	0.025	0.025	0.075
1.000	0.059	0.013	0.029	0.030	0.089

图 2 大气 SO₂ 浓度预测图 (95% 置信度)

3 结论

(1) 植物叶片含硫量与硫酸盐化速率具有极显著的相关性, 相关系数达 0.952, 与大气 SO₂ 浓度的相关性较差, 相关系数为 0.754。硫酸盐化速率与大气 SO₂ 浓度 2 者呈极显著相关, 相关系数达 0.794, 说明用大气硫酸盐化速率来预测大气 SO₂ 浓度更符合实际。

(2) 严格控制好大气 SO₂ 的监测条件, 尽量减少各监测点因采样位置不统一所造成的误差, 可提高 2 者的相关性, 使换算更合理可靠。

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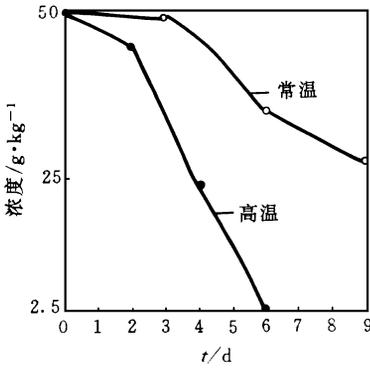


图6 石油烃浓度变化

就有较明显的降解. 这说明堆肥过程开始时, 由于微生物对高浓度石油烃还不能适应, 因而只能先降解易降解有机物而获得能量, 借以生长繁殖, 扩大自身数量, 这一点对比于 VM 及 TOC 变化图即可得出. 随着易降解有机物的减少, 微生物活性及数量都逐渐增强(多), 因而经过几天以后, 微生物开始降解石油烃. 对比常温、中温下的降解情况可发现, 高温堆肥微生物活性高一些. 经过 6d 反应, 高温堆肥可降解近 94% 的石油烃, 而常温堆肥经 9d 的反应只降解了 45% 的石油烃, 这说明在足够的有机质、适量的水分及氧含量、合适的 C/N 比的环境中, 采取一定的隔热保温措施, 可促进石油烃的迅速降解.

3 结论

温度对提高堆肥化降解率效果显著. 高温堆肥可大大加快有害废弃物的降解, 且处理效率高、周期短, 适用于有毒有害废弃物的集中处理. 常温堆肥处理效率相对低一些, 而且所需周期长, 从本实验结果看, 9d 的时间远远不够, 但常温堆肥不需额外的供热设备、投资较小, 适用于有害废弃物的原位生物修复.

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(3) 用本文提出的回归方程来换算浓度单位, 可对大气 SO₂ 浓度的相对水平作出可靠的评价.

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NO formation are discussed. The defects of De Soete fuel NO model are shown out through numerical calculation and theoretical analysis. Furthermore, after introducing the concept of "native oxygen concentration", the fuel NO formation rate is obtained by multi-component regression method.

Key words fuel NO, global reaction, native oxygen concentration, reaction pathway, multi-component regression.

Study on Treatment of Emulsified Oil Wastewater by Ultrafiltration Method. Wang Jingrong, Wu Guangxia et al. (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing, 100085): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 53—55

In this paper, treatment of emulsified oil wastewater using chloromethylated polysulfone (CMPS), polysulfone and chloromethylated polysulfone (PS/CMPS), polyacrylonitril (PAN), polysulfone and condensation-polymerized product of phenolphthalein and dichlorodiphenylsulfone (PS/PDC), polysulfone (PS) hollow fiber ultrafiltration membranes was studied. The influence of different factors, such as feed temperature, operating pressure and operating time on ultrafiltration performance, as well as recovery of the membrane property by cleaning procedure were investigated. The effect CMPS, PS/CMPS hollow fiber membranes treating emulsified oil wastewater is better. The oil content in the permeating liquid met the standard of production recycling water. The proper operating conditions were: temperature 50 °C, inlet pressure 0.12MPa, exit pressure 0.10MPa and cleaning agent 0.1 mol/L HCl.

Key words: emulsified oil wastewater, ultrafiltration, membrane, hollow fiber.

Study on Treatment of Textile Printing and Dying Wastewater with Facultative Aerobic Process. Guo Maoxin, Yu Ganshen et al. (Zhejiang Industrial Environmental Protection Design Institute, Hangzhou 310005): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 56—58

viron. Sci., **18**(4), 1997, pp. 56—58

The trial's conclusion showed that the process has the advantage of lower electricity consumption, bearing high pH value, degrading some part of organic material and increasing the ability of biochemistry treatment. The result of pilot project showed that the pH value achieved 7.6—10.1 and COD concentration reached 894.0mg/L in the effluent when the pH value was 8.8—12.5 and COD concentration was 1266.9mg/L in influent. The removal rate of COD was 29.4%. The effluent quality was up to the GB8978-88 National Two-Grade Effluent Standard after the continued aerobic treatment.

Key words: facultative aerobic, textile printing and dying wastewater, treatment.

The Primary Study on Treatment of Amino-Acid from Waste Water Using Emulsified Liquid Membrane. Pan Luting, Zhu Yiren (Dept. of Chemistry, Fuyang Normal College, Fuyang 236032), Den Chuan Yun (College of Chemical Engineering, Hefei University of Technology, Hefei 230009): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 59—61

In this article, emulsified liquid membrane separating was applied for purifying the wastewater from production of amino-acid. Influences of separation efficiency such as kinds and concentration of surfactant and carrier, the internal reagent NaOH concentration, the pH of external phase were studied. The results indicated that the separation efficiency is over 60% when the liquid membrane of LMA-1 (3g/100ml kerosene oil)、TOA (2ml/100ml kerosene oil) and 10% NaOH was used. The separation efficiency do not change as the oil phase was reused for many times.

Key words: emulsified liquid membrane, amino-acid, waste water treatment.

Study on Conversion of Two Monitoring Concentration of Atmospheric SO₂. Zhang Deqiang, Yu Mengde, Kong Guohui et al. (South China Institute of Botany, Chinese Academy of

Sciences, Guangzhou 510650): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 62—64

Atmospheric sulphur dioxide (SO₂) concentration and atmospheric sulphate rate was determined at the same time and their relationship was studied with correlation analysis in this paper. The results showed that the atmospheric SO₂ concentration is highly positively correlated with the atmospheric sulphate rate ($r=0.794$, $n=11$). Their relationship could be formulized as: $y=0.090x-0.031$ (y : atmospheric SO₂ concentration, mg/m³, x : sulphate rate, SO₃ mg/100cm²·d). Adaptability of the equation was discussed in this paper. It is reasonable to evaluate the SO₂ pollution using atmospheric sulphate rate.

Key words: SO₂ concentration, sulphate rate, conversion, atmospheric determination.

Treatment of Simulated Hazardous Waste Using Composting Bioremediation Technology.

Ma Ying, Zhang Jiayao, Hou Zujun et al. (Dept. of Environ. Sci., Wuhan University, Wuhan 430072): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 65—68

The dynamic process of simulated hazardous waste biodegradation was studied using forced aeration static pile method at normal temperature and high temperature. It was found that the optimum parameters of degradating hydrocarbon hazardous waste are temperature 50—60 °C, waste containing water ratio 60%, C/N 35, aerating amount 0.05—0.1Nm³/(h·m³), high temperature remaining time 7 days and TOC > 20%, respectively.

Key word: hazardous waste, bioremediation, composting, simulated test, forced aeration static pile.

Adsorption with Crosslinked Chitosan and DP-Cl-Photometry Determination of Trace Cr(Ⅲ) and Cr(Ⅵ) in Nature Water. Jiang Jiansheng, Huang Ganquan et al. (Dept. of Environ. Sci., Wuhan University, Wuhan 430072): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 69—71

A adsorption of Cr(Ⅲ) with crosslinked chi-

tosan was studied and a new method for the determination of trace Cr(Ⅲ) and Cr(Ⅵ) in natural water with DP-Cl-Photometry was developed. The results indicated that adsorption efficiency was 97% at pH 3.0 for 100—200ml of samples and the adsorbed Cr(Ⅲ) was quantitatively desorbed with 0.1mol·L⁻¹ NaOH. The recovery of this method was 90%—105%. The detection limit was 0.015μg·L⁻¹ and coefficient of variation was 1.2%—4.8%. The adsorption mechanism was concerned here.

Key words: chromium, speciation, photometry, crosslinked chitosan.

Investigation on the Radioactive Value of the Soil in Daqing Region. Li Changxing (The Environmental Protection Bureau of Daqing City 163001), Li Zhongwei and Feng Zhiguo (The Environ. Monitoring Central Station of Daqing City): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 72—75

The radioactive value of the soil background, presence in Daqing Region and radioactive intensity of laboratory and around work fields soil were investigated and evaluated. The results showed that the average values of the total α are 897.6, 928.1, 938.4, 973.4Bq/kg and the total β are 750.6, 786.8, 864.9, 827.5 Bq/kg respectively. Abvious, the difference between the background and presence of the radioactive intensity of the soil aren't marked ($P < 0.05$).

Key words: soil, background value, presence value, radioactivity.

Study on Ecological Evaluation of Songshan Conservation Region. Song Xiujie, Zhao Tongrun (Beijing Municipal Research Academy of Environmental Protection, 100037): *Chin. J. Environ. Sci.*, **18**(4), 1997, pp. 76—78

Songshan Conservation Region is a undamaged mountainous temperate zone ecosystem in north China. There are complicated structure, various types and 4150.3 ha of area. There are 783 species of flora and 184 species of animal.