第17卷 第2期　　环　境　科　学　　Vol. 17, No. 2
1996年4月　　ENVIRONMENTAL SCIENCE　　Apr., 1996

西宁地区公路两侧土壤和植物中铅含量及其评价

索有瑞　　黄雅丽

（中国科学院西北高原生物研究所，西宁　810001）　（西宁市环境监测站，西宁　810008）

摘要　对西宁市郊主要公路两侧的土壤和植物中的重金属铅含量采用原子吸收光谱进行了测定。结果表明，土壤和植物中铅污染都较严重。铅的含量比清洁对照区高：土壤2.7—4.1倍，杨树枝叶3.0—4.1倍，小麦青苗3.0—3.7倍，蔬菜1.5—2.3倍。土壤、树木和农作物在距路边80—100 m处铅含量通常降到当地背景水平。

关键词　西宁地区，土壤，植物，铅。

重金属铅是污染人类环境、损害人体健康的微量元素。城市和公路两侧地区，由于交通频繁，汽车废气造成大气性土壤和农作物的铅污染。张春兴等研究了利用树木叶片铅含量指示大气铅污染状况[1]，表明大气污染地区树木叶片的铅主要吸收了大气中的铅；Ter Haar 认为空气污染是粮食作物中铅的一个重要来源[2]；木本植物叶片铅含量与汽车废气引起的大气铅浓度之间有较明显的相关[3]。为了对公路两侧土壤和植物受污染的程度和范围有比较明确的了解，1992-05—1992-08 间采集高原西宁市郊主要交通干线两侧的土壤和植物样品，测定其铅含量，与相对清洁样点比较，进行污染程度的评价。

1　材料与方法

1.1　样品采集与处理

土壤样品采用多点取样组合分析，采样深度0—20 cm，在公路两侧按不同距离分别采样，每个样品均由采自公路平行线100 m内各3个点的样品组成。样品风干，磨碎过100目筛网。

植物样品用不锈钢剪刀剪取。杨树：取3—5棵树上完全伸展的叶片和当年生嫩枝；小麦：在灌浆期取15株以上的地上部分；蔬菜：取3—7株的可食部分。样品用蒸馏水洗净，剪碎后60℃下鼓风烘干，磨碎过60目筛网。

1.2　测定方法[4]

土壤样品用 HCl-NHO_3-$HClO_4$ 消解，火焰原子吸收法测定铅。植物样品干灰化法提取，甲基异丁酮萃取后用原子吸收光谱测定铅。

2　结果与讨论

2.1　清洁对照区土壤和植物中的铅含量

设一处距公路500 m以上，周围无工厂三废污染和不施用工业污泥肥料，土壤类型与被调查公路旁的土壤基本一致的清洁对照区，采集土壤和植物多点组合样品测定铅含量，结果见表1。

表1　清洁对照区土壤和植物中的铅含量(mg/kg)

采样地点	土壤	杨树枝叶	小麦青苗	萝卜	芹菜	白菜	甘蓝
彭家寨	24.3	2.46	1.96	1.18	1.90	2.05	1.06
十里铺	22.7	1.93	1.87	1.45	2.17	2.11	1.32
杨家寨	21.8	2.24	2.03	0.97	2.44	1.78	1.66
平均值	22.9	2.21	1.95	1.20	2.17	1.98	1.35

收稿日期：1995-08-23

© 1994-2009 China Academic Journal Electronic Publishing House. All rights reserved.　http://www.cnki.net

2.2 公路两侧土壤中铅的分布及污染程度

汽车流量较大的郊区廿里铺、马坊和乐家湾距公路边 5－160 m 的土壤铅含量见表 2。汽车尾气造成沿路土壤铅异常的范围随当地条件而变化。马坊与乐家湾在 100 m 时铅已基本趋于一致，而廿里铺在 100 m 处仍有铅分布，这与宁张公路汽车日流量大和周围树木较少有关。在 5 m 处，3 个采样区铅含量分别比对照区平均值高 4.1，3.5 和 2.6 倍，比西宁市表层土壤铅背景值(21.8±2.1 mg/kg)和青海省 A 层土壤铅背景值[5](20.9±5.95 mg/kg)更高。40 m 前廿里铺土壤铅很高，是宁张公路交通最频繁所致；而 40 m 后，马坊地区铅含量高于廿里铺，在 160 m 处比西宁表层土壤背景值高出 1.0 倍，这与附近西宁钢厂的污染及本地区成土母岩有关。

表 2　离公路边不同距离土壤中铅的含量(mg/kg)

采样地点	采样点到公路边的距离(m)							
	5	10	20	40	60	100	130	160
廿里铺	117	105	98.3	60.7	49.8	40.1	32.0	32.4
马　坊	102	94.7	88.2	76.3	59.8	44.0	43.6	44.7
乐家湾	83.2	81.7	77.6	58.9	42.0	25.4	24.8	24.8

2.3 公路边植物中铅的分布及其污染程度

西宁郊区路边杨树枝叶、小麦青苗和蔬菜中铅含量见表 3－5。杨树枝叶和小麦青苗中铅的分布状况与土壤类似，铅含量在 40 m 以内较高，80 m 处通常降到当地背景水平。与对照区平均含量相比，杨树枝叶在 3 m 处分别高出 4.1、3.7 和 3.0 倍；小麦青苗在 5 m 处分别高出 3.6、3.7 和 3.0 倍；蔬菜在 10－20 m 处高出：甘蓝 1.5 倍、白菜 2.3 倍、芹菜 1.5 倍、萝卜2.2倍。马坊地区植物铅的背景值比其它地区高，与土壤铅含量呈正相关，其原因除了来自汽车废气和土壤的铅外，还与植物叶片直接吸收西宁钢厂工业大气漂尘中的铅有密切的关系[6]。

表 3　杨树枝叶铅含量(干重,mg/kg)

采样地点	样点到公路边的距离(m)							
	3	6	10	20	40	60	80	120
廿里铺	11.33	8.14	6.17	5.08	3.87	2.88	2.91	2.74
马　坊	10.48	8.02	6.24	5.32	4.13	4.02	3.97	4.00
乐家湾	8.94	6.44	5.27	4.27	3.09	2.07	1.98	1.85

表 4　小麦青苗铅含量(干重，mg/kg)

采样地点	样点到公路边的距离(m)						
	5	10	20	40	80	120	160
廿里铺	8.93	7.14	6.03	4.95	2.42	2.24	2.19
马　坊	9.26	8.87	8.75	5.24	4.16	4.44	4.30
乐家湾	7.80	6.47	6.08	5.14	3.19	2.48	2.38

表 5　4 种蔬菜可食部分铅含量(干重，mg/kg)

采样地区	样点到路边的距离(m)	甘蓝	白菜	芹菜	萝卜
廿里铺	15－20	3.82	6.06	5.97	4.65
马　坊	10－15	3.71	7.60	5.32	3.17
乐家湾	10－20	2.58	5.88	4.87	3.78
平均值		3.37	6.51	5.39	3.87

© 1994-2009 China Academic Journal Electronic Publishing House. All rights reserved.　http://www.cnki.net

2.4 植物叶片吸附的铅尘

汽车废气对植物的铅污染，有附在叶面的粉尘和吸收在叶内的可溶态2种形式。为了明确附在叶面的粉尘铅含量，测定未经洗涤杨树、蔬菜叶片的铅含量，再减去洗涤后的样品铅含量，其差值定为植物叶片吸附的铅，结果见表6。

表6 不同植物叶片吸附的铅量(干重，mg/kg)

采样地点	植物种类	未洗样品	洗涤样品	叶片吸附铅	吸附百分率(%)
刘家寨	杨树	14.38	7.84	6.54	45.5
刘家寨	芹菜	7.47	4.68	2.79	37.3
十里铺	包心菜	6.74	3.77	2.97	44.1
十里铺	甘蓝	5.43	3.07	2.36	43.5
马 坊	杨树	17.65	9.14	8.51	48.2

杨树叶吸附的铅最高，这是因为杨树枝叶分泌出粘着力较强的粘性物质，铅尘较难飞失和杨树紧靠路边之故。植物含铅量的增加，往往是环境污染所致[1]，尽管植物叶片吸附的铅不被植物全部吸收，但从另一个方面说明了汽车废气对环境污染的程度和造成二次污染的可能性，提示植树造林是防治大气铅污染的有效途径。

3 结论

(1) 西宁郊区公路两侧土壤中的铅比清洁对照区高2.6－4.1倍，随着偏离公路距离的增加，铅含量逐渐降低，在100 m处趋于当地背景值，污染程度与范围取决于车流量和树木密度。

(2) 公路边植物铅含量比清洁对照区高出：杨树3.0－4.1倍；小麦青苗3.0－3.7倍，蔬菜1.5－2.3倍。农作物和树木在距公路80 m左右处，其铅含量通常降至该地区背景水平。

(3) 用未经水洗样品与经水洗样品铅含量之差作为植物叶片吸附的铅。路边植物叶片吸附的铅占未经水洗样品铅含量的37.3%－48.2%。路边较宽的树木林带，能有效地吸附铅尘和其它有害粉尘。

参 考 文 献

1 张春兴等。生态学杂志，1984，(4)：5

2 Ter Haar G.. Environ. Sci.，1970，(4)：226

3 朱颜明译。微量元素地理学。北京：科学出版社，1987：214－216

4 魏复盛，齐文启。原子吸收光谱及其在环境分析中的应用。北京：中国环境科学出版社，1988：189－191

5 中国环境监测站。中国土壤元素背景值。北京：中国环境科学出版社，1990：366－369

6 林舜华等。植物学报，1989，**31**(1)：57

(上接50页)

根据本调研的结果分析，结合国内外有关电磁辐射生物效应研究报道和环境标准，功率在1.5－2.0 MW(脉冲功率为2.0－2.5 MW)或以上的Loran-C系统发射天线，宜设置一个500－1000 m的卫生防护带。在这一区域内不应建造住宅，以免对长期居住和生活在该电磁辐射环境中的人群，包括婴儿、孕妇和老弱病残者带来潜在性不良影响。

由于长波脉冲强大的导航性能对促进航海、外贸、捕鱼和国防事业的发展起到了重要的作用，因此最近5－10年将在东北和沿海区域建成多个更大功率的Loran-C导航台。这样，接触长波脉冲辐射的作业人员和居民会明显增加。因此，建议深入开展脉冲长波电磁辐射预防性卫生监督和卫生标准研究。

参 考 文 献

1 《国防电子工程》编辑部。现代电子工程。北京：科学出版社，1984：355－358。

2 汤世贤。微波测量。北京：国防工业出版社，1981：80－90

3 Czerski P. J. Microwave Power，1985，**20**：233

4 Chiang Huai，Yao Gengdong and Zhou Shuiyan. Bioelectricity，1984，**3**(3)：361

5 作业场所微波辐射卫生标准(中华人民共和国国家标准GB10436-89)。北京：中国标准出版社，1989。

6 姚耿东等。中华劳动卫生职业病杂志，1994，**12**(4)：195

© 1994-2009 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

luted surface water, and the recoveries of p-nitrophenol and 2,4-dinitrophenol were 90±6% and 86±5% respectively.

Key words: polyvinylpyrrolidone, modified carbon paste electrode, nitrophenols.

The Content and Evaluation of Lead in Soils and Plants in Both Sides of Roads in Xining Region. Suo Yourui et al. (Northwest Plateau Institute of Biology, Chinese Academy of Sciences, Xining 810001): *Chin. J. Environ. Sci.*, **17**(2), 1996, pp. 74—76

The content of heavy metal lead in samples of soils and plants was determined by Atomic Absorption Spectrophotometry. The results are as follows: soils and plants are seriously polluted by lead from tail gas of automobiles. the content of lead is higher than that in clean control place: 2.7—4.1 times in soils; 3.0—4.1 times in branches and leaves of poplar; 3.0—3.7 times in wheat seedlings and 1.5—2.3 times in vegetables. Lead contents in soils, trees and crops usually decreased to local background value level in about 80—100 meters distant from both sides of roads.

Key words: both sides of roads, soil, plant, lead.

Principles of the Eco-Environmental Impact Assessment for Development Construction Projects: A Theory of Eco-Environmental Functions Conservation. Mao Wen'yong (Research Center for Eco-Environmental Scineces, Chinese Academy of Sciences, Beijing 100085): *Chin. J. Environ. Sci.*, **17**(2), 1996, pp. 77—81

All types of ecosystem on the Earth constitute the environment on which the sustainable existence and development of human beings rely, that is, the eco-environment. For a sustainable development strategy, more attention should be paid to evaluating the ecological functions of the environment in an environmental impact assessment for a development construction project. As presented in this paper, such an eco-environmental impact assessment should be based on preserving the environmental functions of ecosystems to assess the impacts on the ecological functions of the environment and to indentify the measures for compensating the damaged functions. More than 12 indicators of ecological functions of the environment were identified along with the methods for their valuation suggested. It was also indicated at the same time that, in order to assess the impacts on the ecological functions of the environment, the following three concepts must be set up: ① The concept of the value of ecological resources that is different from the concept of traditional economics, land use, deforestation and water resources development were exemplified to describe the difference between both concepts and the distinguishing between the benefits from two different concepts; ② The concept of integrating quantity with quality. Land and soil, water quantity and water quality, vegetation cover and diversity, etc., were exemplified to describe the correlationship of quantity to quality; ③ The concept of the holistic harmonization of ecosystems and the priority assessment of major influencing factors.

Key words: eco-environmental impact assessment, development construction projects, environmental functions.

An Obstacle Analysis and Policy Recommendation for the Implementation of Cleaner Production in Companies. Zhang Tianzhu (Dept. of Environmental Engineering, Tsinghua University Beijing 100084): *Chin. J. Environ. Sci.*, **17**(2), 1996, pp. 82—85

This paper systematically analyzes the obstacles encountered in cleaner production process. Under present conditions, the obstacles from awareness, organizational, economic, technical, and knowledge aspects are the main problems. It is a basic guarantee of promoting cleaner production in China to adjust and perfect industrial and environmental policies.

Key words: cleaner production, obstacle, policy.

Discussions on Key Problems of Plasma-Catalysis Flue Gas Desulfurization. Liu Shuhai (Institute of Electrostatics, Dalian University of technology, Dalian 116024): *Chin. J. Environ. Sci.*, **17**(2), 1996, pp. 86—89

Three approaches for SO_2 removal were summarized: high energic electron bombardment induced direct dissociation, oxidation by free radicals generated in corona, and thermo-chemical reaction with ammonia. A new way put forward by the author is discussed here of removing ammonia for SO_2 analysis. The performance of this method for flue gas is compared with that for simulated model gas. The differences resulted from gas composition were stressed. Other factors such as temperature, dose of ammonia, pulsed energization conditions were also discussed which affect the performance the most. Some incorrect conclutions in preciously published papers from different authors were examined. Some existing key problems which have to be solved for the commertial application also disscussed, including energy consumption, ammonia slip and production collection. Feasibility of combination with ESP was also concerned too. It was concluded that the key problem of this method is how to oxidize ammonia sulfite effectively by utilization of oxidizing environment generated by corona discharge with aims to solve simultaneously both problems of high energy consumption and ammonia slip.

Key words: flue gas desulfurizaiton, plasma catalysis, free radicals, high energic electron bombarment, thermochemical.

© 1994-2009 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net