

# 厌氧-缺氧-好氧处理城市废水

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**摘要** 用厌氧-缺氧-好氧中试反应器系统对城市废水进行处理。结果表明, 此系统可去除 90% 总 COD、89% TSS、93% VSS, 氮和磷的去除率分别为 80% 和 40%。在此系统的缺氧相污泥中, 脱氮硫杆菌的最高含量(MPN)、最高脱氮作用率、氧化  $\text{Na}_2\text{S}$  的最高浓度、 $\text{S}^{2-}$  的最高污泥负荷率分别为  $1.1 \times 10^8/\text{g VSS}$ 、3.6mg  $\text{NO}_3^-/\text{g VSS} \cdot \text{h}$ 、1750mg/L 和 25mg  $\text{S}^{2-}/\text{g VSS} \cdot \text{d}$ 。

**关键词** 厌氧 缺氧-好氧系统, 城市废水, 氮磷, 脱氮硫杆菌。

城市废水厌氧处理过程近年来得到了很大发展。几种不同的厌氧处理过程, 都取得了较好的效果<sup>[1-6]</sup>。但由于厌氧处理后的出水总 COD 常高于 100mg/L, 并含有一定量的铵态氮和还原硫化物, 还必须进一步处理。污水预处理可用厌氧法, 在厌氧处理后再进行深度处理以提高排放水质。Collivinarelli 等报道了较好的 COD、SS 和 N 去除的厌氧-好氧处理过程<sup>[7]</sup>。污水在用 UASB 处理后, 用缺氧反应流化床进行脱氮处理, 这一脱氮作用是通过循环好氧反应器的排出液进入缺氧反应流化床而实现的。

在厌氧-缺氧-好氧处理系统中, 硫酸盐在厌氧条件下还原并伴随有机物的降解, 被还原的硫酸盐由化能自养细菌(脱氮硫杆菌)在缺氧条件下以硝酸作为电子受体使其还原成氮, 而被还原的硫化物再氧化成硫酸。

本文采用的厌氧-缺氧-好氧系统(ANANOX)处理城市废水的目的在于对此系统的运转进行试验, 以了解去除 COD、TSS、VSS、N 和 P 的能力, 并调查脱氮硫杆菌(*Thiobacillus denitrificans*)在此系统缺氧区中的作用。

## 1 实验

### 1.1 废水特性

此 ANANOX 中试处理城市废水系统安装于意大利北部的 San Giovanni 城市污水处理厂。进水直接来自经 0.75mm 自净滚动隔板后的下水

道。进水特性如表 1 所示。

表 1 进水特性

项 目	含量(mg/L)	项 目	含量(mg/L)
COD <sub>tot</sub>	585.2 ± 321.2	TKN	88.8 ± 25.1
COD <sub>sol</sub>	170.0 ± 78.1	NH <sub>4</sub> <sup>+</sup> -N	52.7 ± 19
TOC	137.6 ± 26.5	NO <sub>3</sub> <sup>-</sup> -N	1.25 ± 1.63
IC	56.6 ± 23.1	PO <sub>4</sub> <sup>3-</sup> -P	6.34 ± 2.22
TSS	321 ± 236	P <sub>tot</sub>	10.32 ± 3.45
VSS	238 ± 172	NH <sub>4</sub> <sup>+</sup>	110.7 ± 60.7

### 1.2 反应器

ABR (厌氧折流反应器, Anaerobic Baffled Reactor) 作为此系统的厌氧相和缺氧相, 一常规曝气罐作为好氧相。由 3 个反应间和一内部沉淀室组成的 ABR 反应器总有效体积为 350L, 第三反应间装有固定膜, 其目的是延长生物固体滞留期。曝气罐体积为 360L, 罐内水高为 0.67m, 空

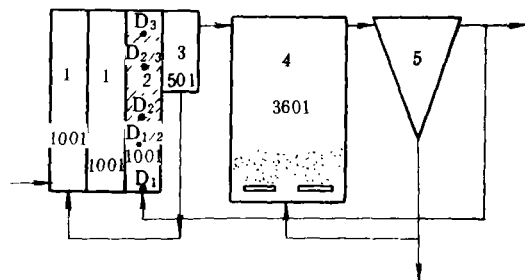


图 1 ANANOX 系统及流程

1. 厌氧相 2. 缺氧相 3. 沉淀室 4. 好氧相 5. 沉淀罐

气由 2 个气泡分散器由罐底部进入。与曝气罐相连的为 90L 沉淀罐,经沉淀后的上清液部分地被循环进入缺氧相,沉淀的污泥再进入到曝气罐<sup>[8]</sup> (图 1)。此中试系统用驯化的厌氧污泥接种,而曝气处理污泥来自于本生产规模处理厂的活性污泥。

### 1.3 测定方法

ABR 所产气体用排水气体流量计(QGM 100,意大利 APES 制造)计量。由实验室制做的常规仪器测进料废水流速。每周测定 2 次 5 个样品的 COD、TKN、VSS 和 TSS,随时测定 SVI<sup>[9]</sup>,氮化物。磷酸盐和硫酸盐浓度用气相色谱(High Performance Ion Chromatograph DIONEX 4000i)进行分析。 $N_2$  用 DANI 3865 GC 气相色谱仪分析。TC、IC 和 TOC 是将过滤的样品(whatman 滤纸 GF/C 过滤器)用 DOHRMANN TOC DC 90 进行测定。气体成分用 DANI 3865 GC 气相色谱仪进行分析。此中试系统装有 HP 3852A 数据获取系统,以便连续记录气体产量、进水流速和溶解氧浓度。

脱氮硫杆菌的脱氮作用率为待测样品(污泥样品取自缺氧区,距底部 0.1、0.5、0.9、1.3 和 1.7m 处,分别称之为样点  $D_1$ 、 $D_{1/2}$ 、 $D_2$ 、 $D_{2/3}$  和  $D_3$ , (见图 1),经缓冲液离心(6000r/min, 7℃, 每次 10min)洗涤 2 次后加进  $NaHCO_3$  和  $KNO_3$ ,使最终浓度分别为 2g/L 和约 10mg  $NO_3^-$ /L,经内源呼吸培养 2h(20℃)后加进  $S^{2-}$  ( $Na_2S \cdot 9H_2O$ ),测起始  $NO_3^-$ -N 浓度,定期取样,测  $NO_3^-$ -N 浓度变化。

采用浓度为 1500mg/L, 1750mg/L, 200mg/L, 2250mg/L 和 2500mg/L 的  $Na_2S \cdot 9H_2O$ ,并接种  $D_{1/2}$  污泥样品,进行  $S^{2-}$  氧化成  $SO_4^{2-}$  的潜力测定。

胰酶解酪蛋白豆汁培养基和胰酶解酪蛋白琼脂培养基各加进 3g/L  $KNO_3$  用来测定异养反硝化细菌的数量(MPN 法和平板菌落计数法);营养琼脂培养基用来测定细菌总数<sup>[9]</sup>;脱氮硫杆菌的 MPN 计数,以试管中培养基混浊,  $SO_4^{2-}$  浓度升高、 $NO_3^-$  浓度下降并产生  $N_2$  为阳性反应。

## 2 结果和讨论

取自运转稳定期的详细数据列于表 2。

表 2 运转稳定期的平均数据(mg/L)<sup>1)</sup>

项目	进料	厌氧相排出液	缺氧相排出液	排出液
pH	8.06	7.72	7.82	7.99
COD <sub>tot</sub>	427.5	258.1	196.2	44.6
COD <sub>sol</sub>	156.5	91.2	45.3	21.3
TOC	52.9	28.6	19.8	8.0
TSS	250	169	196	27
VSS	190	117	132	14
$NH_4^+-N$	47.15	33.9	16.91	1.31
$NO_3^- - N$	1.56	1.07	2.13	10.39
$SO_4^{2-}$	113	52.5	106.5	138.8
$PO_4^{3-}$	9.77	6.23	5.32	5.85

1) 除 pH 外

2) 进料和出料液为总 P, 厌氧和缺氧相排出液为  $PO_4^{3-}-P$

厌氧相中去除 40% 总 COD 和 42% 可溶性 COD。此系统去除 90% 的总 COD, 86% 的可溶性 COD, 89% TSS 和 93% VSS, 氮去除 80%, 总磷去除 40%。28% 的  $NH_4^+-N$  在厌氧相中去除, 其余的则在好氧相中氧化成  $NO_3^- - N$ 。最终排出液的 55% 循环进入缺氧相进行反硝化作用。

图 2、图 3 和图 4 为运转期间 HRT 和甲烷产率变化曲线, 运转期间进水 COD、出水 COD、进水 TSS 和出水 TSS 变化曲线, 以及进水  $NH_4^+-N$ 、 $NO_3^- - N$ 、总氮和出水  $NH_4^+-N$ 、 $NO_3^- - N$  和总氮变化曲线。运转稳定期的总水力停留期保持在 5h 左右, 厌氧相和缺氧相的甲烷产量为 18L/d 左右, 厌氧相中的平均沼气产量为 11.47L/d, 缺氧相中为 16.6L/d, 厌氧相和缺氧相所产气体的平均甲烷含量分别为 73% 和 60%, 缺氧相中其余的气体为  $CO_2$  (3%—5%) 和  $N_2$  (24%—35%)。

在此处理系统中, 厌氧相中产生的电子供体(VFA、还原态硫、 $CH_4$  等)用来进行反硝化作用。所处理的城市废水中含有一定浓度的  $SO_4^{2-}$ , 在厌氧相中, 硫酸盐还原菌进行异化硫酸盐还原作用, 在缺氧相中, 异养反硝化细菌和化能自养的脱氮硫杆菌分别以有机物和无机还原硫化物为电子供体使  $NO_3^- - N$  还原成  $N_2$ 。由于所处理水中含有一定浓度的  $SO_4^{2-}$ , 故在缺氧相中脱氮硫杆菌在氧化硫化物成  $SO_4^{2-}$ , 还原  $NO_3^-$  为  $N_2$  的过程中

起着重要作用。图 5 和图 6 为缺氧相污泥中脱氮  $\text{gVSS} \cdot \text{h}$  和  $2.8 \text{mg NO}_3^-/\text{gVSS} \cdot \text{h}$ 。在 4.5h 的时间里,  $\text{NO}_3^-$  被还原为零。而在相同的时间内,  $\text{D}_1$ 、 $\text{D}_{1/2}$  和  $\text{D}_3$  样品使  $\text{NO}_3^-$  只还原了 58%、50% 和

$\text{D}_2$  和  $\text{D}_{2/3}$  样品的脱氮作用率为  $3.6 \text{mg NO}_3^-/5.4\%$ 。

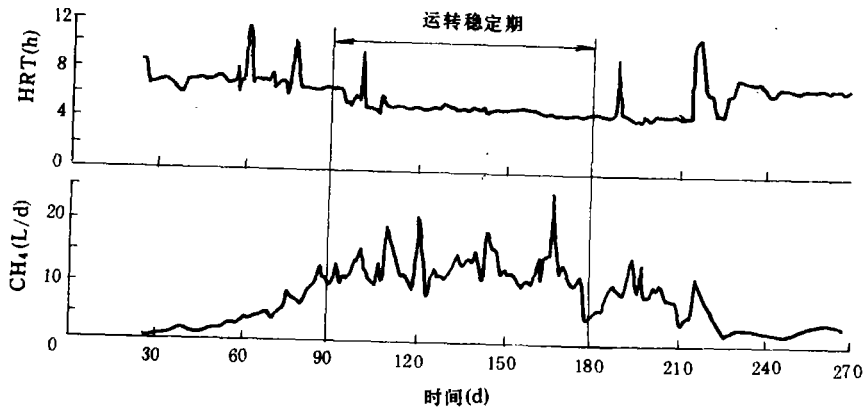


图 2 运转期间的 HRT 和甲烷产率变化曲线

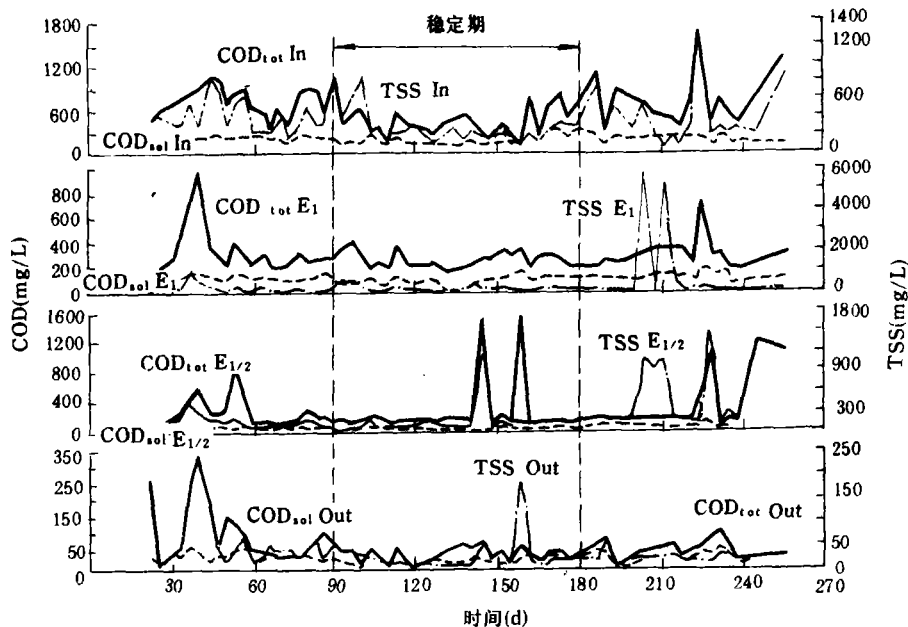
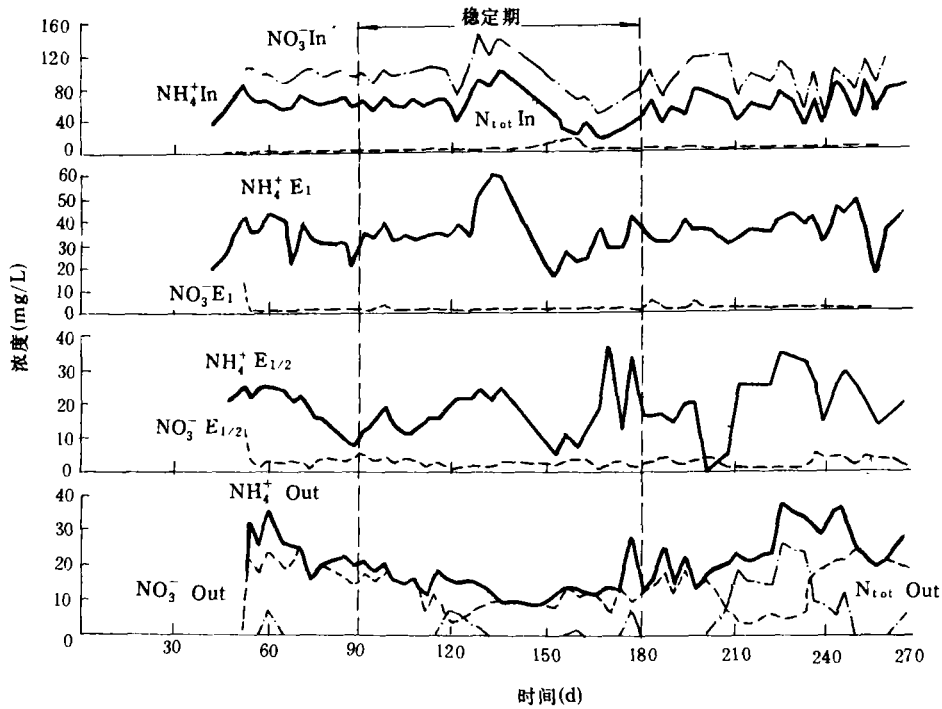


图 3 运转期间进出水 COD、TSS 变化曲线

$E_1$  = 厌氧相出水,  $E_{1/2}$  = 缺氧相出水

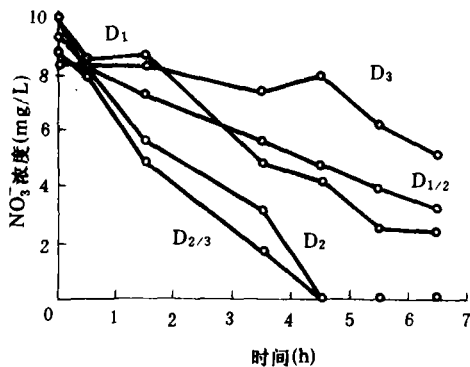
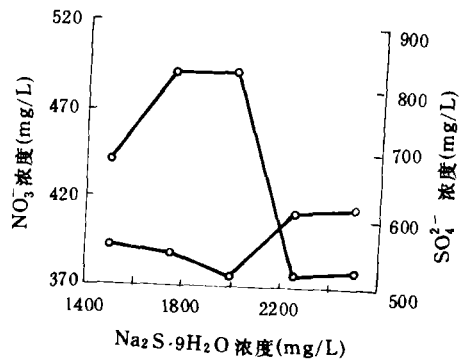
脱氮硫杆菌是专性化能自养菌, 氧化  $\text{S}^{2-}$  成硫酸, 同时硝酸作为电子受体而还原成氮气。通过测定培养液中  $\text{SO}_4^{2-}$  浓度和  $\text{NO}_3^-$  浓度的变化而得知脱氮硫杆菌氧化  $\text{S}^{2-}$  成  $\text{SO}_4^{2-}$  和还原  $\text{NO}_3^-$  为氮的能力。但高浓度  $\text{S}^{2-}$  对细菌有毒害作用, 在抑制浓度以下, 脱氮硫杆菌氧化  $\text{S}^{2-}$  使培养液中  $\text{SO}_4^{2-}$

图 4 运转期间进出水  $\text{NH}_4^+$ -N、 $\text{NO}_3^-$ -N、总氮变化曲线

$E_1$  = 厌氧相出水,  $E_{1/2}$  = 缺氧相出水

浓度升高,而由于  $\text{NO}_3^-$  被还原而浓度下降,  $\text{S}^{2-}$  达到完全抑制浓度时,培养液中  $\text{SO}_4^{2-}$  浓度则明显下降,而  $\text{NO}_3^-$  还原量下降即  $\text{NO}_3^-$  浓度升高。从图 6 可以看出,当  $\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$  浓度低于 1750mg/L (污泥负荷率为  $25\text{mg S}^{2-}/\text{gVSS} \cdot \text{d}$ ) 时,  $\text{SO}_4^{2-}$  呈直线上升;而  $\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$  浓度高于 1750mg/L, 小于 2000mg/L (污泥负荷率为  $28.5\text{mg S}^{2-}/\text{gVSS} \cdot \text{d}$ ) 时,  $\text{SO}_4^{2-}$  浓度无明显变化;当

$\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$  浓度高于 2000mg/L 时,  $\text{SO}_4^{2-}$  急剧下降。说明最适污泥负荷率为  $25\text{mg S}^{2-}/\text{gVSS} \cdot \text{d}$ 。

图 5  $D_1$ 、 $D_{1/2}$ 、 $D_2$ 、 $D_{2/3}$  和  $D_3$  的脱氮作用率图 6  $\text{Na}_2\text{S}$  与  $\text{SO}_4^{2-}$  和  $\text{NO}_3^-$  之间的相互关系曲线

好氧和厌氧条件下测得的缺氧相污泥样品中的细菌总数、异养反硝化细菌菌落数和 MPN 计数、厌氧条件下脱氮硫杆菌的 MPN 计数结果列于表 3。

表 3 缺氧相中不同细菌的计数结果

取样点	细菌总数菌落 计数(好氧)/gVSS	细菌总数菌落 计数(厌氧)/gVSS	异养反硝化细菌 菌落计数/gVSS	异养反硝化细菌 MPN/gVSS	脱氮硫杆菌 MPN /gVSS
D <sub>1</sub>	$3.9 \times 10^8$	$5.2 \times 10^7$	$3.1 \times 10^7$	$2.8 \times 10^7$	$1.4 \times 10^7$
D <sub>1+2</sub>	$5.59 \times 10^8$	$4.41 \times 10^8$	$1.2 \times 10^8$	$2.3 \times 10^8$	$1.4 \times 10^7$
D <sub>2</sub>	$7.98 \times 10^8$	$4.6 \times 10^8$	$1.65 \times 10^8$	$1.5 \times 10^8$	$1.1 \times 10^8$
D <sub>2+3</sub>	$9.25 \times 10^8$	$3.8 \times 10^8$	$1.25 \times 10^8$	$5.3 \times 10^8$	$4.2 \times 10^7$
D <sub>3</sub>	$3.24 \times 10^8$	$5.3 \times 10^8$	$1.72 \times 10^7$	$6.6 \times 10^7$	$6.2 \times 10^3$

脱氮硫杆菌在样品 D<sub>2</sub> 和 D<sub>2/3</sub> 中含量较高,这一含菌量与测得的 D<sub>2</sub> 和 D<sub>2/3</sub> 样品有较高的脱氮作用率相一致。

曝气相中 SVI 受缺氧相逸出的悬浮固体浓度所影响。要使 ANANOX 系统的运转稳定和保持高处理效率,厌氧/缺氧和好氧污泥的分离是重要环节。本处理系统与常规的反硝化-反硝化处理过程相比较,产生污泥少,并产生甲烷。达到了既去除 COD、TSS 和 N,又获得甲烷的目的。磷去除率的提高有待进一步研究。

ANANOX 系统处理城市废水,总 COD 去除 90%,TSS 和 N 分别去除 89% 和 80%,并产生甲烷。缺氧相污泥的细菌学测定表明,脱氮硫杆菌在将硫酸化成 SO<sub>4</sub><sup>2-</sup> 和将 NO<sub>3</sub><sup>-</sup> 还原成氮中起着一定的作用。这种测定的结果当属首次。

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系中的 Ni<sup>2+</sup> 含量,维持正常运行所允许的污泥负荷应不超过 200mg/kgVS。当超过 380mg/kgVS 时,厌氧体系就受到明显的抑制作用。

### 3 结论

(1) 厌氧体系受镍影响的程度与日加入镍量有关,日加入浓度低于 36.4mg/L 时,基本无抑制;日加入浓度为 40—60mg/L 时,体系受到轻微的影响;超过 80mg/L 时,对厌氧体系产生严重的抑制作用。

(2) 厌氧体系中 Ni<sup>2+</sup> 含量与日加入量成正比,在相同累积浓度下, Ni<sup>2+</sup> 浓度越高,所产生的

抑制作用越严重。Ni<sup>2+</sup> 浓度低于 2.5mg/L 时,厌氧体系基本不受影响;在 8—12mg/L 时,受到严重抑制作用。

(3) 维持厌氧体系正常运行所允许的镍日加入量应不超过污泥干重的 0.08%。

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# Abstracts

Chinese Journal of Environmental Science

Ra-226, K-40 in various waters are 0.12—8.94, 0.02—0.66 $\mu$ g/L and 6.0—98.1, 19.2—643 mBq/L, respectively. The geographical distribution of the environmental radiation levels is higher in the west-north mountain area and lower in the east-south plain of Beijing.

**Key words:** environmental radiation level, dose rate, Beijing.

**Study of Treating Acid Cd-Containing Effluent with Expanded Graphite Fluidized Electrode.** Zhang Hongbo et al. (Chemistry and Chemical Engineering Department, Hunan University Changsha); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 20—23

Acid Cd-containing effluent was treated with expanded graphite fluidized electrode effectively. It has advantages of fairly high current efficiency (40—50%), rapid removal of Cd<sup>2+</sup> (40.7mg/min), fairly low energy consumption (6—10kWh/kg Cd) and so on. The concentration of cadmium ion in treated effluent can be decreased to below 10ppm. It does not comply with national effluent discharge standard, but it is still effective in the recovery of cadmium. Suitable conditions of treating acid Cd-containing effluent and methods for Cd-recovering were also investigated.

**Key words:** expanded graphite, fluidized electrode, Cd-containing effluent.

**Pollution by Phosphorus in Farmland Drainage to the Taihu-Lake Water system.** Zhang Shuiming et al. (Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 24—29

By the phosphorus balance method in a closed system, this paper dealt with the discharge of phosphorus from agricultural non-point source in Taihu-Lake region in southern Jiangsu Province, and the measures to reduce this discharge. The results showed that the total discharge of phosphorus from the surface drainage of farmland in Taihu-Lake region was 440.4 t/a in a rainy year as 1987, and 299.9 t/a in a dry year as 1988.

**Key words:** farmland drainage, phosphorus discharge.

**Study of the Genotoxicity and Concentration of Five Metals in Air-Borne Particles.** Lei Xiufen et al. (Department of Epidemiology, Beijing Medical University, Beijing 100083); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 30—33

Samples of variously-sized total suspended particulates (TSP) in the air of one sampling site of Taiyuan are collected in winter. The concentration and the percentage of the particulates are measured, five metals including Pb, Mn, Cr, Ni and Cd in the

extracts from the samples are quantitatively analyzed by atomic absorption spectrometer, and the genotoxicity of the extracts are detected by the SOS chromotest and the mouse bone marrow cellular chromosome aberration assay in vivo. The results show that the mean concentration of TSP is 1.04mg/m<sup>3</sup>, much higher than the National Standard. The pollution of the smaller-sized particles is serious, as nearly half of the particles are less than 7.0 $\mu$ m in diameter. The concentration of Pb, Mn and Ni are high. Besides, the metals can be enriched strongly on the surface of the small particles. Having extracted by simulated lung fluid (SLF), it has been found that metals can dissolve partially into the SLF. The experiments show that both the extracts of acid and that of SLF of the smaller sized particles can induce SOS response and cause an increase in chromosomal aberrations. This indicates the existence of genotoxicants which may cause DNA damage or have clastogenic effects in the smaller-sized particles.

**Key words:** air-borne particles, genotoxicity, SOS chromotest, chromosome aberration assay.

**Study on the Collection Efficiency of a Granules-moving Bed Dust Filter.** Zhang Liping et al. (Department of Chemical Engineering, Tsinghua University, Beijing 100084); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 34—37

Based on analysing the mechanism of filtration through a granule layer and the factors affecting the dust collection efficiency of a granule layer moving bed filter, an orthogonal multi-factor method was used in a laboratory apparatus to preliminarily study the effects of the factors such as the filtration velocity, the size and type of particles, the bed thickness, and the dust load of granule layer, on the dust collection efficiency. Then, a demonstration was made in an industrial pilot plant. The results showed that the suitable filtration velocity was 0.2m/s, the particle size in the moving bed was preferred in 1—2mm, and the bed thickness should be equal to or slightly more than 150mm.

**Key words:** dust collection efficiency, granular moving-bed, filter.

**Anaerobic-Anoxic-Aerobic Process for Municipal Wastewater Treatment.** Yang Xiushan et al. (Capital Normal University, Beijing, 100037); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 38—42

A pilot reactor of anaerobic-anoxic-aerobic process was operated to treat municipal wastewater. The results indicated that the process was able to remove 90% total COD, 89% TSS, 93% VSS, and the removal rates of nitrogen and phosphorus were 80% and 40%, respectively. In anoxic phase, the

# Abstracts

Chinese Journal of Environmental Science

maximum number (MPN) of *Thiobacillus denitrificans*, the maximum denitrification rate, the maximum concentration of oxidizing  $\text{Na}_2\text{S}$ , and sludge loading rate of  $\text{S}^{2-}$  were  $1.1 \times 10^8/\text{g VSS}$ ,  $3.6\text{mg NO}_3^-/\text{g VSS} \cdot \text{h}$ ,  $1750\text{mg/L}$  and  $25\text{mg S}^{2-}/\text{gVSS} \cdot \text{d}$ , respectively.

**Key words:** anaerobic- anoxic- aerobic process, municipal wastewater, nitrogen and phosphorus removal, *Thiobacillus denitrificans*.

**Study on the Catalytic Oxidation of Na Alkylbenzenesulphonate in Aqueous Solution.** Wang Xiaocheng et al. (Department of Environmental Engineering, Taiyuan University of Technology, Taiyuan 030024); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 43—46

A catalytic oxidation and degradation process of Na alkylbenzenesulphonate (NABS) in aqueous solution was experimentally studied by using  $\text{NaClO}$  as an oxidant, the type "TU" catalyst selected from a set of experiments, and the IR analysis to monitor the process. The factors affecting the removal of NABS from water were also studied. The results show that the type "TU" catalyst has a better ability to catalytically oxidize NABS in water, generally with a removal of about 80%, and almost all of the NABS in water can be degraded by the catalytic oxidation into simple inorganics and less carbonyl compounds.

**Key words:** Na, alkylbenzene sulphonate, catalytic oxidation, wastewater treatment.

**Effect of Benzoylphenyl Ureas on Non- target Organisms and Their Metabolism in the Organisms.**

Liu Guoguang et al. (Department of Chemistry, Henan Normal University, Xinxiang 453002); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 47—50

The reported research results concerning the probable effect of benzoylphenyl ureas on non- target organisms and their absorption, and metabolism in organisms have been reviewed in this paper, which include the effect of the insecticides on terrestrial life (including bees, silkworms and birds) and aquatic life (including fishes, crustaceans and arthropods), and their absorption, and metabolism in animal. It was suggested that the insecticides would not cause evident poisoning and pollution to bees, birds, poultry, cattle and fishes, but they are toxicants to silkworms, crustaceans and arthropods, especially to their larvae.

**Key words:** benzoylphenyl ureas, ecosystem, terrestrial, aquatic, poultry, cattle, toxicity, absorption, metabolism.

**Theories, Methods and Applications about Environmental Carrying Capacity of Reservoir-**

**induced Resettlement.** Xun Houping et al. (Centre of Reservoir- Induced Resettlement Research, Nanjing 210024); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 51—54

Environmental carrying Capacity of reservoir-induced resettlement is an important theory in reservoir-induced resettlement. Its basic theories are that living conditions of human being are restricted by the environment, environmental carrying capacity of reservoir-induced resettlement has a variability depending on the quality and quantity of the affecting factors. Its analysis methods are based on combining macroscopic qualitative analysis with microcosmic quantitative analysis as well as dynamic, primary and secondary, reliability analysis etc. Its theories and methods have been applied successfully in resettlement planning, with good results achieved.

**Key words:** reservoir-induced resettlement, environmental carrying capacity, resettlement planning.

**Application of Bacteria to Monitoring of Environmental Contaminant Toxicity.**

Cheng Jingquan et al. (Shenzhen Public Health and Anti-Epidemic Station 518020); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 55—59

This paper deals with a sort of monitoring methods in which germs are used as indicators for biochemical toxicity screening, bacteria growth inhibition, respirometric techniques, bioluminescence microtox, microcalorimetric and mutation test etc.

**Key words:** toxicity assay, biochemical toxicity screening, bacteria growth inhibition, microtox, microcalorimetric.

**A Survey on the Levels of Total Organic Compounds**

**in Indoor air.** Chen Guifu et al. (Wannan Medical College, Wuhu 241001); *Chin. J. Environ. Sci.*, 14(6), 1993, pp. 60—62

The total organic compounds in air of the living rooms of 82 households in both rural and urban areas were determined by monitoring AOD which serves as a synthetic index to show the level of air pollution by total organic compounds. The results showed that the concentration of air borne total organic compounds was  $4.87 - 5.05\text{mg/m}^3$  in the rural living rooms, and  $3.69 - 4.71\text{mg/m}^3$  in the urban living rooms, and the level of concentration depends on the degree of air pollution. It is also revealed that the increased human activity, smoking, residential volume  $< 25\text{m}^3$ , room temperature  $> 5.0^\circ\text{C}$ , wind velocity  $< 0.07\text{m/s}$ , and ACH  $< 1.0$  are among the factors which raise the concentration of air borne total organic