第17卷 第1期　　环　境　科　学　　Vol. 17, No. 1
1996年2月　　ENVIRONMENTAL SCIENCE　　Feb., 1996

新型柴油机消烟消声器的研制

曾德芳

（武汉交通科技大学轮机学院，武昌　430063）

摘要　通过在原柴油机消声器的底部注入对柴油机尾气有明显吸收和转化作用的吸烟液，使柴油机尾气通过此消烟消声器时同时得到净化和降噪。在135型柴油机上与原柴油机消声器进行同等条件下的对比试验表明，烟度下降80%，噪声由99 dB降至85 dB，效果令人满意。

关键词　柴油机，消烟消声器，尾气，噪声，吸烟液。

柴油机作为动力和能源的主要设备，在人们的生产和生活中得到越来越广泛的应用，但柴油机在工作时新引起的烟尘和噪声污染也日益严重。为此，笔者研制出一种集柴油机消烟和消声于一体的柴油机消烟消声器，试车效果明显。

1　研制过程

1.1　设计原理

本着经济实用的原则，在原消声器的底部增设一盛有一定量吸烟液的消烟装置，当柴油机尾气进入消烟消声器后，先经过进气管周围的导气蜂管进入吸烟液，尾气经吸烟液吸烟后再经过中部多孔隔板进行第1次消声，然后气流经过上方多孔共振式消声器进行第2次消声[1]，最后经上方出口排出器外。

该消烟消声器的工作原理及基本结构见图1。其中箭头所指方向为柴油机尾气流动方向。

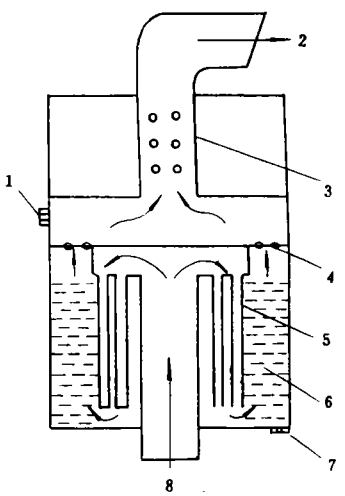

图1　消烟消声器轴剖面图

1 吸烟液进口　2 尾气出口　3 多孔出气管　4 多孔隔板　5 导气蜂管　6 吸烟液　7 吸烟液出口　8 尾气进口

1.2　消烟消声器结构大小的确定

1.2.1　消烟消声器各部分体积大小的确定

从图1可以看出，该消声消烟器为一圆柱（筒）形，其圆柱直径与圆柱高度之比为1∶1.5—2。其中吸烟液上方气体容量空间（V_g）可按美国Nelson消声器公司的最佳消声器气体容量经验公式推出：

$$V_g = \frac{C \times V_n \times n}{1000} \times \sqrt{\frac{i}{\tau}}$$

式中，C为经验常数，视柴油机大小一般为2—5；V_n为柴油机气缸排气量(L)；n为柴油机转速(r/min)；i为柴油机气缸数；τ为柴油机冲程数。

通过求出消烟消声器的最佳气体容量后，再根据吸烟液体积（V_1）与其上方最佳气体容量（V_g）之比为3∶7的最佳比例关系，则可求出吸烟液体积和整个消烟消声器圆柱的体积（V_t）。

收稿日期：1995-06-03

1.2.2 消烟消声器中孔径和管径的确定

根据共振式穿孔薄板的消声原理，孔径一般为5—7 mm为宜，穿孔率(即孔的总面积与所在板的总面积之比)一般以1%—3%为宜，而每个均匀分布的孔间距一般以孔径的5倍为宜。所以在消烟消声器中中层多孔隔板(出气孔)和上层多孔出气管的孔径大小应按此原则进行计算。

消烟消声器的上部多孔出气管的管径应为整个消烟消声器圆柱直径的$\frac{1}{4}$[2]，即$D_{孔径}=\frac{1}{4}D_{圆柱}$，而下部进气管周围的导气蜂管的管径应为上部多孔出气管管径的$\frac{1}{5}$，即$D_{蜂管}=\frac{1}{5}D_{孔管}$。

1.3 吸烟液的配制及使用

1.3.1 吸烟液的配制原理

柴油机尾气主要由碳氧化合物(CO_x)、氮氧化合物(NO_x)、硫氧化合物(SO_x)、碳氢化合物(HC)及碳烟微粒(C)等5种成分组成[3]。其中NO_x、SO_x和CO_x均为酸性气体，故吸烟液必须是碱性的方可中和除去上述酸性气体；其中碳氢化合物是未燃烧完全的柴油，故吸烟液中必须加入既亲油又亲水的非离子表面活性剂方可将HC吸收溶于水中；尾气中的碳烟微粒C进入吸烟液后可被自然吸收而沉于液中。所以，该吸烟液应为含有碱和非离子表面活性剂的水溶液。

1.3.2 吸烟液的配方及成本

吸烟液的最佳配方(均为重量百分比W%)为：

纯碱(工业一级1.8元/kg)5%；S-4非离子表面活性剂(工业一级2.6元/kg)1%；水(自来水或地下水)94%。

这样每kg吸烟液的原料成本为0.116元/kg，比重为1.10。而一台195型柴油机消烟消声器中吸烟液的重量为：

$$W = d \cdot V_1 = 1.1 \times 1.4 = 1.54(\text{kg})$$

仅耗资0.118元/次。

1.3.3 吸烟液的用法

按上述配方将吸烟液配好后，于螺栓处注入吸烟液(图1)，吸烟液经吸烟使用后pH值开始下降，当吸烟液的pH值降到7以下时(用市售pH值试纸测定)，应及时更换新的吸烟液，否则酸性液体会腐蚀器壁。通常更换1次吸烟液可用3—5个月。所以，一般只需花0.2元人民币就可使用半年，成本非常低廉。

2 消烟消声器的测试[4]及结果

以135型柴油机为测试对象，使用江西吉安红声器材厂生产的ND-2型精密声级计，测烟度用奥地利AVL公司生产的4D9DZ型烟度计。在所有测试条件相同的条件下，在同一135型柴油机上分别对原135型柴油机消声器和现在研制的新型消烟消声器的烟度和噪声进行对照测试，其测点均离消声器的出口处水平方向1 m，结果见表1。

表1 对照测试结果

测试项目	原135型柴油机消声器	新型消烟消声器
燃油种类	0#柴油	0#柴油
转速(r/min)	1500	1500
负荷(%)	75	75
工作时间(s)	48.80	48.80
燃油消耗率[g/(kW·h)]	276	278
平均噪声(dB)	99	85
平均烟度(BH)	2.83	0.56

3 结论

从对照测试结果可以看出，新型柴油机消烟消声计同原柴油机消声器相比，具有明显的降烟降噪效果，其中烟度下降了80%，大大降低了柴油机工作时所造成的环境污染，同时减少了柴油机操作人员由于噪声和烟尘所致的职业病的发生，因而且有明显的经济和环境效益。

参 考 文 献

1 陈绎勤编著。噪声与振动的控制。北京：中国铁道出版社，1985：200—206

2 郑兴泰等编。环境噪声控制工程。北京：高等教育出版社，1988：202—234

3 Santhanam C J et al.. Flue Gas Cleaning Watses Disposal and Utilization. New Jersey (U. S. A.), 1981: 63

4 Donald E B. Noise Control in Internal Combustion Engine. Misconsin: John wiley & Sons, Inc. 1982: 69—72

to fluidize easily in the reactor. The treatment system can resist the loading fluctuation and possess high dehydrogenase activity.

Key words: fludized, biofilm, treatment, phenolic wastewater, carrier.

Development of a New Type Dispelling Smoke Silencer of Diesel Engine. Zeng Defang (Turbine College, Wuhan University of Science and Technology of Traffic, Wuhan 430063): *Chin. J. Environ. Sci.*, **17**(1), 1996, pp. 63—64

This paper introduces a kind of method of making a new type dispelling smoke silencer of diesel engine. The method includes adding a kind of solution which can clean the end gas of diesel engine to the buttom of the old silencer of diesel engine. The end gas of diesel engine can be both cleaned and silenced by passing through the dispelling smoke silencer. A comparison of new silencer with the old one under the same condition on the type 135 diesel engine has shown that the dispelling smoke silencer can reduce 80% of smoke and 14.1% of noise (from 99 dB to 85 dB).

Key words: diesel engine, dispelling smoke silencer, noise, end gas of diesel engine.

A Study on Treatment of Traditional Chinese Medicine Wastewater by SBR Process. Han Xiangkui et al. (Jilin Architectural and Civil Engineering Institute, Changchun 130021): *Chin. J. Environ. Sci.*, **17**(1), 1996, pp. 65—67

Experimental resutls showed that at the concentration range of COD in influent from 1000 mg/L to 2500 mg/L, effluent COD can be reduced to less than 250 mg/L, BOD_5 and SS less than 100 mg/L. These levels comform to discharge permission standard of pharmaceutical wastewater. The variation behavior of dehydrogenase during the process of aeration is also discussed in this paper.

Key words: SBR process, wastewater treatment, traditional Chinese medicine wastewater.

Dioxins in Stack Ash from PCBs Incinerator. Ke Jiang et al. (Research Center for Eco-environmental Sciences, CAS, Beijing 100085): *Chin. J. Environ. Sci.*, **17**(1), 1996, pp. 68—71

The PCDD/Fs in stack ash from a experimental incinerator for destruction of PCBs waste have been determined by ^{13}C isotope HRGC/HRMS method. Seventeen 2, 3, 7, 8-substituted toxic dioxins congeners were quantitatively measured. The TEQ value of the stack ash is 47.2 ng/g.

Key words: stack ash, PCBs, dioxins.

Releasing of PAHs from Coal-ash in Seawater. Fu Yunna and Liu Yiwen (Inst. of Mar. Environ. Prot., SOA, Dalian 116023): *Chin. J. Environ. Sci.*, **17**(1), 1996, pp. 72—74

Releasing of PAHs from coal-ash in seawater was determinated by fluorescence spectrophotometer. The amounts of PAHs from coal-ash soaked before and after in seawater were also analysed by reversed high performance liquid chromatography with UV or fluorescence detectors. The results show that the static state releasing and adsorption of PAHs from coal-ash in seawater are reversible, releasing of PAHs is pool, and PAHs in the fine coal-ash dumped into sea from heat and power plant have little effect to the marine environment.

Key words: coal-ash, PAHs, releasing, seawater.

Spectrophotometric Determination of Anionic Surfactants in Water with Bromocresol Green and Cetylpyridinium Bromide. Wang Yongsheng et al. (Hengyang Medical College, Hengyang 421001): *Chin. J. Environ. Sci.*, **17**(1), 1996, pp. 75—77

In this paper a spectrophotometric method has been developed for the determination of anionic surfactants in water with bromocresol green (BCG) and cetylpyridinium bromide (CPB). Sodium dodecylbenzenesulfonate (SDBS) and sodium dodecylsulfate (SDS) were determined at 614 nm and pH range of 5.5—9.0. In the concentration range of 0—80 μg/10 ml for SDBS and 0—75 μg/10 ml for SDS, both of them obey Beer's law in the presence of 86 μg CPB. The apparent molar absorptivities are 2.9×10^4 $L\cdot mol^{-1}\cdot cm^{-1}$ for SDBS and 3.1×10^4 $L\cdot mol^{-1}\cdot cm^{-1}$ for SDS. The proposed method has been applied to the determination of anionic surfactants in river water and wastewater. The average recovery of environmental water samples was 99.3% and the relative standard deviation was less than 3.0%.

Key words: anionic surfactants, bromocresol green, cetylpyridinium bromide, spectrophotometry.

Photometric Determinations of Nickel and Copper in Wastewater by Reversed Flow Injection Ana-lysis. Wang Peng et al. (Department of Applied Chemistry, Harbin Institute of Technology, 150006): *Chin. J. Environ. Sci.*, **17**(1), 1996, pp. 78—79

The new wastewater monitoring system by use of reversed flow injection spectrophotometry has been developed with injection of different reagents to produce similar color compounds by chemical reactions. The system has been used to simultaneous determination of nickel and copper in wastewater. The detection freqency of the method is 60 sampels h^{-1}, the minimum detection limits are 0.03 μg Ni ml^{-1} and 0.04 μg Cu ml^{-1} respectively.

Key words: environmetnal monitoring, flow injection analysis, nickel, copper.

Acidification Models and Their Application to the Determination of Critical Load for Acid Deposition. Xie Shaodong et al. (Dept. of Environ. Eng., Tsinghua Univ., Beijing 100084): *Chin. J. Environ. Sci.*, **17**(1), 1996, pp. 80—84

This paper briefly discusses different models developed abroad in the study of precipitation effects to predict the long-term effects of acid deposition on soil, surface water, ground water and lakes in the past ten years. The basic methods to establish these models and the principles to apply them to the determination of critical load for acid deposition are presented based on through comparisions and analyses.

Key words: acidification model, critical load, acid depostion, acid rain.

(下转第92页)