

# 糖矿浆尿素复合秸秆处理剂的应用研究\*

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**摘要** 用处理造纸废液资源化产品——糖矿浆与尿素混合处理秸秆, 可提高秸秆作为家畜饲料的利用率。本实验用绵羊瘤胃内 48 h 干物质消失率(DMdp)作为对家畜可利用程度的指标。用河北涿州市造纸厂的糖矿浆处理的稻草干物质消失率提高了 40%, 中性洗涤纤维含量降低了 22.6%。稻草和玉米杆经糖矿浆尿素混合处理后饲喂绵羊日增重较氨化秸秆分别提高了 22.8% 和 9.25%。

**关键词** 造纸废液, 糖矿浆, 秸秆处理。

我国目前多用氨(尿素、碳酸氢铵或液氨)处理秸秆作粗饲料。由于氨为弱碱, 秸秆的干物质消失率仅提高 10%—12%, 许多营养成分仍未能利用。而为数众多的中小型碱法草浆蒸煮制浆废液大多数未经处理直接排入江河, 造成严重的环境污染。将废液中的木质素和部分碱回收后, 滤液中仍含有许多营养物质, 诸如, 粗蛋白、氨基酸、微量元素、糖类<sup>[1]</sup>等。符合 GB 13078-91 国家饲料卫生标准, 所含的碱度又可使秸秆软化。笔者等将这种滤液称为糖矿浆, 首次将之与尿素合用处理秸秆, 饲喂绵羊。

## 1 实验材料与方法

### 1.1 实验材料

糖矿浆: 河北涿州市造纸厂麦草为原料碱法蒸煮制浆黑液, 采用二氧化硫酸化分离木质素后的滤液, 加入  $\text{Ca}(\text{OH})_2$ , 分离沉淀后的滤液称为糖矿浆<sup>[2]</sup>。

糖矿浆成分分析见表 1。

秸秆: 选用当年产的北京郊区稻草和玉米秸。

糖矿浆尿素复合处理秸秆: 将秸秆铡碎, 长度为 1—2 cm。秸秆: 糖矿浆: 尿素的比例为 100:30:3, 充分混合后, 压实, 用塑料薄膜密封。混合后的秸秆湿度不少于 30%, 若过于干燥, 可加适量水。当气温 25℃ 左右时密封 7 d, 8—12℃ 时密封 10—14 d。对照秸秆: 尿素为 100:5。2 种方法秸秆的处理温度、时间条件相

表 1 糖矿浆成分

成分 <sup>1)</sup>	含量(%)	成分 <sup>2)</sup>	含量(%)
Mo	$2.14 \times 10^{-4}$	天门冬氨酸	$32.36 \times 10^{-3}$
Zn	$4.92 \times 10^{-3}$	谷氨酸	$11.75 \times 10^{-2}$
Cd	$0.96 \times 10^{-5}$	脯氨酸	$55.22 \times 10^{-3}$
B	$1.032 \times 10^{-3}$	甘氨酸	$25.09 \times 10^{-3}$
Mn	$3.34 \times 10^{-2}$	丙氨酸	$42.70 \times 10^{-3}$
Fe	$8.30 \times 10^{-2}$	缬氨酸	$45.08 \times 10^{-3}$
Mg	$7.06 \times 10^{-3}$	蛋氨酸	$38.04 \times 10^{-3}$
Cu	$0.576 \times 10^{-3}$	亮氨酸	$19.03 \times 10^{-3}$
As	痕 量	异亮氨酸	$41.25 \times 10^{-3}$
Pb	痕 量	酪氨酸	$8.88 \times 10^{-3}$
S	1.32	苯丙氨酸	$19.06 \times 10^{-3}$
Na <sup>3)</sup>	2	赖氨酸	$17.73 \times 10^{-3}$
Ca <sup>3)</sup>	0.3	组氨酸	$6.26 \times 10^{-3}$
		粗蛋白	1.92
		P	0.054

1) 各成分含量由北京理化分析测试中心提供

2) 各成分含量由国家饲料质量监督检验中心提供

3) 各成分含量由中国科学院环境评价部采用电化学分析仪 ASD-1 测定

同<sup>[2]</sup>。

### 1.2 秸秆样品的分析

参照 GB 13078-91 的检测方法, 秸秆样品在 60℃ 烘干, 测定干物质(DM)和中性洗涤纤维(NDF)的含量。用尼龙袋法将秸秆放置在绵羊瘤胃内, 48 h 后测定并计算干物质消失率(DMdp)。

### 1.3 饲喂实验

(1) 糖矿浆稻草秸秆喂养绵羊实验 绵羊

\* 国家“八五”科技攻关项目

收稿日期: 1995-06-14

系河北省平泉县细毛羊当年羊羔, 体重 18.3—31.5 kg。按常规方法去势、驱虫、剪毛编号, 预试期 10 d 后随机分组, 每组 10 只, 各组均自由采食, 记录每 d 采食量, 混合精料每只每 d 350 g, 实验开始和结束时分别于清晨空腹称重。实验由 1991-07-01 到 1994-07-15, 在中国农业科学院畜牧所进行。

(2) 糖矿浆玉米秸秆喂羊实验 实验方法及羊种同糖矿浆稻草秸秆, 每组 6 只, 实验由 1994-11-21 到 1994-12-20, 在北京农业工程大学非常规饲料研究所进行。

## 2 实验结果

(1) 糖矿浆处理可提高稻草的 DMdp 和降低 NDF 含量, 结果见表 2。

表 2 糖矿浆处理对稻草 DMdp 和 NDF 的影响 (%)<sup>1)</sup>

饲料品种	普通饲料	氨化处理	糖矿浆处理
DMdp	45.13±2.2	50.5	65.13±1.85
提高率		11.9	44.3
NDF	66.2		51.13
降低率			22.8

1) 表中数据系 3 次平均数,  $P < 0.01$

由表 2 看出, 糖矿浆处理的稻草 48 h DMdp 明显高于未经处理, 比氨化处理的稻草还提高了 29%, NDF 明显低于未经处理的稻草, 说明糖矿浆处理可明显提高秸秆的家畜可利用程度。

(2) 糖矿浆处理秸秆饲料对绵羊日增重的影响 结果见表 3。

从表 3 看出绵羊对糖矿浆稻草的日采食量

表 3 糖矿浆处理秸秆对绵羊日增重的影响<sup>1)</sup>

秸秆品种	始重 (kg)	终重 (kg)	平均日增重 (kg)	日增重提高率 (%)	日食秸秆量 (g)	日食量提高率 (g)	总摄入量占 体重比(%)
氨化稻草	22.12±3.68	23.70±4.53	112.5		458.4		3.41
糖矿浆稻草	21.73±2.95	23.67±3.15	138.2	22.8	469.5	2.4	3.46
氨化玉米杆	28.21±3.59	31.09±3.47	96.2		372.5		2.3
糖矿玉米杆	30.12±4.84	33.27±4.92	105.1	9.25	387.9	4.1	2.2

1) 绵羊不喜食玉米杆芯, 造成摄入量偏低, 日增重低于稻草饲料

比氨化稻草仅高 11.1 g, 而日增重却提高了 22.8%。说明糖矿浆秸秆的营养价值高于氨化秸秆饲料。

## 3 结论

(1) 糖矿浆含有一定的营养成分, 如粗蛋白、氨基酸、微量元素、糖类等, 符合 GB13078-91 国家饲料卫生标准, 可作为家畜的饲料。

(2) 糖矿浆与尿素合用处理的稻草比不经处理的和氨化处理的稻草, 48 h DMdp 分别提高了 44% 和 29%, NDF 比不经处理的稻草降低了 22.8%。与后两者比均提高了稻草作为家畜

饲料的利用率。

(3) 糖矿浆处理稻草和玉米秸秆饲喂绵羊日增重率比氨化秸秆分别提高了 22.8% 和 9.25%。

(4) 糖矿浆是造纸黑液资源化处理的产品, 用之处理秸秆, 对于秸秆高值利用和环境保护都不失为一条新的途径。

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Science, Jilin University, Changchun 130023); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 40—42

On the basis of some classical value theories, a theory on the functional values of natural resources was discussed in this paper, by building its elementary accounting model, studying the water resource in detail and giving an example. A new point of view was provided for the study on value theories of natural resources, together with a new method for pricing in the course of accounting.

**Key words:** natural resources functional value, integrated economical loss due to pollution.

**Development of a Planning and Management Model for Pollutants Discharge into a Tidal River.** Huang Ping and Zhou Jingfeng (Dept. of Environ. Sci., Zhongshan University, Guangzhou 510275); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 43—46

Based on a differential river water quality model, a planning and management model for pollutants discharge into a tidal river has been derived, which described the relationship between a permissible discharge from each of all outfalls along the river reach,  $P_i$ , and its permissible discharge when they were discharging separately,  $Y_i$ , as a sum of  $P_i/Y_i=1$ . Examples were used to present the application and validation of the model. It was concluded that the model was simple in structure, easy to calculate, and convenient to be used in planning, management and real time control for pollutants discharge into a tidal river.

**Key words:** outfall, permissible discharge, water quality management.

**Coordination Planning of Economy and Environment: Comprehensive Planning of Benxi Shiqiaozi Development Zone.** Ru Jiang et al. (Center for Environmental Sciences Peking University, Beijing 100871); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 47—49

To achieve sustainable development, it is essential to address environmental and economic construction in the planning stages. But it is recognized that how to evaluate the coordination of plans becomes the key problem for planning. Using environmental supporting capacity (ESC), this presentation assesses three plans of Benxi Shiqiaozi development zone and chose one plan, which is sounds more practicable and reasonable on the

comprehensive analysis of economic output and the consequent environmental impacts, including the demands for resources and the relevant discharges of pollutants from the economic development.

**Key words:** coordination development, environmental supporting capacity (ESC), development zone, sustainable development.

**Cooperation of Mixed Carriers in a Three Phase Airlift-Loop Reactor.** Cai Jian'an et al. (Dept. of Chem. Eng., East China Institute of Metallurgy, Maanshan, Anhui 243002); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 50—52

Mixed carriers consisting of fine sand grains and coarse coke grains were found to have a good cooperation in a three phase airlift-loop reactor with a side settling zone for wastewater treatment. The treatment of coking industrial wastewater in this reactor indicated that, as compared to a single carrier, the mixed carriers were not easy to lose with effluent and gave a higher COD removal rate [ $11 \text{ kg}/(\text{d} \cdot \text{m}^3)$ ], a better effluent quality (e. g., phenol or cyanide had a concentration of  $1/3 - 1/5$  times that in the case of a single carrier), the biomass easy to grow up on the surface of the carriers, and lower energy consumption.

**Key words:** carrier, airlift, three phase flow, wastewater treatment.

**Study on a Straw Feed Treated with Mineral Saccharide.** Fan Xiuying and Sun Lianchao et al. (EIA Unit, Chinese Academy of Sciences, Beijing 100085); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 53—54

A new straw feed has been developed by using a mineral saccharide, a filtrate left from straw pulping black liquor after recovering lignin and chemicals from it, to treat crop stalks mixed with urea, resulting in an increased utility of crop stalks as domestic animal feed. The mineral saccharide was found to be rich in amino acids, raw proteins, essential elements and saccharides, to comply with the national standards (GB 13078-91) for feed hygiene, and to enable providing a source of nutrients for domestic animal and erecting straw due to its residual alkalinity. The 48 hours dry matter disappearance (DMdp) in the rumen of sheep was used as an indicator of straw availability for animal. Rice straw had a DMdp increased by 40% and a NDF (Neutral Detergent Fiber) reduced by 22.6%, when the straw was

erected with the mineral saccharide from the Zhuozhou Paper Mill in Hebi Province. By feeding the rice and maize straw treated with the mineral saccharide, sheep had a daily weight increase by 22.8% and 9.25%, respectively, as compared to those treated with ammonia.

**Key words:** pulping black liquor, straw feed, waste recycle.

**Determination of Dioxin-like PCB in Both Commercially Available PCBs in China and Stack Ash from PCB Incinerator.** Li Lingjun and Jiang Ke (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 55–58

Considering the fact that the toxicity of PCBs congeners is related to the substituted positions of chlorine atoms, the evaluation of PCBs environmental toxicity depends on the analysis of dioxin-like PCBs. Multi-layer silica column and basic alumina column clean-ups were applied to the pretreatment of samples. The composition and content of dioxin-like PCB congeners in two commercially available PCB in China were determined by GC/MS, and were compared with those from other countries. The determination results of dioxin-like PCB in the stack ash sample from PCBs incinerator showed that the content and toxicity of dioxin-like PCB in stack ash were diminished by 20000 and 50000 times, respectively.

**Key words:** dioxin-like PCB, incineration, GC/MS.

**Study on the Interference Patterns in the 4-Amino Antipyrine Photometric Determination of Volatile Phenols in Wastewater.** Yuan Cunguang et al. (Dept. of Chemical Engineering, University of Petroleum, Dongying 257062), Peng Li (Dept. of Environmental Protection, China Petroleum and Natural Gas Corp., Beijing 100724); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 59–62

The interference patterns with different mineral oils (crude oil, machine oil and diesel oil), aniline, some metal ions and  $\text{ClO}^-$ , etc. in the 4-AAP photometric determination of volatile phenols were studied. The recovery of phenols in the presence of different amounts of interference substances was determined separately. Then, the total recovery equation  $Y$  was established. The true

concentration  $C_T$  of volatile phenols in wastewater was determined with the value  $C_D$  found by 4-AAP method and the equation  $Y$ . The result from standard addition experiment with mixed interference substances shows that its relative error to the calculated value by the equation  $Y$  is below 5%. The determined result of wastewater sample is coincident with the results determined by the derivative photometric method. This method can be used for the determination of volatile phenols in oil-field wastewater.

**Key words:** volatile phenols, interference patterns, 4-amino antipyrine, photometry.

**Accumulation of Asphalt Fractions from Total Suspended Particulate Matters in Various Plant Species.** He Kebin (Dept. of Environ. Eng., Tsinghua University, Beijing 100084); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 63–65

With reference to ASTM D4124, asphalt fractions, including polar aromatics, naphthene aromatics and saturates, were characterized both in various plant samples and in total suspended particulate sample. In comparison to the results of background plant samples and asphalt cement sample from highway surface, it is concluded that asphalt makes the main contributions to the accumulation of the three organic fractions mentioned above in plant species. For the plant samples used in this research, the concentrations of the three fractions are 0.29–3.07 mg polar aromatics, 0.89–3.89 mg naphthene aromatics and 0.37–1.53 mg saturates per gram dry plant materials.

**Key words:** total suspended particulate, asphalt fraction, plant, accumulation.

**Study on the Distribution Accumulation and Critical Level of Lead in Soil and Rice Along Road Sides.** Cao Lixin et al. (Environmental Monitoring Centre, Ministry of Communications, Beijing 100036); *Chin. J. Environ. Sci.*, **16**(6), 1995, pp. 66–68

The soil and rice samples were collected simultaneously at the sites of 5, 10, 50, 100 and 200 meters away from road, respectively. The analysis results of samples collected along two roads demonstrated that the pollution of lead from automobile exhaust gas was within a range of about 50 m along the roads. The soil characteristics had a significant effect on the distribution and accumulation of lead in soil and rice. The accumulation amount of lead in light loam was less than