石棉尾矿水热合成建筑材料的研究*

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摘要 对利用石棉尾矿水热合成建筑材料进行了研究. 结果表明: 石棉尾矿预处理的最佳温度为 950℃, 石棉尾矿 90%、MA 和 NB 各 5% 时材料的性能较好.

关键词 石棉尾矿, 建筑材料, 水热合成.

由于石棉矿石开采品位一般仅为 1%–4%[1], 因此尾矿排弃量很大. 据统计, 全国石棉矿山平均每年排弃尾矿近千万 t. 由于无合理大宗利用途径, 年复一年, 各矿山已堆积如山. 通过分析测试石棉尾矿的矿物组成和结构, 利用石棉尾矿生产蒸压建筑材料, 在国内还未见报道. 本研究表明, 采用适当的工艺措施, 可以水热合成抗压强度达 25MPa 以上的建筑材料, 其性能达到一般蒸压建筑材料标准. 并且该材料耐高温性能很好, 制品加热到 800℃, 保温 2h, 强度不但不降低, 反而增加 10% 左右.

1 材料和方法

1.1 石棉尾矿

石棉尾矿取自四川彭县石棉矿, 经 XRD 鉴定分析(图 1) 主要矿物为叶蛇纹石, 少量滑石、白云石和方解石. 化学组成见表 1.

表 1 石棉尾矿的化学成分(Wt)/%

LOSS	SiO_2	MgO	Al_2O_3	Fe_2O_3	Cr_2O_3	CaO	NiO
13.19	39.20	40.09	1.32	7.44	1.00	0.52	0.00

1. 实验方法

将石棉尾矿破碎成 10mm 左右的碎粒, 装在耐火钵中, 在 700℃– 1050℃的温度下煅烧一定时间冷却后, 粉磨 0.08mm 方孔筛筛余小于 10%, 然后按设定的配方配料、成型、脱模后在 174.5℃和 8×10^5Pa 的饱和水蒸气下水热合成 8h, 冷却后测其物理力学性能.

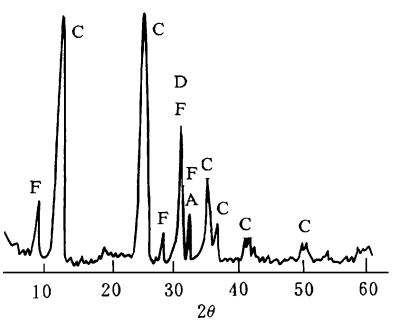

图 1 石棉尾矿的 XRD 图

A. Mg_2SiO_4 C. $3MgO\cdot2SiO_2\cdot2H_2O$

D. $CaCO_3\cdot MgCO_3$ F. $Mg_3[(OH)_2/SiO_4O_{10}]$

实验结果及分析

实验结果见表 2、表 3 和表 4.

表 石棉尾矿煅烧温度与抗压强度的关系

编号	温度/℃	抗压强度/MPa
1	25	0.00
2	700	6.94
3	850	19.86
4	950	23.65
5	1050	17.63

从表 2 可知, 以试件抗压强度作为考核指

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标, 石棉尾矿的煅烧温度以 950℃最佳. 从表 3 可知, 在相同的工艺条件下, 配方不同, 配合比

表 **3**　材料组成与制品抗压强度的关系

编号	石棉尾矿(Wt)/%	外加剂(Wt)/%			抗压强度
		MA	NB	LS	/MPa
1	95	5	0	0	10.89
2	90	10	0	0	11.31
3	95	0	5	0	13.91
4	90	0	10	0	13.91
5	95	0	0	5	12.42
6	92	0	0	8	13.27
7	90	0	0	10	15.52
8	90	5	5	0	19.96
9	100	0	0	0	10.79

表 **4**　较佳工艺技术参数下石棉尾矿水热合成制品性能[1)]

编号	吸水率/%	容重/g·cm^3	抗冻性	抗压强度/MPa	抗压强度[1)]/MPa
1	18.5	1.76	好	28.5	31.4
2	15.2	1.90	好	29.6	33.2
3	22.8	1.62	好	27.8	30.6
平均	18.8	1.76		28.6	31.7

[1)]样品在 800℃煅烧 2h

不同, 所得制品的强度也不相同, 其中以 8 号样品最高. 由表 4 可见, 利用石棉尾矿水热合成建筑材料制品性能优异, 尤其是它的耐高温性能好, 在 800℃的温度下煅烧 2h, 其强度平均值反而从 28.6MPa 提高到 31.7MPa. 但在同样条件下, 水泥砼的强度却会降低 30%以上[2]. 石棉尾矿经煅烧后再水热合成建筑材料具有优异的性能, 主要是由于石棉尾矿经高温煅烧后形成橄榄石和顽辉石, 而经水热合成处理后, 顽辉石和部分镁橄榄石又转变成了蛇纹石(图 2).

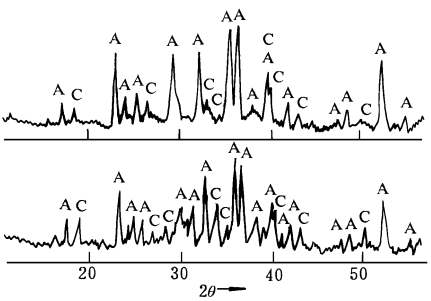

图 2　水热合成蛇纹石制品的 XRD 图

A. Mg_2SiO_4　C. $3MgO \cdot 2SiO_2 \cdot 2H_2O$

D. $CaCO_3 \cdot MgCO_3$　F. $Mg_3[(OH)_2/SiO_4O_{10}]$

3　小结

(1) 利用石棉尾矿可水热合成性能优异的建筑材料. 该种建筑材料可作墙体材料、保温隔热材料和装饰材料等.

(2) 利用石棉尾矿生产建筑材料, 用量大, 可为工业副产物的大宗利用开僻一条广阔的途径, 具有显著的环境效益、社会效益和经济效益.

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the lake; studies on the succession of phytoplankton; assessment of the fishery potential on the basis of phytoplanktonic primary productivity; determination of the standing crop and production of zooplankton; studies on the function of organic detritus in the system and the top-down effects of fish on the system, etc.

Key words: Lake Donghu, ecology, structure and functioning, top-down effects.

Thermal Environment of Urban Area and The Improvement of Its Micro-thermal Environment. Liu Xiaotu and Chen Enshui (Dept. of Architecture, Southeast University, Nanjing 210096), Shao Tieru (The Association for Science and Technology of Zhenjiang City 212001): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 54-58

On the basis of the change of thermal environmental factors in several cities and counties of southern part in Jiangsu province, this article analyzed firstly the changing trend of thermal environmental factors that caused by the urbanization, then introduced the effects for improving micro-thermal environment of habitation by using the measures including the planning of road network in urban area, the control of density of the buildings, the greenery and the waters in the urban area.

Key words: development of the cities, thermal environment, heat island effect, improvement of micro-thermal environment.

The Photolysis Character of Methyl Bromide and Tribromomethane in the Presence of Hydrogen Peroxide. Zhong Jinxian, Zhang Deqiang (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085), Chen Dazhou (Chinese Center for Certified Reference Materials, Beijing, 100013): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 59-61

Under simulated atmospheric condition, photolysis for $CH_3Br + H_2O_2$ and $CHBr_3 + H_2O_2$ systems were studied. H_2O_2 was irradiated by 253.7nm UV and produced OH radicals. The OH radicals can initiate photooxidation of $CHBr_3$ and CH_3Br. The products of photooxidation were determined by a fourier transform infrared spectroscopy with 20m long path cell. The products were CO, CO_2, CH_2O and H_2O for $CH_3Br + H_2O_2$ system, CO_2, CO, H_2O and $COBr_2$ for $CHBr_3 + H_2O_2$ system, based on those results the mechanisms of photooxidation were suggested.

Key words: photolysis, OH radicals, brominated methanes.

The Effect of Parents Smoking on the Urinary Concentration of 1-Hydroxypyrene of Children. Zhao Zhenhua (Beijing Municipal Research Academy of Environmental Protection, Beijing 100037), Tong Jingyi (Shanxi Provincial Children's Hospital, Taiyuan 030013): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 62-64

Using the urinary 1-hydroxypyrene as a biological index, the effect of parents smoking on the content of 1-hydroxypyrene in the pupil's urine was investigated. The 1-hydroxypyrene level in 234 urine specimens of pupils from 4 urban districts was determined, and the ambient air in these districts was synchronously sampled and analyzed for the content of benzo(a)pyrene (BaP). It was found that the content of urinary 1-hydroxypyrene of the pupils is significantly correlated with the ambient concentration of benzo(a)pyrene in the corresponding region where the school is located. For the groups of pupils whose parents smoke the urinary level of 1-hydroxypyrene are always higher than that of the groups with non-smoking parents, but the t-tests indicate that the difference is not statistically significant due to small populations.

Key words: smoking, urinary 1-hydroxypyrene, benzo(a)pyrene.

Primary Study on Sulfur Capture in Coal Briquet Combustion by Fe_2O_3 Promoting. Zhang Liangquan, Chen Siwei et al. (China Chemical Industry Economic and Technical Development Centre, Beijing 100723): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 65-67

According to the ignition point of sulphur in coal, the sulphur capture reaction process was divided into two stages in this paper. It was found that sulphur capture in coal ash mainly happened in stage of below 500℃. Relationship between time of raising temperature and fraction of sulphur capture was obtained that time of raising temperature must be below 30 min. It was found that the more Fe_2O_3 was used, the more $CaSO_3$ changed into $CaSO_4$. The actual process of sulphur captured in coal ash was simulated through the reaction $CaO + SO_2 + 0.5O_2 \rightarrow CaSO_4$. At last some special experiments were designed and proved that Fe_2O_3 mainly promoted the reaction $CaO + SO_2 \rightarrow CaSO_3$.

Key words: coal briquet, sulphur capture, Fe_2O_3.

Study on the Synthetizing Building Materials by Steam Curing Asbestos Tailings. Lu Zhongyuan, Wang Haibin et al. (Southwest Institute of Technolgy, Mianyang 621002): *Chin. J. Environ. Sci.*, **18**(1), 1997, pp. 68-69

A Study on synthetizing the building materials by steam curing from asbestos tailing have been done in the present thesis. The effects of calcined temperature of the raw materials, the additions on the properties of products have been studied in this paper. The results showed that function of the material are the best when optimum temperature of pretreating the asbestos tailing is 950℃ and component in the material is 90% for the asbestos tailing and component in the material is all 5% for MA and NB.

Key words: asbestos tailings, building materials, steam curing.