

Preparation of Energy Saving Blocks by Use of Lake Sludge

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Abstract Energy saving blocks manufactured from lake sludge were investigated. Different contents of lake sludge (60% ~ 100% by weight) were mixed with fly ash and additive. The blending strength, compressive strength of the fired samples were examined and compared with the Chinese National Standards (CNS). Results show that additive can result in the improvement of strength and blocks thermal conductivity is low. At the same time, fly ash and additive may also broaden the firing temperature range and reduce firing temperature. Toxic characteristic leaching procedure (TCLP) tests of blocks also show that the metal leaching level is low. The conditions for manufacturing good quality blocks are 80% sludge with 10% additive and 10% fly ash fired at 1000℃ for 60 min.

Key words lake sludge; energy saving blocks; strength; microstructure

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Eighty percent of all kinds of houses in China are built by the solid red blocks from clay soil which brings out many disadvantages^[1-3]. So, the National Economy and Commerce Commission prohibited the usage of solid soil blocks from sales part of wall material innovation and decided that solid soil blocks was prohibited using in the 170 large and medium cities before 6 \30 \2003. It is imperative to develop new succedaneums for conventional solid soil blocks^[4-5]. A feasible way for using Lake sludge as a clay substitute to produce good quality blocks was explored in this study.

1 Experiments

1.1 Materials

Sludge was obtained from the bottom of the North Lake in Wuhan. Fly ash came from boiler the Aluminum Corporation of Shandong. Additive was purchased from the market. Sludge was further oven-dried at 105℃. At last, they were ground and sieved to a granular size < 2.0mm.

1.2 Methods

The samples thus prepared were subjected over 2min at 80 kg/m² pressure to prepare working blocks by half dry pressure molding process. Firing temperatures were set at 960 ~ 1140℃. The oven temperature was increased at 5℃ /min. Holding time was 0.5 h respectively at 100℃, 200℃, 300℃, 400℃, 500℃, 700℃, 800℃, 900℃. While holding time was 1 h at 1000℃ and maximum firing temperature. The recipes

of samples are presented in Table 1.

Tab 1 The recipe of samples (%)			
Recipe number	North lake sludge	Additive	Fly ash
1	100	—	—
2	80	—	20
3	70	—	30
4	70	10	20
5	70	15	15
6	80	10	10
7	60	10	30
8	60	20	20

2 Results and discussion

2.1 Influencing factors of strength

Fig 1 shows bending strength and compressive strength as a function of recipe number. As far as the recipe one, two and three are concerned, bending strength and compressive strength reduce with increase of fly ash, which is due to vitreous phase and mullite crystalline phase that lead to the bad plasticity of green body. And in the recipe four, five and six, bending strength and compressive strength increase with addition of additive. The reasons are that additive is an elasticizer owing to its needle and chip crystals and their staggered arrangement, and β -CaSO₄ crystals that can heighten strength of green body are formed at a low fir-

ing temperature. The causes of strength change in the recipe six, seven and eight are the same as the above. According the sludge content, the plasticity and strength, the recipe six is optimal.

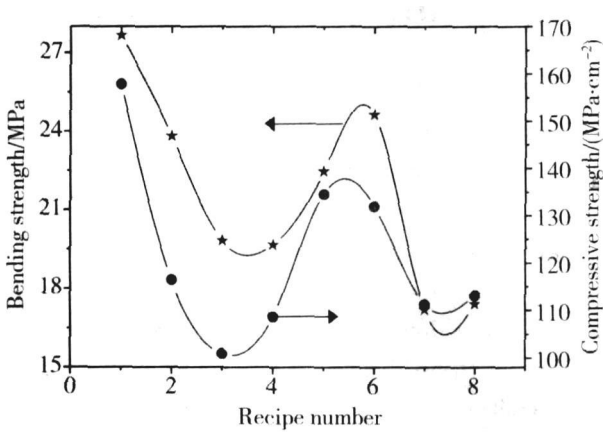


Fig 1 Bending strength and compressive strength of different recipe in the firing temperature (1000℃)

2.2 Property of insulation on samples produced
There are many symmetrical crystals in the samples which are connected with vitreous phase and pores. It is advantageous to strength enhancement of samples. These pores are connective by themselves, which is of value in the function increase of insulation work, thermal insulation and sound insulation and in weight reduction of blocks. Coefficient of heat conductivity of samples fired at 1000℃ as recipe six is $1.033477 \times 10^{-2} \text{ W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$. Compared with that of common blocks ($5 \times 10^{-2} \text{ W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$), it is low. So that purpose of building energy-saving is achieved.

2.3 TCLP test of blocks
Pb and Zn are leached from sludge and blocks, but the concentrations are much less than those of the

Chinese EPA regulated TCLP limits. Other leached metals from either dried sludge or blocks are of insignificant concern.

3 Conclusion

- (1) Ceramics energy saving blocks of light weight, low thermal conductivity and high strength were produced with lake sludge whose content reaches 80%. The optimal recipe is the sixth.
- (2) Fly ash may increase porosity of blocks and reduce density and broaden firing temperature. Additive can reduce firing temperature and enhance drying and firing strength.
- (3) Symmetrical crystal phase and rich open pore should be responsible for champion performance of blocks made from lake sludge.

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利用湖泊淤泥制备节能砌块

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摘要：研究了利用武汉北湖污泥制备节能砌块。在不同含量污泥（60%~100%）中加入粉煤灰和添加剂，检验了烧成样品的强度并与相关国家标准比较。结果显示：加入添加剂能提高烧成样品的强度，砌块的导热系数较低，同时粉煤灰和添加剂也可以宽化烧成温度范围和降低烧成温度。烧成样品的毒物浸出试验显示重金属的浸出容量低于国家标准。较佳制备节能砌块的工艺条件为：80%的污泥+10%的添加剂+10%的粉煤灰，在1000℃保温60 min。

关键词：污泥；节能砌块；强度；显微结构

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