



國立臺北科技大學

資源工程研究所

碩士學位論文

穩定化焚化飛灰再利用於混凝土磚之研究  
Reuse of Cement-Stabilized Municipal Incinerator  
Fly Ash in Concrete Block



研究生：簡呈至

指導教授：柯明賢

中華民國 102 年 1 月

# 摘要

論文名稱：穩定化焚化飛灰再利用於混凝土磚之研究

頁數：104

校所別：國立台北科技大學 資源工程研究所

畢業時間：一百零一學年度第一學期

學位：碩士

研究生：簡呈至

指導教授：柯明賢

關鍵詞：焚化飛灰穩定化物、混凝土磚、抗壓強度、田口式實驗設計法、溶出試驗

本研究將經水泥固化之焚化飛灰作為製作混凝土磚之骨材原料，期望達成焚化飛灰再利用之目的。焚化飛灰穩定化物之組成以鈣、矽為主。焚化飛灰穩定化物經烘乾、破碎前處理後，依田口式實驗設計法進行參數設計，以實驗型成型機台製作混凝土磚試體，脫模後經 28 天室溫養護後進行抗壓強度試驗，探討不同參數對混凝土磚抗壓強度之影響，並以 28 天養護抗壓強度最高的試體進行其重金屬長期溶出特性分析。

研究結果顯示混凝土磚 28 天最高抗壓強度可達  $440.7 \text{ kgf/cm}^2$ ，已達 CNS 3930-預鑄混凝土緣石之抗壓強度標準( $250 \text{ kgf/cm}^2$ )，而由田口式實驗設計分析、反應曲面分析及變異數分析結果顯示水膠比對於 28 天抗壓強度之影響最大，玻璃骨材粗細比則是影響最小的控制因子。另外，由向上流動滲濾試驗法 (NIEA R219.10C) 及以擴散試驗測定成塊廢棄物材料中無機溶出成分 (NIEA R217.10C) 溶出試驗結果均可以發現混凝土磚試體中 Pb、Zn、Cr、Cd 及 Cu 的溶出量低於荷蘭 BMD 之標準，混凝土磚中焚化飛灰所含之重金屬具有長期穩定性，而由焚化飛灰穩定化物部分取代細骨材產製之混凝土磚具有良好的環境相容性。由酸可萃取物成分試驗得知，重金屬溶出量隨抗壓強度增加而減低。

# ABSTRACT

Title : Reuse of cement-stabilized municipal incinerator fly ash in concrete block

Pages: 104

School: National Taipei University of Technology

Department: Institute of Mineral Resources Engineering

Time: January, 2013

Degree: Master

Researcher: Cheng-Chih Chien

Advisor: Ming-Sheng Ko

Keywords: cement-stabilized municipal incinerator fly ash, concrete block, compressive strength, Taguchi methods, leaching test

In this study, the cement-stabilized incinerator fly ash(abbreviated as CSIFA) is used to replace fine aggregates for manufacturing concrete blocks, and it applied Taguchi methods for finding the optimum operating parameters such as particle size of CSIFA and glass aggregate, amount of blast furnace slag. The main chemical compositions of cement-stabilized incinerator fly ash are Ca and Si. The experimental molding machine was used to produce concrete block specimens and the compressive strength test of concrete block is performed after 28 days of curing at room temperature. The leaching test of heavy metals in specimens which had maximum compressive strength was investigated.

The results showed that the maximum compressive strength of concrete blocks has reached up to 440.7 kgf/cm<sup>2</sup>, it complied with CNS 3930 standard (250 kgf/cm<sup>2</sup>). Through Taguchi methods, response surface methodology and ANOVA, it showed that the ratio of water to binder was the significant operating parameter to affect the

compressive strength of concrete block, whereas the particle size of glass aggregate was insignificant operating parameter. In addition, the results of column leaching test and tank leaching test showed that the leaching amounts of Pb, Zn, Cr, Cd and Cu from concrete block specimens is lower than the Netherland BMD standards. It indicated that heavy metals contained in concrete blocks have long-term stability, the concrete blocks produced by CSIFA aggregate would be environmentally friendly products. Based on the result of JIS K0058-2 leaching test, it showed that the higher compressive strength of concrete block was, the lower leaching concentration of heavy metals was.

