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By Fax & Post
(25705917)

13th January 2005

Hon Choy So-yuk
Chairperson
Panel on Environmental Affairs, LegCo
6/F, China Harbour Building
370 King's Road
North Point, Hong Kong

Dear Hon CHOY,

Co-Combustion Pilot Plant Project

You might be aware of the co-combustion pilot plant project, which is jointly undertaken by the Hong Kong University of Science and Technology and our company. I would like to give you the update about the project.

On 25 November 2003, we were granted the specified process license by the Environmental Protection Department (EPD) to allow the operation of the pilot plant within the premises of Green Island Cement at Tap Shek Kok, Tuen Mun. On 26 April 2004, we got the building permit from the Buildings Department (BD). Following this, the construction and installation of the pilot plant was started on 23 June 2004. The works have now been finished, and it is scheduled that the commissioning tests of the pilot plant will be conducted in mid-Janaury this year lasting for about three days. Then, the acutal operation of the pilot plant will commence in about a month later. In compliance with the licensing conditons, the pilot plant will only operate for a cumulative duration of 16 weeks maximum, and it will not treat more than 40 metric tonnes of of municipal solid waste per day (i.e. equvialent to about 4 typical refuse collection vehicles).

Both commissioing tests and the actual operation of the pilot plant will be accompanied by a series of monitoring measures. The Hong Kong Prodcutivity Council (HKPC) will be the independent assessor to comudct both in-stack exhaust gas monitoring as well as offsite ambient air monitoring. Two offsite monitoring stations have been set up in Butterlfy Estate and Lung Kwu Tan Village at Tuen Mun. Monitoring includes particulates; nitrogen dioxide; sulphur dioxide; heavy metals; and dioxins. The monitoring results will be made available to the EPD on regulart basis, and it will also be posted on the our website at www.gii.com.hk.

As a backgournd information again, attached please kindly find an introduction about the project for your reference.

Should you have any enquiries about the project, you are welecomed to contact the undersigned at any time at 2440-5305 (Telephone) or viviank@gich.com.hk (Email).

Yours sincerely,

Vivian Kwok
Environmental Project Officer

Encl.

Pilot Plant Project on
"An Integrated Co-Combustion Cement Manufacturing Facility for Waste Minimization and Energy Optimization"

Introduction and Research Objectives

Entitled as "Integrated Co-Combustion Cement Production Facility for Waste Minimization and Energy Optimization", it is a pilot plant study collaboratively undertaken by the Department of Chemical Engineering, Hong Kong University of Science and Technology (HKUST) with Green Island Cement (GIC) Company Limited. The main purpose is to develop a process and equipment design of an integrated waste management facility, accommodating a materials recovery and recycling facility (MRRF) to sort out the useful and valuable recyclable materials from the main stream of Hong Kong's Municipal Solid Waste (MSW), and then the less useful fraction will be thermally treated in a novel Co-Combustion (hereinafter "Co-Co") cement manufacturing facility. Use of cement manufacturing for waste treatment has been widely adopted in Europe, US and Japan, and the development is already mature[1]. But, the similar practice has not happened in Hong Kong before, so that this pilot plant project has been initiated to do the technical feasibility testing and verification on the related technology for treating Hong Kong's MSW.

The main objectives of this project are:

- To investigate and develop a practical method for separation/sorting of recyclables in Hong Kong's waste;
- To provide a precise analysis and assessment on the thermal characteristics of MSW produced in Hong Kong;
- To provide scientific information and technical data on the emissions from the cement production process when incorporating the "Co-Co" process;
- To assess the properties of residual ash for reuse in cement production;
- To determine critical process parameters and operation criteria; and
- To conduct with more precision the environmental impacts of MSW combustion facility in Hong Kong.

[1] Some overseas examples on use of cement kilns for solid waste treatment:

a) **Europe and US**
Holcim Ltd., originated from Switzerland, has cement manufacturing plants in Europe, the US and Canada. The corporate promotes the use of waste materials as alternative fuel to replace fossil fuels consumed in the cement manufacturing. In 2001, the overall Holcim fuel substitution rate, due to input of waste materials, was 12.3%, which is equivalent to replacing 1.3 million tonnes of coal per year. For details, please refer to the company's website at http://www.holcim.com.

b) **Japan**
Taiheiyo Cement, in Japan, developed a system to utilize MSW in the cement manufacturing by converting waste into material resources. In 2001, 15,000 tonnes of MSW were treated. The residues from incineration, such as ash and soot, can be reused for the so-called "Ecocment" manufacturing. For details of its technical and environmental performance, please refer to the company's website at www.taiheiyo-cement.co.jp

Project Details and Progress

The "Co-Co" project was commenced in May 2000. Two years were spent on in-depth desk studies and process design improvement. Until mid-2002, the preliminary process design was finished, and the project entered the phase of pilot plant study. A demonstration scale pilot plant will be built within GIC in Tap Shek Kok, Tuen Mun, consisting of a material recovery and recycling facility as well as a rotary kiln for thermal treatment of waste.

According to Section 14 of the Air Pollution Control Ordinance, GIC submitted its license application to the Environmental Protection Department (EPD) in October 2002. EPD granted the license in November 2003, allowing the operation of the pilot plant in Tap Shek Kok, Tuen Mun. EPD's website contains the details regarding the license at www.epd.gov.hk/epd/english/news_events/what_new/gic_application.html. In April 2004, Buildings Department (BD) issued the construction permit. Then, construction and installation of the pilot plant started in June 2004. Now, the works have been completed.

Commissioning tests of the pilot plant will be conducted in late January 2005, and the normal operation is estimated to commence in late February 2005. No more than 40 metric tonnes of municipal solid waste will be treated every day, and the pilot plant will operate for a cumulative period of 16 weeks maximum only. When the pilot plant study is concluded, the plant will be demolished and taken away.

During operation of the pilot plant, it will be accompanied by a series of air monitoring measures. Besides in-stack exhaust gas monitoring, there will be establishment of two ambient air monitoring stations at Butterfly Estate and Lung Kwu Tan Village. Monitoring started in early December 2004 for baseline measurement. The monitoring results will be made available to EPD on regular basis, and it will also be posted on the project website at www.gii.com.hk.

Moreover, public consultation is always a critical part of the project. We maintain continuous and active communications with the public, including local residents; green groups; institutional and professional organizations; as well as politicians. Over 20 consultations and briefing activities have been organized since year 2001.

Research Missions

Prevention of Dioxin Formation

Unlike conventional MSW incineration, relying on the end-of-pipe treatment for the removal of dioxin from emissions, "Co-Co" adopts the upstream preventive approach to prevent the formation of dioxin and hence eliminate its emission at end-pipe. An advantage of "Co-Co" is its high combustion efficiency by providing excellent combustion conditions throughout the thermal treatment process. High temperature (up to 1200°C), long gas residence time (at least 4 seconds) and intense turbulence ensure complete combustion and hence complete destruction of organic compounds, which are the main dioxin-forming precursors, into basic combustion gas products.
Another unique feature of "Co-Co" strongly favourable against dioxin formation is the Dry

Scrubbing process inherent in the precalciner of the cement manufacturing system which converts limestone (Calcium Carbonate) into lime (Calcium Oxide) for further processing in the cement kiln. Limestone ($CaCO_3$) constitutes up to 80% of raw materials feed in cement manufacturing, generating massive amount of calcium oxide (CaO), which is 80 times over the conventional MSW incinerators. CaO in the precalciner serves as an absorbing agent to neutralize and remove acidic gases and hydrogen chloride (HCl), which are formed during the thermal treatment process. Acidic gases and HCl are the active precursors and catalysts for dioxin formation, respectively.

Therefore, the dioxin prevention mechanism of "Co-Co" is more cost-effective than any other types of MSW combustion process, because "Co-Co" is a co-generation process integrating with cement manufacturing. By making use of the features of cement manufacturing, this will effectively prevent dioxin formation and hence eliminate any potential reformation at the critical temperature window (500 to 200°C). Tests run conducted in cement kilns have demonstrated 99.9999% destruction for stable organics in waste and the kiln's alkaline environment absorbs 95-99% of HCl formed during combustion of chlorinated waste (Heart, 1999a; Heart, 1999b). As a safeguard, activated carbon will be used to adsorb any trace amounts of dioxin remaining. If any dioxin emission occurs, it will also be far below the statutory limit of 0.1ng/Nm^3, which is the most stringent limit for incinerators all over the world.

Promotion of Waste Recycling

"Co-Co" is not a sole incinerator, but it is an integrated waste management facility promoting waste recycling as well. "Co-Co" includes a materials recovery and recycling facility (MRRF) to sort out the useful and valuable recyclable materials from the main stream of Hong Kong's MSW. Then, the non-recyclable and less useful fraction will be treated thermally in the novel "Co-Co" cement manufacturing facility.

In reality, there is no single solution for tackling a city's MSW. The management of waste must be in an integrated approach. Waste recycling is a "must" component in an integrated waste management system. But, 100% recycling is not possible technically as some waste is not technically recyclable or not economically justifiable to be recycled. Then, end solutions, other than landfill, are needed for treating the remaining instead of direct disposal. One of the feasible options is waste-to-energy thermal treatment.

Therefore, "Co-Co" is not against recycling. In practice, the front-end of the process aims at maximizing waste-to-materials recycling, and the back-end provides a solution for handling the non-recyclable wastes for waste-to-energy recovery.

Waste-to-Resource Recovery

(1) Waste-to-Materials
Reuse of residual ash resulted from thermal treatment of waste as supplementary material feed in the cement manufacturing, achieving the target of "no waste" discharge from the "Co-Co" facility.

(2) Waste-to-Energy

Recovery of energy generated from waste burning to be reused as an alternative fuel in cement manufacturing, and thereby achieving energy optimization and conserving non-renewable fossil fuels.

Benefits of Co-Combustion System

Waste-to-energy "Co-Co" technology (i.e. synergy of waste treatment and cement manufacturing) has been internationally recognized (e.g. UK, France, Belgium, Germany, Japan). But, it is still in its infant stage in Hong Kong. Therefore, a detail study on its applicability and feasibility in Hong Kong is necessary. We believe that the technology will lead to an alternative solution to Hong Kong's waste problems of bulk reduction and disposal, and ultimately towards the goal of sustainable development in waste management. The following is the benefits brought about by the technology, if operated in full-scale commercial facility:

Environmental Benefits:

- As an energy wise and self-sustaining process, "Co-Co" allows possible waste recovery of high calorific value (i.e. the combustible rich fraction of waste) at the MRRF;
- Advanced thermal treatment significantly reduces waste volume over 90%, contributing to solving the problems of bulky waste transportation and disposal, and hence alleviating space pressure on land and extending life span of our landfills;
- As an innovative technology, featured by high Temperature; long residence Time; and intense Turbulence, high emission control standard is attainable, even outperforming the internationally adopted standard. For example, adoption of dioxin prevention technology can effectively eliminate precursors of dioxin formation, and hence control the dioxin emission well below the existing standard of <0.1 ng/Nm^3;
- Possible reuse of residual ash derived from thermal treatment of waste as supplementary material feed in the cement manufacturing, achieving the target of "zero waste" discharge from the "Co-Co" facility;
- Possible recovery of energy from waste burning to be used as an alternative fuel, thereby achieving energy optimization and conserving non-renewable fossil fuels.

Socio-Economic Benefits:

- "Co-Co" implies a higher economic benefit to our society. It enables waste recycling of even the combustible rich fraction, such as plastic, which is often of high market value. Moreover, as a closed system, "Co-Co" enables re-circulation of heat and residues generated from the process of operation back to the system instead of disposal. Extension of resources life-span leads to possible decrease in demand for virgin materials, the exploration and exploitation cost of which is climbing up while stock of natural resources is diminishing. Waste recycling for re-manufacturing provides an alterative means to reach cost-effective production;
- "Co-Co" contributes to the reduction of waste handling and disposal cost, and most importantly the external costs of relying on landfills as waste outlet;
- "Co-Co" could be a catalyst boosting the development of local recycling industry in Hong Kong;

- Contribution to the local community development by establishing environmental resources and tourism centers integrated with the "Co-Co" facility;
- Support private-public partnership on solving the alarming waste management problems in Hong Kong towards our quality future.

Comparison of "Co-Combustion" System with Conventional Incinerators

	"Co-Combustion" System	Conventional Incinerators
Waste Recovery	Can recover large amounts of recyclables of high market value, such as plastics, paper and wood	Not feasible, as it will directly reduce calorific value of waste
System Stability	Can handle waste with high water content and low calorific value	Waste calorific value at least 1,400 to 1,600 kcal/kg
Thermal Treatment	Combine thermal waste treatment process with cement manufacturing process	Only waste incineration
Combustion Environment	Up to 1,200 °C for at least 4 seconds	850 °C for 2 seconds
Waste Volume Reduction	95%	75-80%
Residue Handling	Recycled as cement raw materials, conserving natural resources	Dumped at landfills
Flue Gas Treatment	Adoption of Dioxin Prevention Technology: Elimination of dioxin forming precursors so as to minimize dioxin emissions	End-of-pipe treatment: Adsorption of dioxin formed with activated carbon to prevent it from emitting to the atmosphere; transfer it to landfill instead
Technical Synergy	• Modified cement plants can operate with higher efficiency and cost-effectiveness • Reduce pollution from the cement industry	Nil

For any enquiries about the "Co-Co" pilot plant project, you are welcomed to contact the team.

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「環保熔化系統」試驗設施計劃

香港科技大學、青洲英坭有限公司

簡介

「環保熔化系統」(以下簡稱「環熔系統」)試驗設施計劃乃香港科技大學(以下簡稱"科大")化學工程學系與青洲英坭有限公司(以下簡稱"青洲")合作的項目，旨在設計一套都市固體廢物綜合管理系統的設備與流程。有別於傳統的焚化爐，「環熔系統」是一套實踐資源回收循環再造的廢物綜合處理設施，系統包括物料回收及循環再造設施，回收有循環再造價值的都市固體廢物；而剩餘沒有循環再造價值的部份則會利用水泥生產工藝作高溫處理，故此「環熔系統」可被形容爲一個與水泥工藝「共生」的技術。

「環熔系統」的運作如下：都市廢棄物經垃圾收集車運送至水泥廠，先進入物料接受及處理站作前期處理，利用自動化機械及人手將可循環再造的資源物分選出，轉往循環再造下游工業；而不可循環再造或沒有市場價值的可燃物則進入廢棄物旋轉窯作高溫處理。高溫處理的剩餘物可被轉化成水泥原材料，廢氣則經過二級燃燒室作進一步高溫處理及石灰分解爐作乾式洗煙工序，而餘熱則進入鍋爐以產生電力。

計劃目的

- 發展實用技術，以有效分選及回收香港廢物中可以循環再造的部分；
- 詳細分析及評估香港都市固體廢物的熱能特性；
- 提供「環保熔化系統」的科學性資料及監察排放數據；
- 評估高溫處理後剩餘物的特性，以再投入於水泥生產；
- 找出實際操作的參考數據和準則；
- 研究將某些種類的廢棄物循環再造成活性炭的可行性；及
- 監察各項有關的排放數據及準確評估城市固體廢物高溫處理設施對對環境、社會及經濟的影響

計劃內容及進度

「環熔系統」計劃始於2000年5月，期間用了兩年時間搜集資料及數據並作出詳細而深入的分析；至2002年中旬，流程設計工作初步完成，計劃進入試驗設施階段，於屯門踏石角青洲英坭廠址興建一座示範性規模的「環熔系統」試驗設施，包括一個物料回收及循環再造設施和一個用作廢物高溫處理

的水泥旋轉窯，透過設施運作以收集數據並作出化學分析及環境影響評估，旨在驗証「環保熔化系統」處理香港都市固體廢物的技術可行性。

根據《空氣污染管制條例第十四條》，青洲英坭於2002年10月向環境保護署提交《空氣污染管制(指明工序)》牌照的申請；至2003年11月，環保署正式批核申請並發出牌照，准許在屯門踏石角進行「環熔系統」的試驗，詳細內容可瀏覽環保署有關的網頁(www.epd.gov.hk/epd/tc_chi/news_events/what_new/gic_application.html)。接著，於2004年4月，獲屋宇署批發建築許可証，試驗設施的興建及安裝工程便於2004年6月開始，經過約六個月的時間，有關的工程已完成。

試驗設施的測試可望於2005年1月下旬進行，並於2月下旬開始正式的運作；每日處理不多於40公噸都市固體廢物，運作時間最長累積合共只會16星期，之後便會停止運作並被拆卸搬離屯門踏石角。

試驗設施運作期間，將會配合一系列空氣質素監察措施，除了持續及定期監測煙囪的排放外，還會於屯門區內設置兩個空氣監察站，分別位於蝴蝶邨及龍鼓灘村，監測站於2004年12月已開始運作，量度背景數據。所有監察數據的收集和分析會全由獨立認可的機構負責，並會定期呈交環保署及透過是次計劃的官方網頁向公眾發放(網址：www.gii.com.hk)。

另外，我們亦會繼續積極保持與公眾的溝通(包括：市民、綠色團體、學術及專業團體)，由2001年至今已舉行了超過20個不同形式的諮詢或簡介活動，聽取各方的意見。

計劃的宗旨及理念

防止二噁英形成

有別於傳統焚化爐「先污染，後清理」的模式，「環熔系統」採取防止二噁英形成的技術，利用水泥生產工藝的特性，在二噁英未形成之前有效地把其形成的主要元素分解與抽出。首先，旋轉窯至二次燃燒室的長時間高溫處理(高達攝氏1200度，停留長達至少4秒)，加上密集的湍流，確保完全燃燒及有效地把形成二噁英的有機物分解與破壞；另外，水泥原材料中有百分之八十是石灰石(碳酸鈣)，生產過程中產生大量的氧化鈣，與傳統的焚化爐比較，「環熔系統」所含氧化鈣量是前者的80倍，可有效地將廢物高溫處理過程中所產生的酸氣與氯化物中和淨化，氯化物正是催成二噁英的主要成份之一。

以上的過程可有效地防止二噁英的形成，目標是將二噁英的排放減至低於國際間最嚴格排放標準0.1ng/Nm³的水平。

支持廢棄物循環再造

「環熔系統」並非只是一個焚化爐，而是一套都市固體廢物綜合處理設施，支持廢物循環再造。首先，都市廢物進入系統，會先經物料回收及循環再造設施作初步分選，回收可循環再造及有市場價值的物料；當中最主要的目標是可提升塑料的回收率，將可循環再造的塑料盡量回收，以減少燃燒塑膠。接著，不可循環再造的廢物則會進入旋轉窯，利用水泥生產技術作高溫處理。

廢物轉化資源

1. 廢物轉化成物料

廢物經高溫處理後的剩餘灰燼可被循環再造，用作爲水泥生產的補充原材料，而不需運往堆填區處理，期望可達到系統沒有廢物產生的目標，同時亦可減少天然資源的耗用。

2. 廢物轉化成能源

廢物經高溫處理後所產生的能源可以回收，發展爲燃料替代品，可被用於支持系統本身的運作，有助優化能量的耗用，減少不能再生能源(例如：煤)的耗用。

「環保熔化系統」的優點

環境效益

- 實踐循環再造、善用資源的精神，將香港都市固體廢物分類，回收可循環再造的物料；
- 廢物高溫處理可減少需送往堆填區廢物的體積達九成以上，大大減輕對堆填區土地需求的壓力，有助延長堆填區的壽命；
- 採用先進防止有害污染物產生的技術，有效控制排放低於國際排放的標準；例如二噁英的排放被有效地控制，低於現有的國際環保標準(< 0.1 ng/Nm^3)；
- 廢物經高溫處理後所產生的剩餘物可被循環再用，作水泥生產中的補充性原材料，期望達到系統沒有排放的目標及減少耗用天然資源；
- 回收能源及發展燃料替代品，優化能量的耗用，減少耗用地球上不能再生的能源(如化石燃料)

經濟社會效益

- 回收再造有市場價值的物料，延續資源的經濟價值；
- 減低處理及棄置廢物的經濟成本；
- 可處理低熱值的廢棄物，有別於一般焚化爐；
- 帶動香港本地循環再造下游工業的發展；

- 推動社區發展，建設多元化環境資源教育及遊客中心；
- 支持私人與公營機構的合作(Private-Public Partnership)，在公營機構的協助下，私人機構作投資，共同解決香港日趨嚴峻的廢物處理問題，建設美好香港。

附表一：「環保熔化系統」與傳統焚化爐的比較

	環保熔化系統	傳統焚化爐
廢物回收	大量回收塑料及紙張	不可行，會直接降低熱值
系統穩定性	可收納含水量高及低熱值的廢棄物	廢棄物熱值最少1,400至1,600千卡/公斤
高溫處理	結合水泥生產及廢棄物處理工藝	廢物焚化
燃燒環境	高達1200℃不少於4秒	在850℃不少於2秒
廢物之體積	減少95%	減少85%
剩餘物處理	循環再用作水泥原材料	於堆填區棄置
廢氣處理	採用「防止二噁英產生」技術	產生之二噁英，依靠後段處理
廢氣處理成本	無需額外洗煙系統	需要昂貴尾氣洗煙系統

倘若對是次計劃有任何查詢，歡迎隨時與我們聯絡。

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