

FINAL REPORT

Waste Minimization and Recycling Potential of Construction Materials

Introduction

The Project on Waste Minimization and Recycling Potential of Construction Materials commenced on January 2002 and concluded in June 2005. The Construction Industry Development Board of Malaysia (CIDB) granted a research fund amounting to RM 682,920 to the Institute for Environment and Development (LESTARI) and Forest Research Institute Malaysia (FRIM) to conduct the Project. LESTARI focused on establishing the characteristics and quantity of waste generated and disposed off in the Klang Valley; socio-economic profile of contractors including their willingness to pay for proper waste management; cost benefit analysis of waste management at a project level; flow of aggregates in the construction industry; and documentation of good environmental practices. FRIM focused on investigating the technical and economic feasibility of recycling wood waste from the construction industry. The CIDB conducted financial monitoring as well as assessment of substance and technical merit of the Project.

Project Team

This multidisciplinary Project involved various experts from the disciplines of environmental geoscience, environmental chemistry, biology, forestry, engineering, law and economics. Members of the research team are listed below:

Principal Researchers:

Assoc. Prof. Dr. Joy Jacqueline Pereira (Project Leader), LESTARI (Env. Geoscience)
Dr. Mohd Dahlan Jantan (FRIM Coordinator), FRIM (Forestry)
Prof. Chamhuri Siwar, LESTARI (Economics)
Prof. Dr. Mazlin Mokhtar, LESTARI (Env. Chemistry)
Prof. Dr. Mohd Raihan Taha, LESTARI (Engineering)
Ms. Sarah Aziz Abd. Ghani Aziz, LESTARI (Environmental Law)
Ir. Mohd Shukari Midon, FRIM (Engineering)
Dr. Salmiah Ujang, FRIM (Biology)
Dr. Ismariah Ahmad, FRIM (Economics)

Research Asistants:

Mr. Victor Wong Lee Wee, LESTARI
Mr. James Bachat, LESTARI
Ms. Rawshan Ara Begum, LESTARI
Ms. Siti Khadijah Satari, LESTARI
Ms. Maria Zura Mohd Zain, FRIM

In addition to researchers from LESTARI and FRIM, the Project also involved close collaboration with Putrajaya Holdings Sdn. Bhd., the Solid Waste Contractors Association (SOWACO) and ARIF Solutions Sdn. Bhd., a project management services company. Putrajaya Holdings through the participation of Ms. Chui Yuet Yue and Mr. Suresh Kumar Lachimpadi provided support in documenting good practices for industry-wide dissemination. SOWACO and Arif Solutions through the participation of Mr. David Zone, Mr. Daniel Ruppert and Ms. Azrin Zuhdi utilized preliminary results from the Project to initiate a Pilot Project on recycling concrete and masonry waste that is separately funded by investors from the private sector.

Major Achievements

The Project has resulted in the following items that have not been produced before in Malaysia:

- Local good practices for construction waste management that enhance efficiency in reducing, reusing and recycling of concrete, soil and wood wastes that are generated on-site. It has been submitted to CIDB to be considered for adoption as guidelines for the construction industry in Malaysia.
- Recycled products from construction wood waste i.e. coloured wood chips, wood briquette and wood-fibre cement block. Coloured wood chips and wood briquette have the potential to become a new business for income generation and investment creation that can be purely private sector driven.
- A course structure on construction waste management for a CIDB training module to be delivered on a routine basis to improve the capacity of contractors. No such course is delivered by CIDB at the moment.
- Four brochures, 6 posters and a website have also been developed, including a database containing digital copies of these materials. In addition a model demonstrating the use coloured chips for landscaping and a multimedia show has also been produced. These items can be used by CIDB on a routine basis for road shows and exhibitions, to raise awareness among contractors regarding the benefits of construction waste management.

The Project has resulted in the following items:

1. A Final Report highlighting findings of the Project to be uploaded onto the website of LESTARI and linked to CIDB.
2. Four Milestone Reports and 10 Technical Reports detailing substantial findings from the Project.
3. Ten Progress Reports and 6 Financial Reports detailing activities and expenses of the Project.
4. Sixteen publications comprising 3 articles in peer reviewed journals; 10 proceeding papers, 1 peer reviewed book and 2 general articles.

5. Four international and 23 local presentations by Project researchers at seminars, conferences and other technical meetings for peer review purposes.
6. Five Seminars and Workshops, organised by the Project and CIDB to build capacity in construction waste management that benefited about 400 contractors.
7. Products recycled from construction wood waste i.e. coloured wood chips, wood briquette and wood-fibre cement block.
8. Good practices for construction waste management to be considered as guidelines for industry wide adoption by CIDB.
9. Course structure on construction waste management for a CIDB training module to be delivered on a routine basis to improve the capacity of contractors.
10. A Multimedia Show (6 Minutes) highlighting findings from the Project that can be used for training purposes.
11. Four Brochures and 6 Posters from 3 exhibitions to raise awareness among contractors regarding the benefits of construction waste management.
12. A model demonstrating the use of coloured chips for landscaping, made from recycled construction wood waste to be displayed at CIDB to raise awareness.
13. A Website (www.lestari.ukm.my/wmrpcm) highlighting findings from the Project to disseminate information that can be linked to the CIDB server
14. A Database of archived photos, technical papers, reports etc. from the Project that can be used by CIDB to access information for various purposes.
15. One doctoral and 2 masters graduates specialising in aspects of construction waste management.
16. A gold medal at the university level and a bronze medal at the national level in recognition of the work conducted in the Project.

Highlights of Project Findings

The Project conducted a case study to determine the economic feasibility of waste minimization. Results revealed that the benefits exceeded the costs of waste minimization and that the primary beneficiaries are the contractors and not the developers. Cost savings can amount to about 5% of the total project and this indirectly translates to improvement of productivity. Industry-wide dissemination of this case study could serve as an example to bring about a paradigm shift of contractors regarding waste minimization practices.

The Project conducted an extensive survey of the CIDB Registered Contractors, particularly regarding their level of awareness, attitudes, behaviour and willingness to pay for improved construction waste management. The findings of the survey have been published to enable CIDB to formulate appropriate policy interventions in addressing the construction waste problem in Malaysia and indirectly improving the quality of construction in the country.

The Project, with support from Putrajaya Holdings Sdn. Bhd., documented good practices for construction waste management in Putrajaya, which currently practices stringent environmental standards in the country. Implementation of these practices has translated to cost savings to contractors operating in Putrajaya. These good practices have been submitted to CIDB to be considered for adoption as guidelines for the construction

industry in Malaysia. The practices documented encompass management and procedural measures at construction sites that enhance efficiency in reducing, reusing and recycling of concrete, soil and wood wastes that are generated on-site.

The Project established the characteristics and quantity of construction waste generated and disposed of in the Klang Valley. A spin-off from this activity is a Pilot Project on recycling concrete and masonry waste being conducted by the Solid Waste Contractors Association (SOWACO) and ARIF Solutions Sdn. Bhd. This innovative spin-off is a business, separately funded by investors from the private sector and does not utilise any government funds. Similar innovative spin-offs can be sought for recycling of wood waste into coloured wood chips and wood briquette. Thus, the Project has shown that recycling of construction waste material has the potential to become a new business for income generation and investment creation that can be purely private sector driven.

The scientific merit of the research conducted in the Project has been verified through 16 publications, 4 international and 23 local presentations. The technical aspects have been detailed out in 4 Milestone Reports and 10 Technical Reports that has been submitted to CIDB for assessment throughout the duration of the Project.

Environmental Features of the Products

The Project has resulted in three products recycled from construction wood waste i.e. coloured wood chips, wood briquette and wood-fibre cement block. Coloured wood chips are biodegradable, suitable and attractive for landscaping, and preliminary results indicate that industry-wide scale production is cost competitive. Wood briquette production is an established industry and commands an international niche market. The industry currently requires new sources of wood dust due to the decreasing number of sawmills in the country. Waste from the construction industry can be channeled to the wood briquette industry after intermediate mechanical processing. Thus, there is a ready market for wood waste from the construction industry. Wood-fibre cement blocks produced from construction wood waste and ordinary Portland cement is found to be technically suitable for the local construction industry. The recycling of wood waste into coloured wood chips and wood briquette on an industry wide scale would result in a value for the waste, and a reduction in disposal of wood waste to landfills or through burial and illegal dumping or open burning, as currently practiced by the contractors. For further information, please contact Dr. Mohd Dahlan Jantan of FRIM.

Sociological Value and Long-term Importance to Society

The long-term value to society from this Project will come from building the capacity of contractors in construction waste management. For this purpose, the Project has developed a course structure on construction waste management for a CIDB training module to be delivered on a routine basis to improve the capacity of contractors. The Project has also developed a multimedia show (6 Minutes) highlighting findings from the Project that can be used for training purposes. One doctoral and 2 masters graduates

specialising in aspects of construction waste management have also resulted from the Project, contributing to increase the specialists in this field.

The Project has also conducted 5 Seminars and Workshops, organised in conjunction with CIDB to build capacity in construction waste management, which has benefited about 400 contractors. Four brochures, 6 posters, a model demonstrating the use of coloured chips for landscaping, and website (www.lestari.ukm.my/wmrpcm) have also been developed. A database containing digital copies of these material, archived photos, technical papers, reports etc has been submitted to CIDB. In the short-term, these materials can be used by CIDB on a routine basis to raise awareness among contractors and society in general, regarding the benefits of construction waste management.

The success of the Project is in the institutional partnership between LESTARI and FRIM in building a team of multidisciplinary researchers in addressing the construction waste management problem in Malaysia. Collaboration between academics, researchers, contractors and industry players through the participation of Putrajaya Holdings Sdn. Bhd., the Solid Waste Contractors Association (SOWACO) and ARIF Solutions Sdn. Bhd. under the auspices of CIDB has also resulted in industry relevant products and outcomes.

Awards

At the university level, the Project was awarded a gold medal in 2004 and selected by UKM for national level competition, where it was awarded a bronze medal at the S & T and Innovation Exhibition in 2004.