13 Eco-efficiency analysis of the plastic recovery systems in Hyogo eco-town project

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Abstract

Japan started the promotion and development of eco-towns in 1997, with the aim of reducing the environmental pressure through a symbiosis of industries and cities. Hyogo prefecture (located in the west of Japan) has been promoting a recycling-oriented society with the cooperation of industries, citizens and businesses.

This study analysed the possibilities of implementing a reverse logistics network for plastics recovery and its coupling with existing industries and technologies. Since many industries are operating in Hyogo, the use of their facilities and/or equipment for plastics recovery has been proposed, specially the steel and chemical industries. Reverse logistics was used to analyse the supply of input plastics in terms of quantity and quality. This means clustering small neighbouring cities for synchronised sorted collection (there is a difference between small cities, which already use sorted collection, and big cities, where no sorted collection for plastics exists), and coordinating activities between larger cities.

This study was part of a research project aimed at closing the loop in the Japanese plastics industry by introducing an integral approach with improvements to the upstream and downstream sides of the plastic supply chain life cycle.

This paper presents the results of the first part of the study, which included the use of domestic plastic packaging as plastic sources and material, feedstock and energy recovery as recovery technologies. The results

G. Huppes and M. Ishikawa (eds.), Quantified Eco-Efficiency, 307–327.

of this study indicate that the application of reverse logistics, combined with the appropriate recovery technologies in Hyogo eco-town, is both environmentally and economically beneficial. However, it requires close collaboration between local governments and the industrial sector.

13.1 Introduction

Fostering sustainable development requires changing linear economies towards a system where production and consumption cycles are closed as much as possible. Strategies for this goal of closing the loops include the re-use and re-integration of products and components, recycling of materials and energy recovery (Indigo Development 2004). Further strategies towards more sustainable production include increasing yields by new or optimised production technologies and using less material to manufacture the same product. All of these options aim to reduce the materials input into a given system (Moriguchi 1999). The reduction of materials requirements, both absolute and relative, is also referred to as dematerialisation.

This paper is part of a research project which aims at closing the loop in the Japanese plastics manufacturing sector. The research project introduces improvement strategies to both the upstream and downstream sides of the sector's supply chain (Morioka et al. 2003).

In this paper, we focus on an eco-efficiency analysis of the plastics end-of-life improvement strategies based on streamlining plastic waste materials and energy recovery. Since the main impediment to improving recycling levels are the collection, sorting and transport costs (Yabar and Morioka 2002), we propose the introduction of reverse logistics as a method to reduce these costs, in order to make plastics recycling an economically attractive option. Coupling the reverse logistics system with an adequate recycling technology, using existing industrial facilities should make it possible to construct a plastic recovery system covering a wide area. The scenarios were driven by the Japanese environmental policy, which set targets to increase recycling levels and reduce final waste disposal. As for the methodology, the environmental and cost impacts of four scenarios were evaluated, using life cycle assessment and life cycle costs, respectively. Both evaluations were normalised and an eco-efficiency analysis was used to identify the best scenario.