4  A lifecycle inventory of solid waste

Summary

The lifecycle inventory technique described in Chapter 3 is applied to waste management. The possible uses for an inventory of different waste management options are discussed. The functional unit for the comparison is defined, as are the system boundaries. This includes defining the ‘cradle’ and ‘grave’ for waste. The general structure of waste management systems, which forms the basis of the LCI model, is mapped out, and the computer spreadsheet developed to conduct the LCI is introduced.

4.1 Integrated waste management and lifecycle inventory

The objective of integrated waste management is to deal with society's waste in an environmentally and economically sustainable way (Chapter 2). To assess such sustainability, we need tools that can predict the likely overall cost and environmental impacts of any system. Lifecycle assessment is an emerging environmental management tool that allows prediction of the likely environmental impacts associated with a product or service over the whole lifecycle, from ‘cradle to grave’. This technique can be usefully applied to waste management to assess environmental sustainability. At the same time, a parallel economic lifecycle assessment can determine the economic sustainability of waste management systems, a criterion equally crucial to their successful implementation.

As described in Chapter 3, a lifecycle assessment is comprised of four stages: goal definition, inventory, impact analysis and valuation (Box. 3.1). Currently the goal definition and inventory stages (which together comprise a lifecycle inventory study) are routinely carried out in various applications; impact analysis and valuation present significant challenges. This book and the associated computer spreadsheet are based on a lifecycle inventory of solid waste. This chapter addresses the concept and practicalities of using lifecycle assessment to compare waste management systems.

Whilst the lifecycle technique has been used to compare specific options for waste disposal (e.g. Kirkpatrick, 1992), it has not previously been used to assess complete integrated waste systems. Consequently, it is necessary first to address such basic questions as where is the cradle of waste, and where is its grave?
4.2 A lifecycle inventory of waste

4.2.1 Goal definition

The first stage of a lifecycle inventory, the 'goal definition stage', addresses three major questions, namely, What is the purpose of the study?, What will be compared, i.e. what is the functional unit for comparison? and What are the boundaries of the system? (Box 4.1) This last question defines what will be included in the study and what will be omitted, and specifies the 'length' and 'breadth' of the study.

What are the purposes of the lifecycle inventory?

- To predict both environmental performance (in terms of emissions and energy consumption) and economic costs of an integrated waste management system. Because specific data for all parts of the lifecycle are not available, and thus generic (typically averaged) data will be frequently used, the result of the inventory will not be 100% accurate. However, it will provide a 'first cut' and will provide rough comparisons between different system options. The objective of predicting environmental performance of waste management systems can be met in two ways. Detailed lifecycle inventory studies can be run for several individual waste management systems, and general conclusions extrapolated from the results. The alternative is to construct a generic, flexible tool that can be applied to any waste management system to assess the overall environmental performance. Constructing a model that is flexible enough to describe all possible waste management scenarios is a very challenging task, but is the option attempted in this book. A general model such as this will rely on generic data, so will not give such accurate results as specific studies that describe particular waste management systems. However, the flexibility to apply the same model to most waste management systems, both existing or planned, is considered to outweigh this.

- To demonstrate the interactions that occur within waste management. As it attempts to model the whole waste system, a lifecycle model will show how different parts of the system are inter-connected and will aid understanding of the system's behaviour.

- To clarify the objectives of the waste management system. Above, it has been argued that the objective of waste management is environmental and economic sustainability, i.e. minimising the environmental impacts for an acceptable cost. Because it specifically calculates both the cost and individual environmental impacts (i.e. energy consumption, air emissions, water emissions, landfill requirements, etc.) it focuses attention on which parameters need to be maximised or