LCA Methodology: Applications in South Africa

Comparison of LCI Studies in South Africa and Germany

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Abstract

This article investigates the possibilities for and potential applications of Life Cycle Assessments (LCA's) and specifically of Life Cycle Inventories (LCI's) in developing countries (e.g. South Africa). The situation in South Africa is compared to that prevailing in Germany, a highly developed country. Although South Africa is unique concerning the different degrees of development within the industry, most of the principles discussed in this article can be applied similarly to other developing countries.

No significant full LCI studies have yet been performed in South Africa. Although the immediate local needs for the South Africa enonomy are solving labour problems, creating jobs, building houses, the industries should seriously consider performing LCA and related studies for their products. The concept of quality should be extended to include the environmental performance of a product, process or service.

Key words: LCA methodology; methodology, LCA; life cycle inventories, South Africa and Germany; LCI/LCA studies, South Africa and Germany; data acquisition process, South Africa; concept of quality, South Africa; environmental performance, South Africa

1 Introduction

This article investigates the possibilities for and potential applications of Life Cycle Assessments (LCA's) and specifically of Life Cycle Inventories (LCI's) in developing countries (e.g. South Africa). The situation in South Africa is compared to that prevailing in Germany, a highly developed country. Although South Africa is unique concerning the different degrees of development within the industry, most of the principles discussed in this article can be applied similarly to other developing countries.
The article begins with the background from which the arguments on LCI's in developing countries, specifically South Africa, originate. Consequently, the situations in Germany and South Africa are discussed briefly. The need for LCI's in developing countries is then outlined, followed by some general conclusions concerning LCA/LCI studies.

2 Background

From February to June 1994 the author participated in an LCI study at the Technical University of Berlin (Prof. Dr.-Ing. G. FLEISCHER) in Germany which compared three different recycling alternatives for LDPE and HDPE plastic waste from the household waste stream (Duales System Deutschland mbH). These three alternatives include direct material recycling (mechanical), raw material recycling (chemical) and energetic utilisation (burning) of the waste plastic. The Technical University of Berlin was commissioned to perform the LCI of the direct material recycling process, while the other parts of the study were performed by the Fraunhofer Institute (Munich) and the University of Kaiserslautern.
The author was involved specifically in the data acquisition process of the mechanical recycling process as well as in the goal definition and scoping stage of the complete study. During the data acquisition stage of the LCI, insight into the difficulties of acquiring data from the industry in Germany was obtained in an "external" study. At the time of editing, the inventory analysis of the HDPE recycling process was completed by the author [1].
An LCI (strictly speaking an "inventory analysis") was then performed at a production line – i.e. a life cycle fraction – of the largest plastic recycling company in South Africa. The production line produces recyclates from relatively clean industrial waste plastic film. During this study, actual production figures were used as base data.

3 Germany's Situation

Germany, like the USA, Canada, Japan, etc., is a highly developed country. Technological innovation and developments are well advanced and social structures well established. Governmental, industrial and society's concerns increasingly evolve around environmental issues. Specifically in Germany, strong public pressure and legislation enhance the need for the industry and consumer to minimise the environmental burdens of products, processes and services. Only full compliance to environmental legislation and customer expectations provides companies with a secure place in the market. In other words, in order to maintain a healthy environment and sustain economic development, the industrialised countries "simply do not have a choice". "Fine tuning" of the production processes, the service industry and the consumption of products is required to min-

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imise waste generation and energy consumption, i.e. to reduce the impact on the environment. A relatively high education level of the general public prevails in Germany – and other industrialised countries – which facilitates the introduction of "green" issues (e.g. eco-labelling of products, substitution of environmentally hazardous substances, recycling etc.).

It is therefore evident that means are being sought to determine the environmental impacts – as well as the interactions thereof – for products, processes and services. Life Cycle Assessment [2, 3, 4] is a methodology that determines the impacts on the environment and the relevant interactions by:

1. Determining the inputs and outputs of the system under study to and from the environment (Life Cycle Inventory);
2. assessing these material flows according to a set of environmental criteria (Impact Assessment) and
3. assessing the potential environmental improvements to a product, process or service (Improvement Assessment).

In Europe and America, this methodology has been repeatedly applied and is well known to practitioners in the field. Although the methodology is not yet fully formalised, many LCA and related studies have been performed by the industry and government institutions of the developed countries. Major strategic decisions on the selection of products, processes and services according to environmental criteria have already been made based on the results of such LCA studies.

In Germany, the author participated in the data acquisition process for the waste HDPE bottle recycling part of the LCI study as mentioned in section 2. The study was performed externally to the companies, resulting in problems concerning the acquisition and publication of company-specific data. A procedure to anonymise the results to be published was initiated to enable companies to participate in the study without revealing information on the processes. Furthermore, care had to be taken not to publish any information concerning the technological know-how of the processes or products of the companies due to the small competitive margins that prevail in the plastic recycling business in Germany.

For the transport and energy processes of LCA studies, the databanks from previous studies can be used – if reviewed and updated – in future studies. Equally, similar processes of completed studies may be used in future studies after review. This is possible if the LCI is structured into separate modules [4]. In Germany, process-specific data like electricity consumption, waste generation, water consumption, emissions to air and water and the relevant analyses of the mass flows etc. are generally available due to the level of technology used in the production processes. Many processing details on the inputs and outputs have to be measured due to legislation, customer demands and for process optimisation purposes. Nevertheless, this information is not always released by the companies for external LCA studies, forcing analysts to make assumptions and include information from secondary sources. In this case, the results to be published are then reviewed for validity by the companies involved. The final report then needs to reveal the use of secondary data sources.

4 South Africa's Situation

South Africa is a developing country where the level of technology ranges from very high-tech industries to basic, outdated technology. That is, South Africa is a combination of first and third world countries. As an indication of this, South Africa's gross domestic product (GDP) per employee (in 1985 prices and exchange rates in South African rands) is R 16.959 for 1992 in comparison to R 12.313 in Chile, R 20.227 in Korea and R 89.140 (!!) in the USA [5]. In its recent history, political instability and change in South Africa has caused economic decline, forcing the industry to concentrate almost entirely on investments with short to very short term returns, i.e. not on investments to protect the environment. Process, product and service optimisation to minimise waste generation is secondary to immediate bottom line improvements like the increase of sales and the reduction of labour and purchasing costs.

Problems concerning labour relations arose due to political imbalance, resulting in more losses in revenue by the industries. These problems are addressed by the industry in South Africa before it can even consider the environmental impacts of a process, product or service. For example, transport companies make use of very outdated trucks with an unnecessarily high emission rate. Yet the purchase of new trucks to minimise the emissions is impossible in the prevailing economic climate (although this is obviously a short term solution!).

A major problem is the current level of education and the standard of living amongst the majority of the South African population. Many people are still illiterate and schools must be built to accommodate the rapidly growing population. It therefore seems almost impossible and unreasonable for the government and public institutions to allocate funds to projects concerning the environment when 31 % of the population is jobless and thousands of people do not have a house to live in. The main efforts and funds are therefore dedicated to housing schemes, education, job creation and general public services.

Furthermore, South Africa was excluded from international markets until recently. Many products and services were exclusively South African, while exports were almost impossible. Many products therefore did not compete favorably with the competition from overseas – also regarding environmental performance.

The data acquisition process for the inventory analysis that was performed at a plastic recycling plant in South Africa was facilitated by the fact that the inventory analysis was performed internally within the company. However, much process-specific data was not measured and assumptions had to be made. For example, the emissions into the atmosphere were not measured and effluent water into the municipal effluent system was not analysed. Furthermore, information on the electricity generation processes and energy mix for the region of the plant could not be obtained. These and similar problems can generally be attributed to the level of technology used in the South African industry.

5 Need for LCI's in South Africa

No significant full LCI studies have yet been performed in South Africa [1]. The results of the "inventory analysis" performed in South Africa [1] were of significant use to the recycling company itself. The study was performed as an academic exercise, i.e. the company did not incur any expenses. Process optimisation was initiated for the production line under study to minimise the waste generated and electricity consumed and to increase the production volume. Environmentally hazardous substances were identified and consequently treated to reduce the environmental impact [1]. As BRUNN [6] states, "We need practice in the industry. That means that we can empirically demonstrate to our management that LCA works because it is possible to identify ecologically useful and economically feasible improvement options already with today's state-of-the-art LCI's or LCA's at acceptable cost and human resource demands". Herein lies the restriction to the potential applications for LCA's in South Africa.

Moreover, some public pressure for stronger control – especially concerning environmentally relevant and hazardous substances – increasingly forces the industry to perform environmental impact assessments and reveal more information on their products and production processes and the related environmental relevance. An ideal way to communicate this information is in the form of LCA results. The results should always be given comparatively since absolute figures could be interpreted incorrectly by the public.

Export markets require South African producers to reveal environmental parameters on the production of certain products. LCA's are to become a necessity in the near future for the purpose of eco-labelling in Europe [7]. Therefore, if these products are to be marketed internationally and specifically exported to first-world countries, LCA's need to be performed as prescribed, for example, by EU legislation, the international customers, etc.

South Africa is one of the major international suppliers of minerals – finite resources – like iron, gold, platinum, uranium, chrome, vanadium, etc. In many cases, these are found almost exclusively in South Africa. Extracting the minerals from the earth and processing them into pure materials represents the first stage of the life cycle of a product. These products are then mostly exported to the first world countries for further processing.

LCI's on the extraction and first purifying processes of minerals are of primary importance to all those industries involved later in the life cycle of the product. The fact that South Africa is a major international supplier of minerals, i.e. many mineral extraction processes from the earth are performed in this country, makes it mandatory that some complete LCA studies cross the borders into South Africa. First world countries should consider sending analysts to South Africa to perform the relevant part of the study where the actual processes take place. Another option is to fund a LCI study on the required processes to be performed by analysts in the country.

Although the immediate local needs for the South African economy are solving labour problems, creating jobs, building houses, etc., the industries which are further developed should seriously consider performing LCA and related studies for their products.

The concept of quality – including striving towards zero defect – is well known amongst many South African producers. This concept should be extended to include the environmental performance of a product, process or service – a (more extensive) striving towards zero waste.

6 Conclusions

The exchange of knowledge and LCI related information should be continuously practised in order to assist developing countries with LCA studies. Especially data from LCI studies should be communicated to companies or institutions performing similar studies.

Information from sources like the Canadian databases for the energy and transport processes or extensive LCA studies should be made freely available for application after adaptation in developing countries. In this way, the wheel does not need to be re-invented there at unnecessarily high costs. KLÖPFFER [3], however, warns that, "... original data should be distinguished from generic data taken from tables or data bases". The goal shared by all to globally determine the environmental impacts of products, processes and services, i.e. of human activity, and to consequently protect the environment should always be kept in mind by the leading first-world countries.

Generally, the need for LCA's in such developing countries as South Africa is restricted considering other more relevant problems as mentioned above. However, from the perspective that LCA studies aim at identifying and minimising such environmental effects as global warming, ozone depletion, finite resource depletion, etc., the need for LCA's in all countries becomes inevitable.

7 References

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