

New LCA Theses

Ecobalancial Assessment of Chosen Packaging Processes in Food Industry

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At the Poznan University of Technology, Faculty of Machines and Vehicles, Przemyslaw Kurczewski¹ has worked on environmental interactions generated by packaging systems. He has focused on specific problems typical for Polish conditions, among other things concerned with the identification and quantification of environmental burdens. Results of this research have enabled him to work out the dissertation oriented on solving selected problems concerning the LCA of systems of technological processes. The title of this Ph.D. thesis addresses the term 'ecobalance', a more common term in Poland than 'LCA' [1].

The dissertation consists of nine sections. To analyse the areas of man's technical activity, it touches on selected problems of the influence of technological processes on environment deterioration. The aim of the work is to draw up a way of LCA method application in environmentally-oriented analyses of complex technical objects on the basis of the example of the packaging process. At the beginning, the literature overview is performed. Because of classification aspects, food industry packaging processes are treated as being representative of complex technological processes. For the sake of positive market prognosis, the beverage packaging processes are taken as the object for a detailed study. On the basis of an assumption, environmental influences of this process are considered against a background of the life cycle of the packaging machine, the beverage packaging and the technology process's elementary components. Besides, the need for the inclusion of direct and indirect environmental burdens, it is found to be connected with all environment elements.

In the next part, the main conditions of LCA method application are presented in the area of packaging systems. Advantages and disadvantages of LCA are described as a tool for the ecobalance of complex objects. Furthermore, this method is characterised in detail. The stage – impact assessment – is carried out on the basis of the Eco-indicator procedure. As a consequence, all environmental interactions are divided into three categories – human health, ecosystem quality and resources exhausting.

As a result of the inventory stage, data on the assessed beverage packaging process are classified. Their analysis is carried out in the module structure, which consists of an independent analysis of the packaging machine, beverage packaging and technological process's elementary components. Several configurations of the packaging system components are also considered. Three types of packaging machines are treated separately and five of the following packaging forms are assessed: glass bottles (returnable and non-returnable), PET bottles, aluminium cans and cardboard boxes. As stages of the technological process, the following are analysed:

- washing up of bottles
- filling and closing of packaging

- labelling
- block packing (cartoning, sacking, boxing)

In the end of the study's dissertation section, elementary components of the packaging process are put in order of their environmental interactions, expressed by quantity data, and completed in detail, characterising the activities of process and production engineers.

Regardless of the type of methods used in the packaging process, the main source of detrimental influence on the environment is packaging. Both the technology process's components and packaging machines cause many fewer environmental burdens. In Polish conditions, the most environmentally friendly packaging is returnable glass bottles. A few less harmful environmental impacts are caused by cardboard boxes. Contributing most to the environment, at a similar level, are non-returnable glass bottles, PET bottles and aluminium cans.

The main sources of detrimental interactions among the stages of the packaging process are filling and closing. They cause over 75% of the total generated environmental impacts in the whole technological cycle. Features of the machines used which are responsible for that include:

- electrical energy consumption during exploitation
- unfavourable selection of construction materials
- application of lubricating media

The specific methodological aspect of the dissertation is concerned with the way of limiting environmental data needed to make an LCA study. This problem is especially nagging in the case of such complex objects as the packaging system. It is important to control the influence of the final results of LCA considering the limitation of the scope of system boundaries. To achieve a systematic and flexible solution to this problem in the dissertation, a method based on the theory of signal flow graphs is proposed and verified. Two cells in the whole graph of cumulated values of environmental interactions are created, but the only final-product associated cell is considered in the LCA calculations. The algorithm of determination of a boundary between these cells is based on the continuous analysis of the influence on the final result of LCA.

Finally, the general conclusions of the results and directions for further ecobalance studies on technical projects are presented in the dissertation.

This second Ph.D. dissertation in area of LCA from Poland has met the first symptoms of interests from the side of packaging-machine producers. We hope that there is a good sign for deeper engagement from the economy in Poland for LCA research.

¹ Przemyslaw Kurczewski did his Ph.D. at Poznan University of Technology, Faculty of Machines and Vehicles and was promoted by Professor Zbigniew Klos from Poznan University of Technology.

[1] Kurczewski P. (2001): Ekobilansowa ocena wybranych procesow pakowania w przemyśle spożywcym. Ph.D. dissertation. Poznan University of Technology, Faculty of Machines and Vehicles, Poznan, Poland