LCA Software Report

LCA Software Tool for Corrugated Board

Bringing LCA Within Easier Reach of the Industry

[1]Angeline S.H. de Beaufort, [2]Ueli Stahel

[1]FEFCO-Groupement Ondulé-Kraft Institute, Paris, France
[2]Swiss Federal Laboratories for Materials Testing and Research (EMPA), St. Gallen, Switzerland

Corresponding author: Angeline S.H. de Beaufort

Abstract

FEFCO, Groupement Ondulé and Kraft Institute have integrated the data from their recently published updated "European Database for Corrugated Board Life Cycle Studies" into a software tool that has been developed especially for the corrugated board industry. The tool links input and output data reported in the Database to average European data for upstream and downstream processes from BUWAL 250 [3]. The tool is intended to support environmental management of companies since it provides a possibility to find opportunities for improvements and to take environment into consideration when designing corrugated board boxes.

The entire system of corrugated packaging is the basis for the calculations. It is assumed that the fibres that are used for the production of the corrugated base papers are produced and recycled only within this system. This simplified so-called closed-loop approach, which is described in detail in the Database report, avoids the problem of allocating impacts caused by primary fibre production and the final treatment of corrugated packaging that is not recycled between primary and recovered fibre based paper grades. This means that with the software tool it is not possible to make comparisons between the production of primary fibre and recovered fibre based materials as such.

The tool enables the user to vary parameters such as transport, box design, logistics and waste management according to his personal circumstances. In this way he can use the tool to introduce parameters for possible alternatives he wants to investigate. The LCA results of these alternative cases can then be compared and analysed at inventory, characterisation, normalisation and weighing level. The user cannot change the basic data nor the methodology.

Keywords: Corrugated board, LCA, software tool; Life Cycle Assessment, corrugated board, software tool; software tool, LCA, corrugated board

1 Introduction

Corrugated packaging is used in many different applications with a large variety of design, logistics and waste management. The industry as a whole has gained knowledge based on case studies over the years. These case studies, performed by LCA specialists, have been based on certain specific applications and circumstances. Results of the studies were not always comparable due to choice of different background data, system boundaries etc.

A more flexible form of LCA leading to comparable results was needed to bring the tool within an easier reach for designers and decision makers in the industry. The LCA software for corrugated board, that has now been developed, combines flexibility with fixed choices. The user needs only elementary knowledge of LCA to understand the way the system is developed, which choices are made and how to interpret the results.

2 Description of the Software

The software tool is a light version of Simapro 4 [1] with scripts developed by the three Associations:

- FEFCO (European Federation of Corrugated Board Manufacturers),
- Groupement Ondulé (GO), European Association of Makers of Corrugated Base Papers and
- the Kraft Institute (KI), Association of Virgin Fibre Based Producers of Corrugated Board Materials in Europe.

The user does not have to design the LCA model by himself. He does not have to solve the problem of finding data on the production of base paper and corrugated board production, nor of how and to which upstream and downstream processes he has to link these data.

The software is based on the most recent data from the "European Database for Corrugated Life Cycle Studies" [2].

The report contains environmental data on the production of corrugated base papers from virgin fibres (Semichemical Fluting and Brown Kraftliner, data from the Kraft Institute), recovered paper (Testliner and Wellenstoff, data from the Groupement Ondulé) and corrugated board production in Europe (data from FEFCO).

The data represent the mass-weighted averages for Europe of the inputs into and outputs from the production sites per ton net saleable product (paper and corrugated board) from the production sites.

The "European Database for Corrugated Life Cycle Studies" is not a complete inventory.

Since the Database contains European data, the choice has been made to link these to public available European data for thermal systems, raw material inventories, electricity generation for the public grid (UCPTE), transportation and waste treatment from BUWAL 250 [3]. The process cards and scripts have been reviewed by EMPA.

The software uses the closed-loop approach (which is described in detail in the Database report) to avoid the problem of allocating the impacts caused by primary fibre production and the final treatment of corrugated packaging that is not recycled between primary and recovered fibre bases paper grades.

It is based on the assumption that the primary fibre production and recycling of the fibres only takes place within the entire system of corrugated packaging. Since fibres do not have an eternal life (fibres can be recycled a limited number of times only, not all fibres are recycled) a constant fresh fibre flow is needed to feed the system. This approach is a simplification of complicated fibre flows through various paper production systems.

The software tool can be considered as a "flexible" LCA, where the user can choose a script and introduce the parameters according to his personal situation. Examples of scripts and parameters belonging to each are described in Table 1.

3 Examples of Application

Producers of base papers, corrugated board producers and packers/fillers sit together to discuss several aspects of alternative box designs, such as machinability, protection, communication, distribution simplification and material utilisation. Using the software tool it takes only a little extra time to include the analysis and comparison of the environmental impact of the alternatives.

As can be seen from Table 1 it is possible to make the comparison at several levels. For example when logistics for the alternatives are the same, it should suffice to compare at sheet level using script 3; when only the logistics are different and the box sheet is the same it is sufficient to compare only the logistics part using script 4.

Table 1: Examples of scripts and connected variable parameters that can be changed by the user

Data input	script 1	script 2	script 3	script 4	script 5
paper and corrugated board production					
transport of paper to corrugated board plant: transport vehicle and distance	•	•	•		
Waste treatment (recycling rate, incineration rate, landfill rate)	•	•	•		
sheet type (single face, single wall, etc.)	•	•	•		
layer 1: paper type, grammage	•	•	•		
layer 2: paper type, grammage, flute type, glue	•	•	•		
layer 3: paper type, grammage	•	•	•		
width corrugator	•	•	•		
efficiency corrugator	•	•	•		
number of boxes cut from width	•	•	•		
edge in length of corrugator	•	•	•		
width box sheet	•	•	•		
length box sheet	•	•	•		
transport of box with product by truck					
box weight	•	•		•	
product weight	•	•		•	
transport vehicle	•	•		•	
transport distance	•	•		•	
boxes per layer	•			•	
layers per pallet	•			•	
pallets per truck	•			•	
functional unit: amount of product delivered	•	•		•	
two or more results of script 1, 2, 3 or 4					•

Script 1: LCA corrugated board box truckkm: analyses the full LCA for products delivered by truck
Script 2: LCA corrugated board box tonkm: analyses the full LCA for products not delivered by truck or you do not have details on the number of boxes and the amount of product delivered by one truck
Script 3: LCA corrugated board sheet: for analysing the part "cradle to corrugated board production" (production included)
Script 4: LCA truck: for analysing the part "delivery of the product by truck", details on the number of boxes and the amount of product delivered by one truck and transportation distance available
Script 5: Compare LCA: comparing two or more LCAs you have made with script 1, 2, 3 or 4
• : data the user is requested to fill in depending on the script he has chosen

In most cases, however, it can be expected that the box design influences the efficiency of the transport. **Table 2** describes three cases, where alternative boxes were compared. The functional unit was 1 ton of transported product for all cases. **Figure 1** (→ *Appendix*) shows an example of the result of comparing in Simapro for the alternatives A, B and C. **Figure 2** shows examples of using the results from Simapro for the boxes described in **Table 2** to show the increase or decrease for acidification potential as a percentage of the acidification potential of the original box system for several phases of the life cycle. The result is similar for other characterisation categories. These examples show that sometimes heavier boxes enable more efficient transports (more product per box and/or more pallets per truck), leading to a higher environmental impact when the boxes are compared at sheet level, but lower impacts when the whole system is considered.

Table 2: Examples of comparing alternative boxes

Box B and C are alternatives for box A, containing cookies

Box	Unit	A	B	C
sheet weight	g	272	158	173
box weight	g	222	124	150
product/box	Kg	9,6	9,6	11,2
product/truck	Ton	17,68	17,50	20,43

Box Ln is the alternative for box Lo, containing meat

Box	Unit	Lo	Ln
sheet weight	g	688	795
box weight	g	667	605
product/box	Kg	30	30
product/truck	Ton	7,36	9,79

Box Tn is the alternative for To, containing tomatoes

Box	Unit	To	Tn
sheet weight	g	245	325
box weight	g	172	245
product/box	kg	5	6
product/truck	ton	9,68	14,39

Script 2 can be used when one wants to compare alternative transportation processes, using European averages of loading efficiencies.

The LCA tool will be updated when new or updated databases, evaluation methods etc. are available. Scripts may be changed or new scripts may be added according to wishes of the users.

The software is also available for others than members of the three Associations. Introduction courses are organised for the users.

For more information please contact:
FEFCO
37, rue d'Amsterdam
FR-75008 Paris
Phone: +33-1-53206680; Fax: +33-1-42829707
E-mail: jpierre.lardillon@wanadoo.fr

4 References

[1] Pré Consultants, Simapro 4 (1997)

[2] FEFCO, Groupement Ondulé, Kraft Institute: European Database for Corrugated Board Life Cycle Studies, Paris/ Darmstadt/Stockholm (1997)

[3] Habersatter K.: Ökoinventare für Verpackungen, Schweizer Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Schriftenreihe Nr. 250, Band I, II (1996)

Appendix

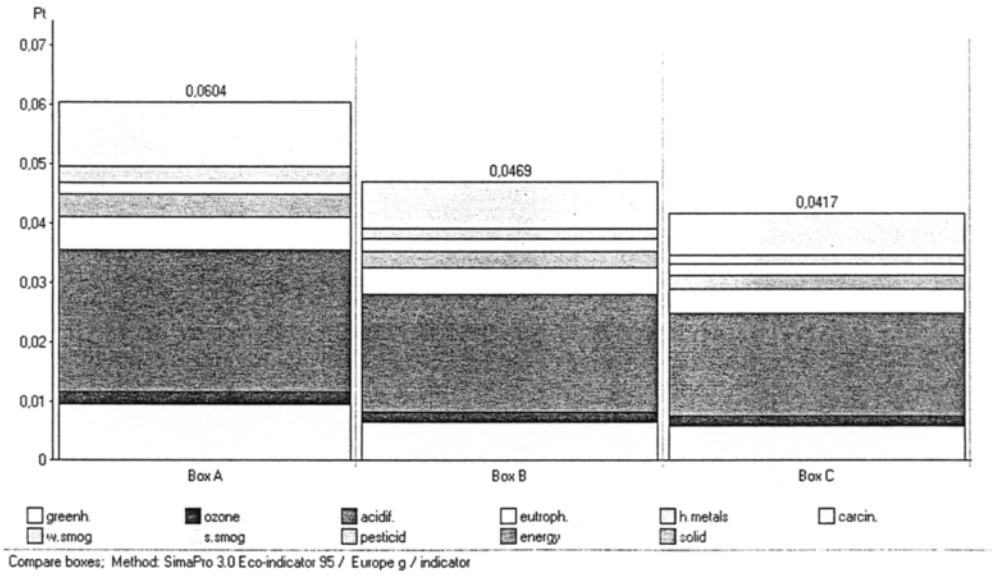

Fig. 1: Example of comparing alternative boxes for cookies (ecoindicator 95)

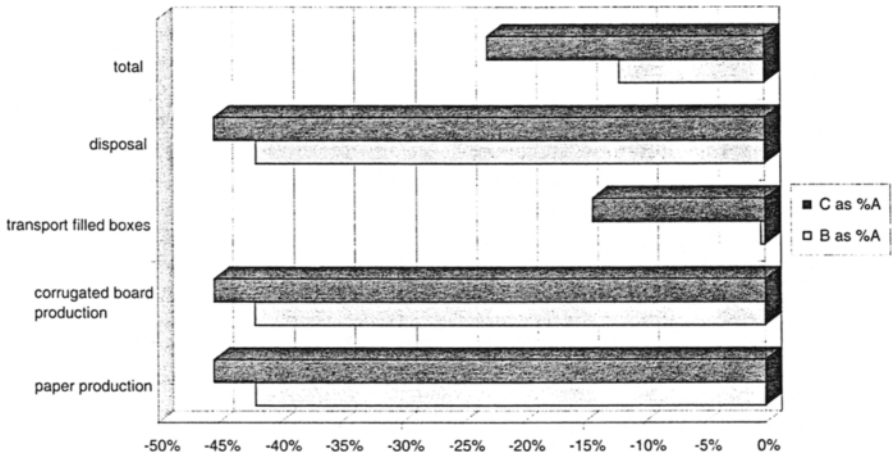

Fig. 2 a: Comparing contributions from phases in the life cycle of alternative boxes (acidification); boxes for cookies

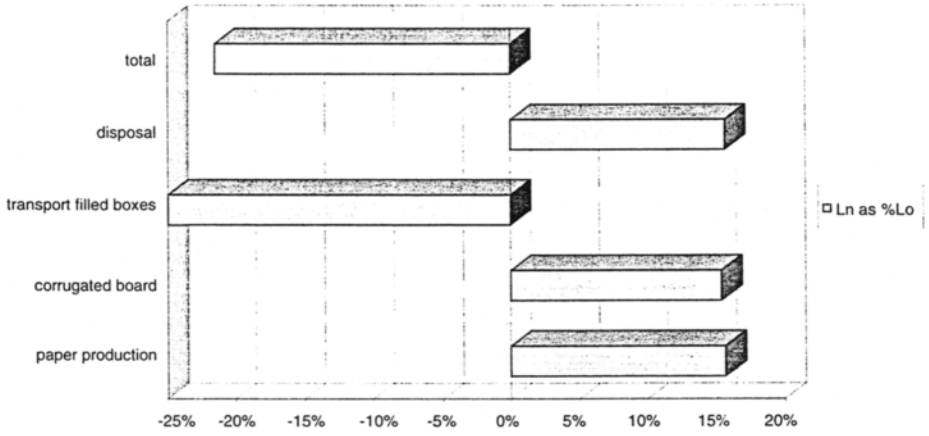

Fig. 2 b: Comparing contributions from phases in the life cycle of alternative boxes (acidification); boxes for meat

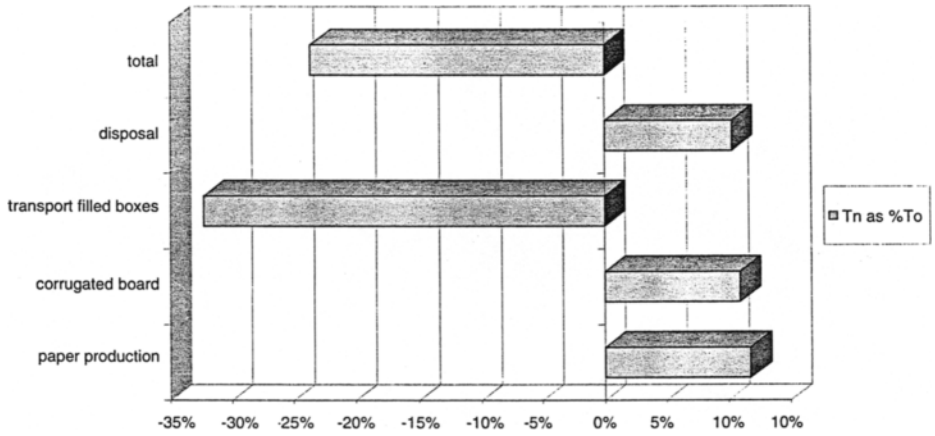

Fig. 2 c: Comparing contributions from phases in the life cycle of alternative boxes (acidification); boxes for tomatoes