CORTICEIRA AMORIM

Analysis of the life cycle of Cork, Aluminium and Plastic Wine Closures

November 2008

ECOBILAN

Agenda

Introduction
General description of the LCA Study
Results
Conclusions

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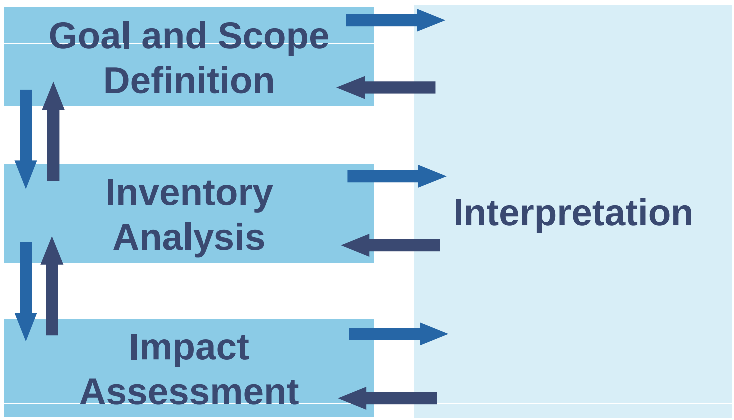
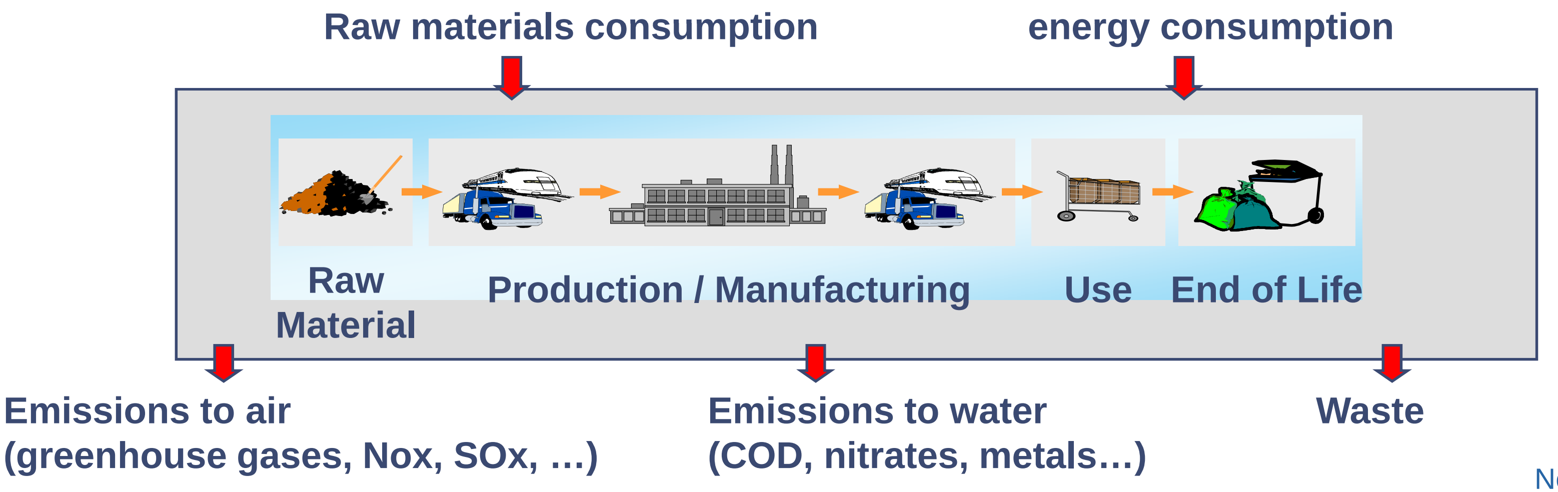
What is an LCA?

- Method for assessing the environmental aspects and potential impacts associated with a product system throughout its life cycle

- Life cycle thinking: compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product





LCA procedure

- Normalized by ISO standards : ISO 14040-4
  - ISO 14040: Principles and framework
  - ISO 14044: Requirements and guidelines

- Critical review: process of ensuring consistency between an LCA and the principles and the requirements of the International Standards on life cycle assessment

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Objectives

- Main goal: Evaluation of the environmental impacts of Cork Stoppers versus Aluminium and Plastic Closures

- Objectives:
  - To identify opportunities to improve the environmental performance of cork stoppers
  - To provide additional information to the wine industry, namely to wineries that want to have a responsible and environmentally friendlier choice
  - To prepare a firm and quantified argument on which Corticeira Amorim can call when comparing cork stoppers with alternative materials

Functional unit

"…sealing a standard bottle of wine bottled and sold on the UK market…"

- Each one of the different closures considered on this survey is studied for an identical functional unit

- The results are presented using one thousand wine closures as the reference flow

- All the three types of closures (cork, aluminium and plastic) can be used for sealing standard 750 ml wine bottles.

Methodology and data used

- TEAM™ software
- The survey was carried out using the methodology of life cycle analysis (LCA) defined by ISO standards, supported by data from:
  - different process units of Corticeira Amorim
  - bibliographic sources, such as internet research
  - Ecobilan LCA database
- This survey does not use proprietary information from the producers of aluminium and plastic closures
- Sensitivity analyses and simulations: variations of the basic scenario in order to validate assumptions (composition of plastic closures, quantity of secondary aluminium used in the process, cork behavior in landfill, carbon sink associated to cork forestry, impact of plastic closures recycling, impact of aluminium closures recycling)

Peer Review

An external critical review was performed by three independent entities, namely:

- An independent life cycle analysis (LCA) expert - Mr. Yvan Liziard
- An independent specialist on cork - Mr. João Santos Pereira - from Instituto Superior de Agronomia of Universidade Técnica de Lisboa
- Association of Plastics Manufacturers in Europe

Besides these entities, an aluminium association was also contacted, but did not accept to cooperate in the review process.

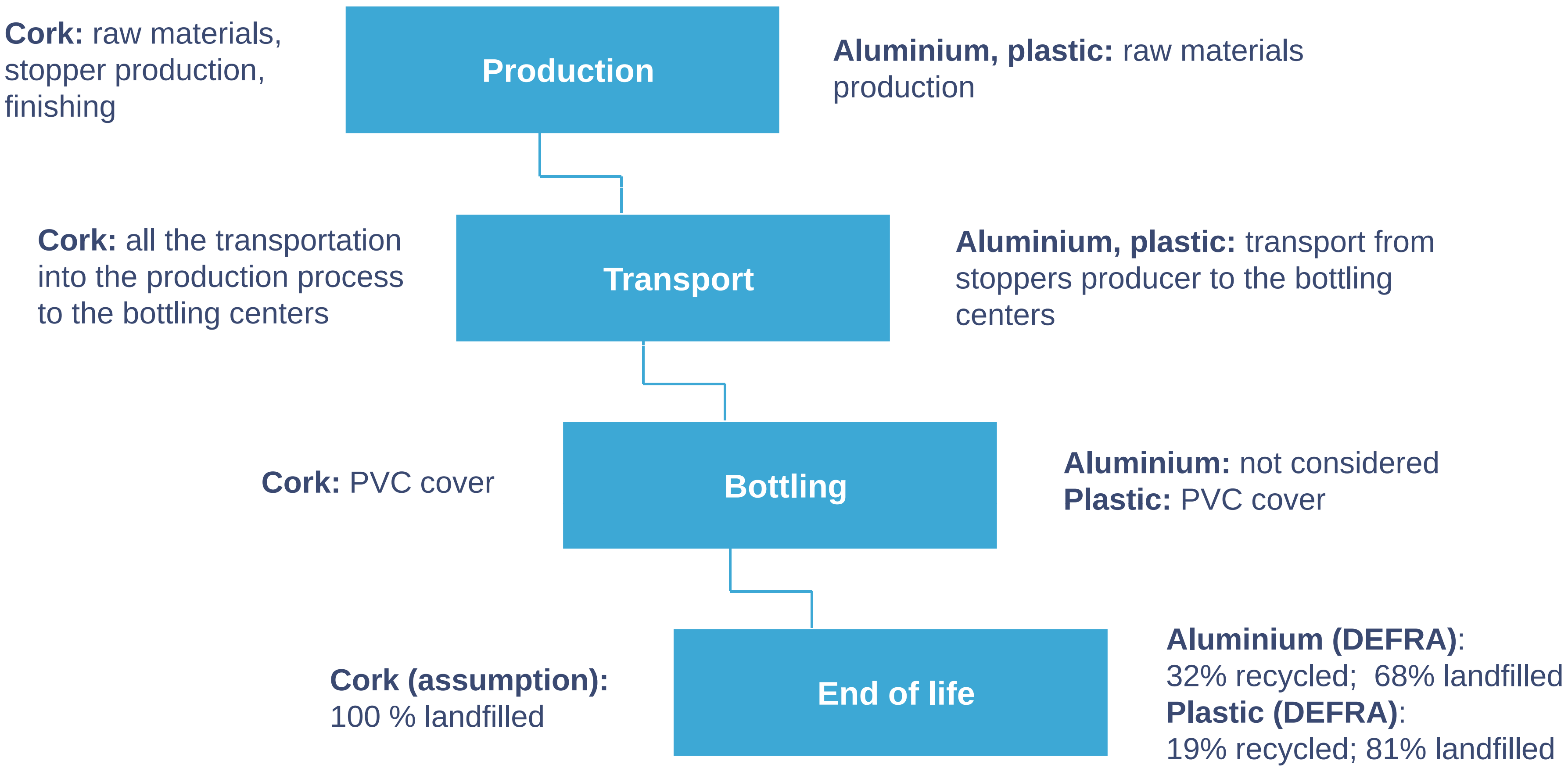
The results of the critical review of the LCA report were considered at the final version of the report and included in the LCA report, together with answers from PwC/Ecobilan

Environmental indicators used

To evaluate the potential impacts of natural and synthetic wine closures on the environment, the survey included the analysis of seven indicators:

- Non-renewable energy consumption
- Water consumption
- Emission of greenhouse gases
- Contribution to atmospheric acidification
- Contribution to the formation of photochemical oxidants (ozone layer depletion)
- Contribution to the eutrophication of surface water
- Production of solid waste

Wine closures model



DEFRA: Department for Environment, Food and Rural Affairs

List of excluded life stages

Due to lack of information In the public domain	Due to methodological reasons	Due to having negligible impacts
• Paints used in PVC covers for cork and plastic closures • Energy consumption in bottling activities, for all types of closures • For aluminium and plastic, production of closures was not included. This survey only includes the production of the necessary intermediate and raw materials.	• Final destination and transportation of wastes • Transport after the bottling site since this will be the same for the three kinds of closures	• The construction of buildings on industrial sites and fabrication of tools and machines • The transport of workers related to the extraction of raw materials, for all types of closures considered • Transport of raw materials for the production of plastic • Energy consumption in administrative areas and laboratory, for all types of closures studied

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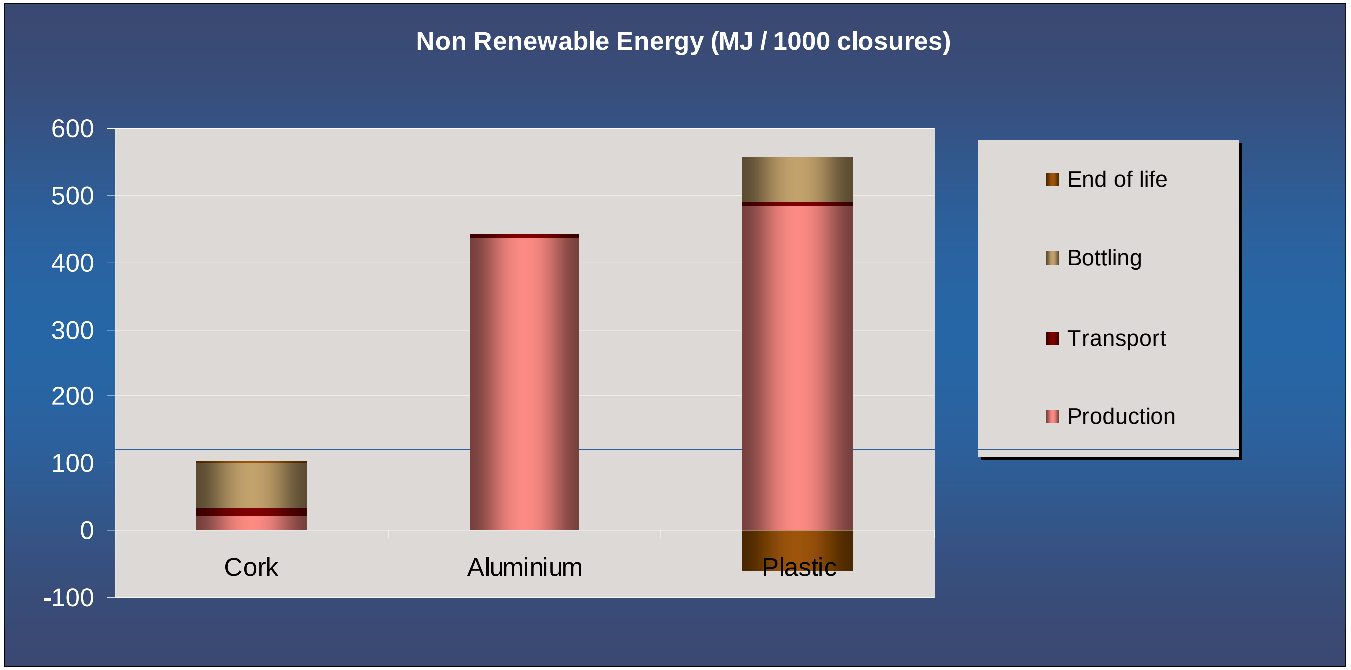
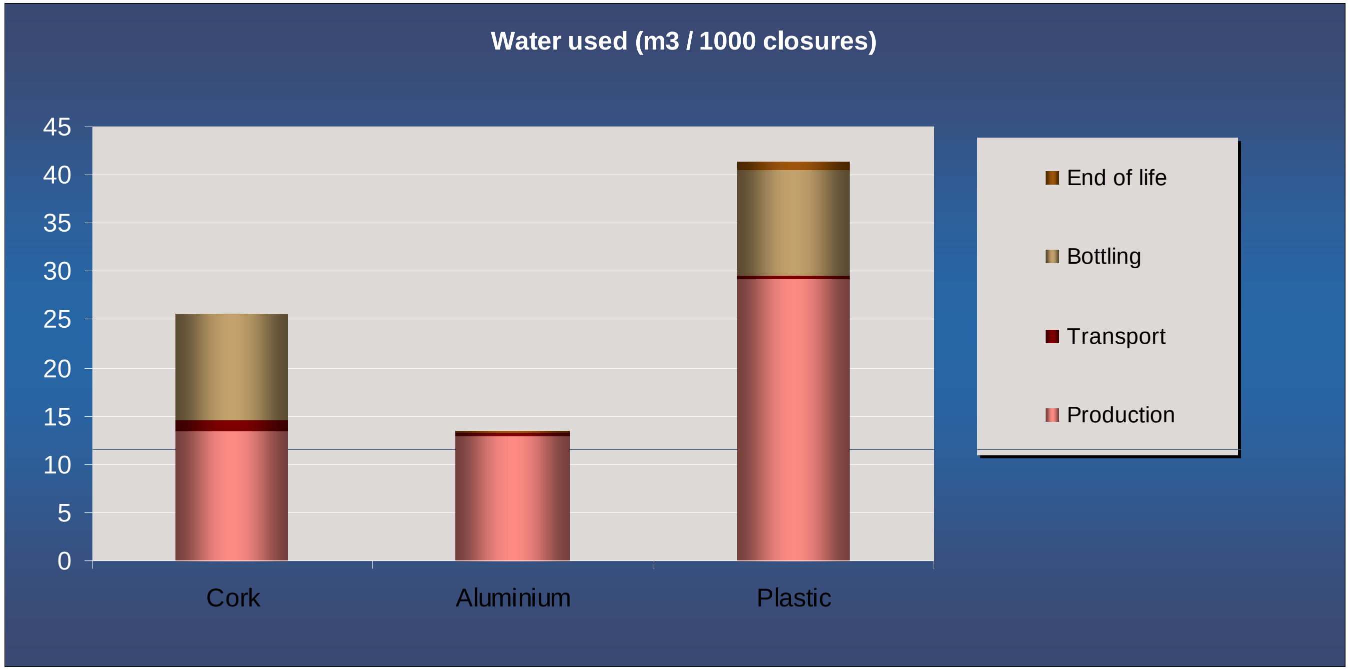
Non-renewable energy consumption



- Higher non-renewable energy consumption for aluminium and plastic closures, due to energy consumed for the production of raw materials.
- Bottling represents for cork stoppers the major part of the energy consumed.

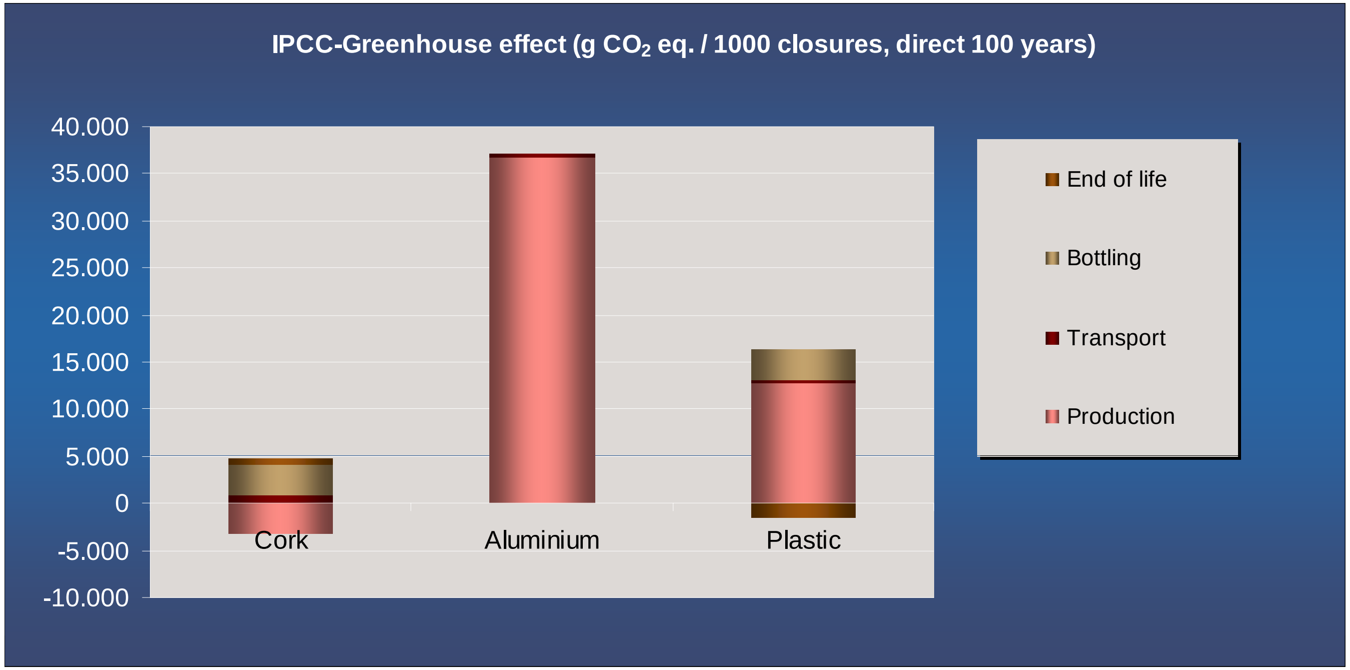
Water consumption



- Plastic closures show the biggest water consumption of all three closures
- Water consumption associated to bottling in the case of cork and plastic closures results from the production of PVC for the PVC cover

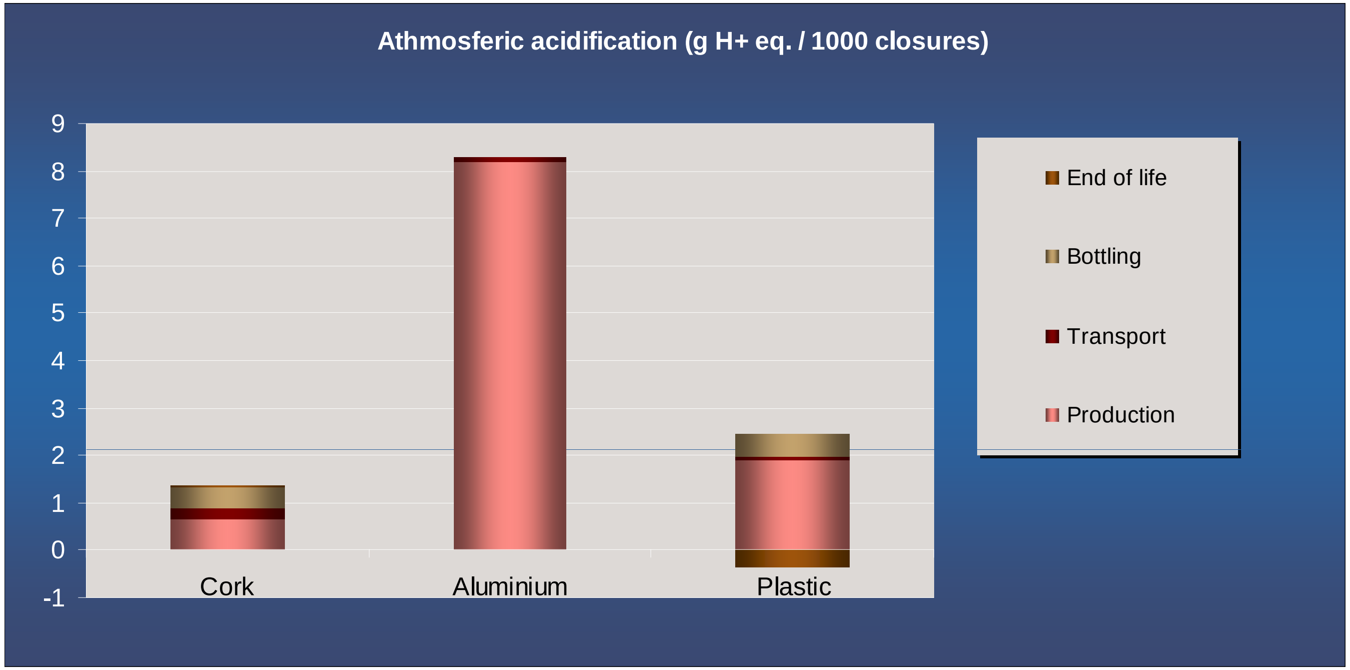
Results

Emission of greenhouse effect gases



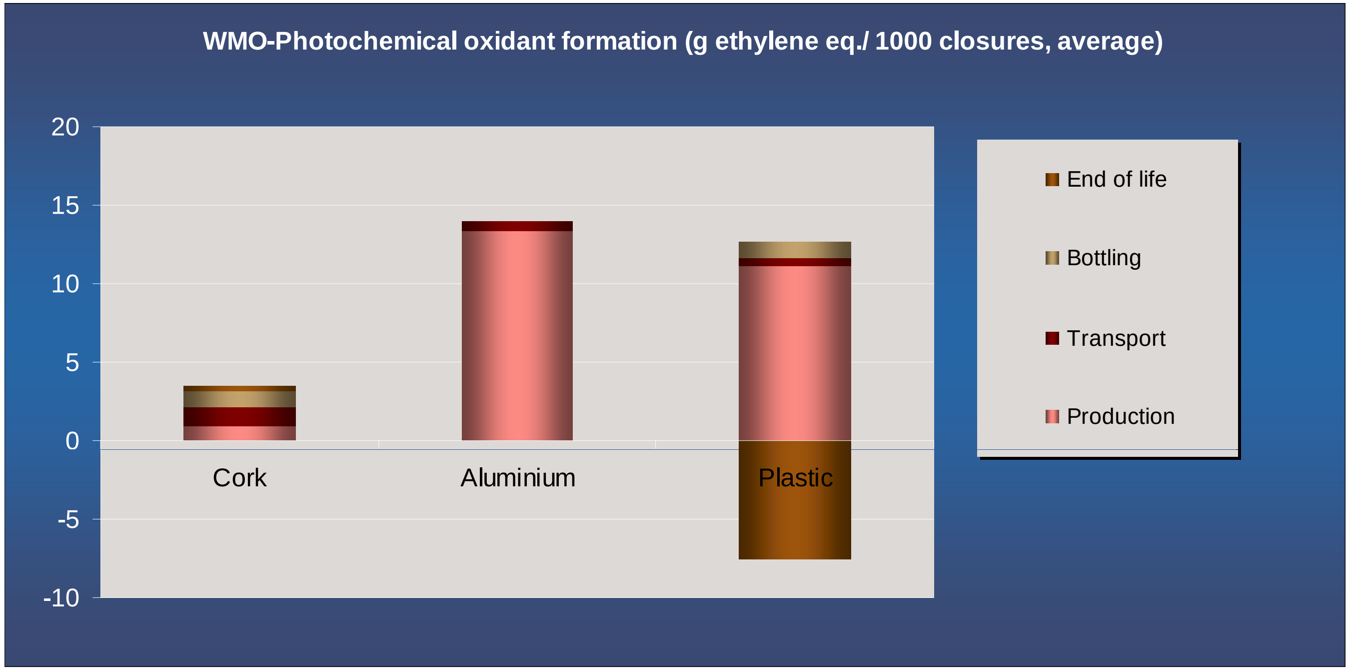
- Aluminium closures are associated to the highest greenhouse effect gases emissions, followed by plastic closures
- Bottling represents for cork stoppers a major part of the greenhouse effect gases emissions.

Contribution to atmospheric acidification



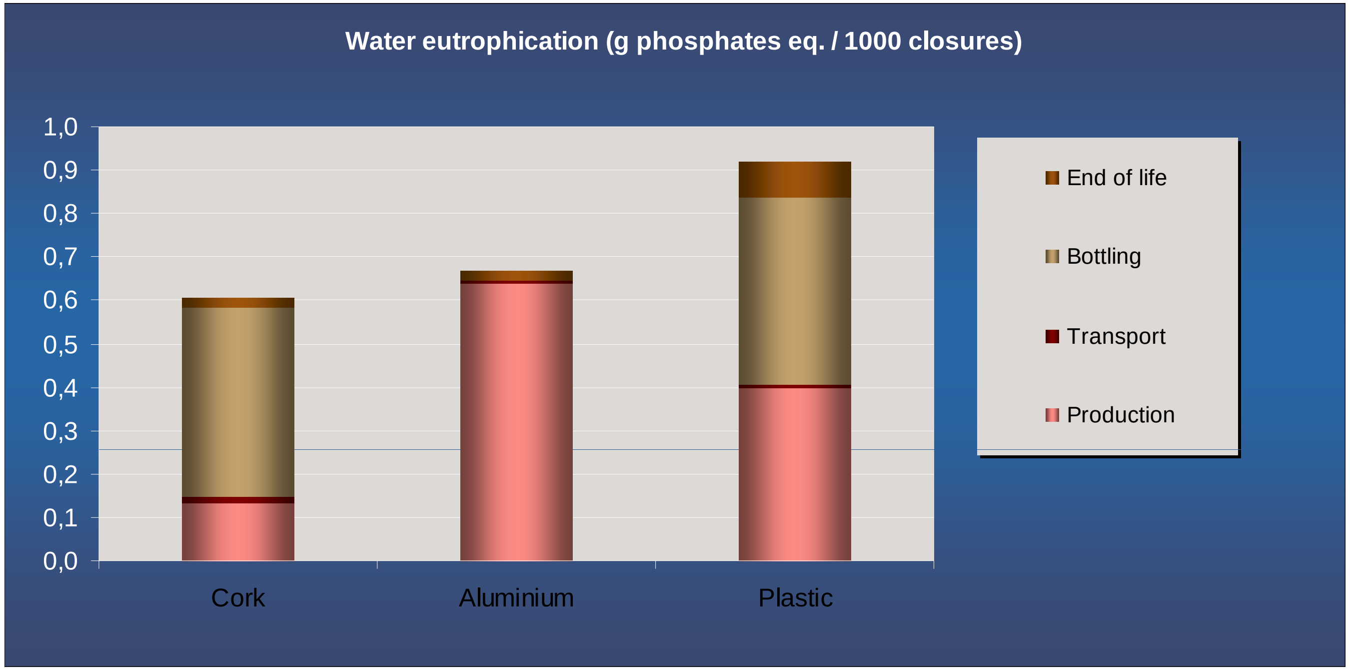
- Aluminium closures are the biggest contributors to atmospheric acidification, followed by plastic closures
- Bottling represents for cork stoppers the major part of contribution to atmospheric acidification

Contribution to the formation of photochemical oxidants



- Aluminium closures are the biggest contributors to the formation of photochemical oxidants, followed by plastic closures
- Transportation represents for cork stoppers the major part of the contribution to the formation of photochemical oxidants

Contribution to the eutrophication of surface water



- Plastic closures are the biggest contributors to water eutrophication, followed by aluminium closures
- Production phase is for the aluminium closures, the most relevant in term of contribution to the eutrophication of water
- Bottling phase is for the cork and plastic closures the most relevant in term of contribution to the eutrophication of water

Total production of solid waste

- Aluminium closures are the biggest producers of solid waste, followed by plastic closures
- In the case of aluminium closures, production phase and end of life are the phases responsible for the major production of solid waste. When compared with cork and plastic closures, production of waste at the production phase in the case of aluminium is significantly higher
- In the case of cork and plastic closures, post-consumer end of life phase is the most relevant in term of production of solid waste

Summary of the relative performances of the closures

Environmental Indicator	Type of stopper		
	Cork Stopper	**Aluminium Stopper**	**Plastic Stopper**
Non-renewable energy consumption	1.00	4.33	4.87
Water consumption	1.90	1.00	3.06
Emission of greenhouse gases	1.00	24.24	9.67
Contribution to atmospheric acidification	1.00	6.15	1.54
Contribution to the formation of photochemical oxidants	1.00	4.04	1.48
Contribution to the eutrophication of surface water	1.00	1.10	1.52
Production of solid waste	1.00	1.99	1.57

Best Performance

Performance poorer by less that 20 % in relation to best performance

Performance poorer by at least 20 % in relation to best performance

Results

Summary of the performances of the closures

Environmental Indicator	Type of stopper		
	Cork Stopper	Aluminium Stopper	Plastic Stopper
Non-renewable energy consumption (MJ/1000 closures)	102,019	441,921	496,747
Water consumption (m^3/1000 closures)	25,643	13,479	41,305
Emission of greenhouse gases ($g\ CO_2$ eq./1000 closures, direct 100 years)	1533,735	37172,460	14833,360
Contribution to atmospheric acidification (g H+ eq./1000 closures)	1,349	8,304	2,078
Contribution to the formation of photochemical oxidants (g ethylene eq./1000 closures, average)	3,452	13,961	5,095
Contribution to the eutrophication of surface water (g phosfates eq/1000 closures)	0,605	0,667	0,918
Production of solid waste (kg/1000 closures)	3,715	7,387	5,839

- Best Performance (light green)
- Performance poorer by less that 20 % in relation to best performance (dark green)
- Performance poorer by at least 20 % in relation to best performance (orange)

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Conclusions – Industrial stages

- The production phase predominates for all the indicators considered (except for solid waste production, where end of life phase predominates)
- In the case of cork stoppers, bottling is the phase of the life cycle with the highest environmental impacts, mainly associated to the PVC cover
- Transport has a minor impact in the total emissions of closures, when comparing with other phases

Conclusions – Environmental Impact

- In comparison to the aluminium and plastic closures, the cork stopper is the best alternative in terms of non-renewable energy consumption, emission of greenhouse effect gases, contribution to atmospheric acidification, contribution to the formation of photochemical oxidants, contribution to the eutrophication of surface water and total production of solid waste

- In comparison to the cork and plastic closures, the aluminium closure is the best alternative in terms of consumption of water, followed by cork stoppers.

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