



Comparative Life Cycle Assessment (LCA) study of tableware for alimentary use

Disposable dishes in PP, PS, PLA, cellulose pulp and reusable ceramic dishes

Disposable glasses in PP, PS, PLA, PE coated cups and reusable glass cups

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EXECUTIVE SUMMARY

Since 2012, the Pro.mo Group has adopted a Life Cycle Thinking oriented approach in order to gain a broader knowledge and greater awareness of the environmental impacts of the products manufactured by its member companies. In the course of 2015, Pro.mo asked company Quotasette S.r.l. to conduct a comparative Life Cycle Assessment (LCA) study of tableware for alimentary use within the framework of food catering services.

The Pro.mo Group brings together the near totality of operators in the industry and therefore the study may be seen as representative of the industry sector, which lends itself to a comparison with products having the same intended uses but coming from different manufacturing sectors (e.g., reusable tableware). The analysis was applied to two types of tableware: plates (single-use dishes in PP, PS, PLA, cellulose pulp and reusable ceramic plates) and cups (single-use cups in PP, PS, PLA, PE coated cups and reusable glass cups).

The study was performed in accordance with standards **ISO 14044 and 14040** and was subjected to a **critical review** process by certification body SGS Italia S.p.a., which means that the review was conducted by knowledgeable and expert reviewers, fully in keeping with the principle of independence.

As part of the research and awareness building activities carried out by Pro.mo, **the comparative Life Cycle Assessment study** aims to contribute to the acquisition of knowledge that might be of use to the Group member companies in pursuing their corporate strategies and policies, with a view to achieving a drastic reduction in the environmental impact of their products, and, at the same time, enable the various stakeholders to gain a better understanding of the issues associated with the life cycles of the products in question and their environmental impacts. In view of the characteristics of the products, which come in contact with food and are widely used in public catering applications, the study is not meant solely for Pro.mo member companies, **but also for lawmakers and the technical staff of public administrations and, in general, all stakeholders committed to the preservation of the environment.**

The **functional unit** adopted consisted of 1000 uses of a dish containing a meal and a cup containing 200 ml of some beverage. In the case of ceramic plates and glass cups, the cleaning process required to make the dishware reusable was also taken into due account (adding up to total of 1000 wash cycles).

The **boundaries of the system** encompass all the stages in the life cycles of the products in question ("cradle-to-grave" LCA), which means that pre-production and production stages are included, together with post-production, up to the end of life of the products.



The LCA study used **primary data** relating to the production process of single-use plastic tableware, i.e., the products manufactured by the Group member companies. The data were acquired in the course of 2014 directly from the production sites of a Group member company. Based on a validation procedure carried out on a statistical basis, these production sites were deemed to be representative of the disposable tableware production modalities adopted by the entire Group. For cellulose pulp plates the primary data were collected at a delocalised plant (eastern Europe), specialising in the production of tableware made from cellulose pulp. **Secondary data** were also used, from the Ecoinvent v. 3.1 database, to include the pre- and post-production processes, i.e., basic materials and chemicals production, energy generation, and, in general, all those processes for which primary data could not be acquired,

The **quality of the data** was assessed according to the criteria defined by the PEF methodology of the European Commission (ref. 2013/179/EU - *Commission Recommendation of 9 April 2013*).

The method used is the most advanced development of the procedures for the assessment of the quality of the data according to standards ISO 14040 and 14044, and it was applied to ensure the reliability and transparency of the results, also for external communication purposes. The assessment performed made it possible to confirm the dependability of the data used in the study, in keeping with ISO 14040/44.

In order to take into account the variability of the end treatments that the products are subjected to after use, different **end of life scenarios** were defined:

1. **CONSERVATIVE**: this is the most adverse scenario for the disposal of the various items considered in the study, which consists of disposal in a landfill;
2. **TARGET**: this is the scenario identified as the technically viable solution for the disposal of the material at end of life, which refers to the objectives established by the European Directive on waste 2008/98/EC;
3. **REAL**: this scenario was defined for, and applied solely to, the disposal of single-use tableware made from plastics (PP and PS) for which reliable data on packaging end of life solutions were available on a national scale (source: Corepla 2013).

The LCA study took into account the benefits arising from recycling and the energy generated through incineration. In other words, the “System expansion” procedure was applied, in order to include in the assessment the impacts avoided in the product systems that come after the System(s) in question.

The benefits taken into account include the fact that recycling reduces the need to produce virgin new raw material as well as electric/thermal energy (through the waste-to-energy process) in new Product Systems. Moreover, a sensitivity analysis was conducted within the framework of the LCA in order to assess the incidence of the composting process in terms of raw materials avoided. The sensitivity test showed that composting does not generate significant benefits in terms of LCA results.

In accordance with the objectives of the study, the following **impact assessment methods** accepted at international level were used in conducting the LCA study: *CML-IA baseline*, limited to the 4 impact categories subject to reporting requirements for purposes of the Environmental Product Declaration (EPD). This method was chosen to serve as the main term of reference to calculate the results and to carry out all the analyses associated with the calculation process (e.g., sensitivity analysis, contribution analysis, etc). The impact categories considered, in fact, are the ones used most widely and recognised at international level thanks to the ever wider use of the EPD. The *ILCD 2011 Midpoint+ method*, with 16 impact categories, used in the new PEF methodology of the European



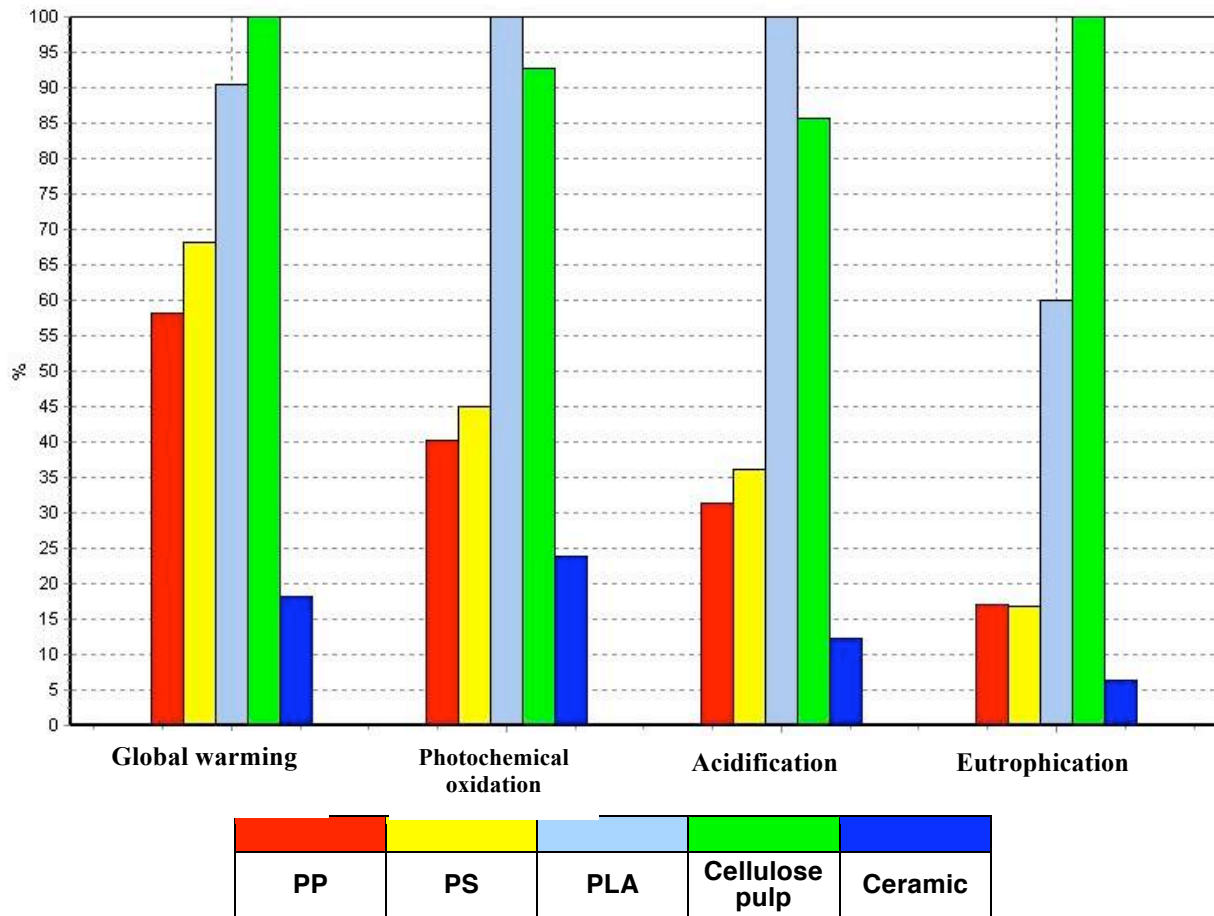
Commission, was also applied. It is believed in fact, that it is important to bring to the attention of the stakeholders the results obtained for the various impact categories through the ILCD method, by adopting the EC approach and allowing for future product environmental performance reporting requirements.

This summary of the comparative LCA shows in chart form the results of **Impact assessment for the entire life cycle** obtained for the two product categories (dishes and cups) according to the CML method and the “target” end of life scenario. The “target” scenario, in fact, was found to be the most representative and closest to actual catering modalities .

In the charts that follow, the results obtained for each impact category are shown in comparative terms. The relative proportions are given in percentage terms: in each impact category, the solution having the largest environmental impact is assigned a value of 100% and the impacts of the remaining options are quantified proportionately.

DISHES: Results of the Life Cycle Impact Analysis study according to the “target” end-of-life scenario

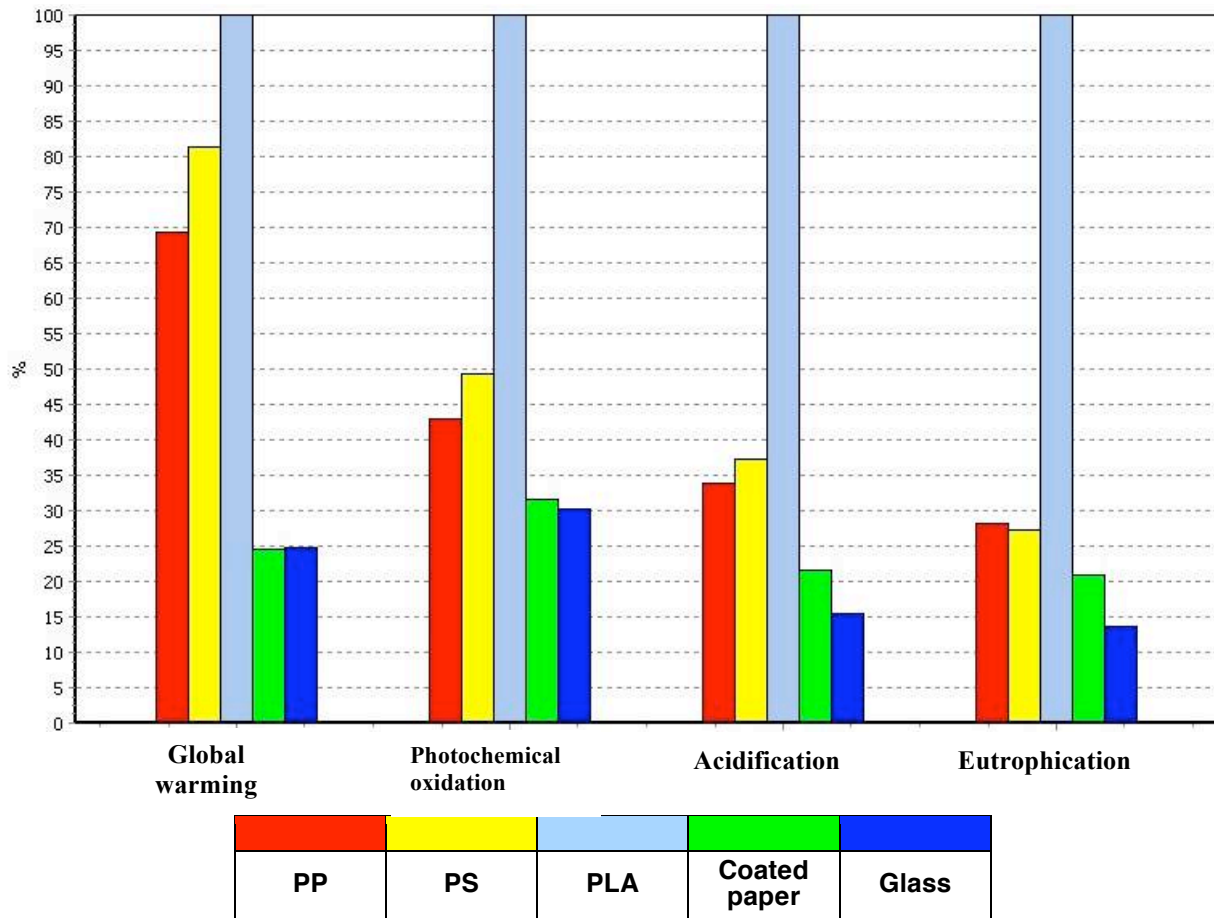
Functional unit: 1000 uses of a dish containing a meal





CUPS: Results of the Life Cycle Impact Analysis study according to the “target” end-of-life scenario

Functional unit: 1000 uses of a cup containing 200 ml of a beverage



From an analysis of the comparative charts we can make the following considerations:

- The products made from biopolymers (represented by PLA in this study) show higher values on average than products made from traditional polymers (PP and PS);
- The environmental performance of products from the wood supply chain (cellulose pulp, paper) are greatly affected by the manufacturing technologies used. In particular, the impact levels obtained for dishes in the cellulose pulp category are always higher than those for dishes made from traditional plastics, and, in two out of four categories, even higher than those obtained for PLA dishes. The results obtained for paper cups, which use a different manufacturing technique from cellulose pulp cups, always show impact values lower than those associated with traditional plastics;



- The impact category values associated with reusable products are significantly lower than those relating to disposable tableware, but for these products the largest impact comes from the utilisation stage, due to the washing process. A more detailed analysis of the washing stage can be performed in the light of the studies currently underway on hygiene related problems and the degree of food safety guaranteed by the washing of the tableware used in catering services.

In general, it can be stated that the different results obtained for the products in terms of impact category show mutual relationships and proportions that remain constant under different end-of-life scenarios and pursuant to different characterisation methods (CML, ILCD), as borne out by the sturdiness of the study in the sensitivity analysis.

The use of the ILCD method offers a wider range of interesting details than the CML method analysed so far. The ILCD method, in fact, is able to assess a number of highly significant aspects of interest to the consumers, such as the impact categories typical of the USEtox model (e.g., various types of human and environmental toxicity), or the Land Use and Water Depletion categories. From an analysis of the results obtained with this method, we find that, in the Land Use and Water Depletion categories, the environmental performance of reusable tableware (ceramic and glass) is worse than that of plastic tableware (PP and PS). Moreover, even paper cups are associated with higher impact levels than those obtained from plastic tableware in 4 categories.

One of the limitations to be noted is that the quality of the data available for the various Product Systems (dishes and cups in the various materials) are not homogeneous and this may affect the uncertainty values in the final results. However, the overall quality of the data always meets the requirements specified in Recommendation 2013/179/EU on environmental footprint determination and reporting. It should also be noted that while it is of great interest in terms of the interpretation of the results, the ILCD method is still at the development stage and shows high uncertainty values in some of the impact categories considered: this is the reason why the results should always be interpreted with the support of LCA experts.

In conclusion, among the strong points whereby this comparative study should be deemed reliable and representative of the overall situation of the sector, we should underscore:

- A careful choice of the products to be compared (dishes and cups) and a consistent application of the functional units (e.g., 1000 uses) and the system boundaries, so as to represent most effectively the context of tableware utilization in catering/collective food consumption services in Italy;
- The decision to conduct the comparative study according to three possible end of life cycle scenarios (conservative, target, real) in order not to overlook any of the situations that may occur within the variable and complex framework of disposal and/or reuse of the materials making up the types of tableware examined;
- The use of specific, and hence higher quality, data, supported by an extensive use of the validation approach (including validation according to statistical models) to guarantee their representativeness relative to the sector;
- The use of two calculation methods, CML and ILCD, which nowadays are the most interesting approaches of LCA as a tool for the environmental assessment of products;



- An extensive series of sensitivity analyses focusing on the most critical aspects of the study, all of them reflecting the sturdiness of the study itself;
- The application of the uncertainty analysis, which, in general, yielded acceptable values, representative of present-day state-of-the-art developments;
- The decision to have the study undergo a critical review by an independent organisation, i.e., a certification body specialising in life cycle studies and accredited by Accredia for EPDs pursuant to ISO 14025.

For a more detailed account, the unabridged version of the LCA study can be downloaded from www.pro-mo.it