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IQPAK® a development by Löning & Partner in cooperation with Fraunhofer LBF Darmstadt

ifeu brief report for the purpose of an indicative environmental assessment

This brief report was prepared by ifeu Institut für Energie und Umweltforschung Heidelberg gGmbH on behalf of Löning und Partner. The primary objective of the report is an environmental assessment of the IQPAK® system, taking particular account of the approximate greenhouse gas analysis carried out by Fraunhofer LBF.

Evaluation of the development/innovation

IQPAK® is a packaging system that combines various reusable and disposable plastic components.

- The central element of IQPAK® is a load-bearing system layer that can be reused because it is a dimensionally stable plastic product. This reusable component is equipped with an RFID chip which allows a range of packaging information to be stored with the product.
- The filling material does not come into contact with the system layer, but is embedded in a so-called content layer. The content layer consists of a thin, dimensionally stable film that is applied directly to the system layer.
- The outer layer is the so-called handling layer, on which product information can be optically applied.
- The content layer and the handling layer are renewed for each application.

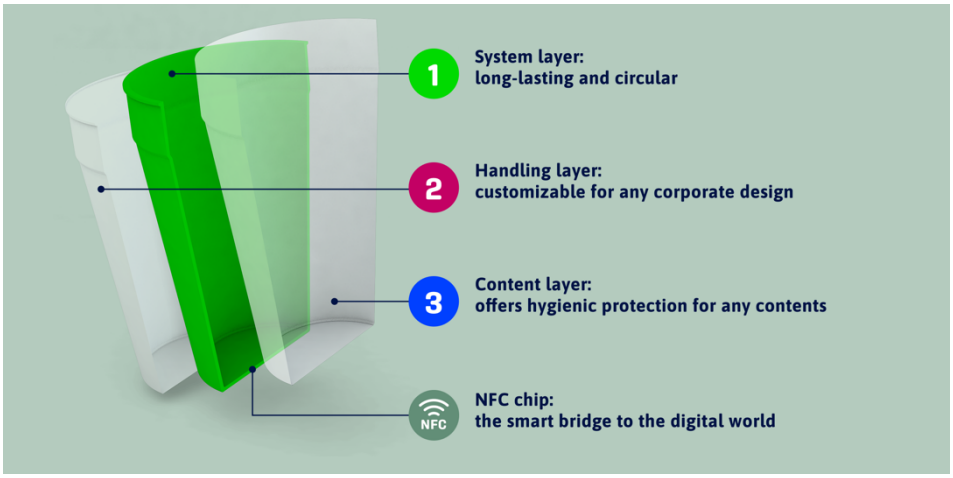

Fig. 1 IQPAK® system architecture *

The IQPAK® system is a welcome innovation on the packaging market, since it enables a significant reduction in single-use packaging thanks to its reusable component as a supporting element and thus serves the ultimate goal of the waste hierarchy - waste prevention.

Concept and ecological performance gain compared to previous systems

The IQPAK® system combines a reusable packaging body with disposable components. This is not unusual, as disposable components are used in many reusable packaging solutions, e.g. as closures, labels and also for outer and transport packaging. Legislation such as the German packaging law does not have a defined threshold value for how much of a packaging system's mass percentage must be reusable for it to be considered reusable[1]. The fact that, as with the IQPAK® system, all parts of the primary packaging that are in direct and permanent contact with the contents are disposable (content layer) is new for consumer-related packaging.

According to the manufacturer, the main goal of this packaging concept is to achieve a high level of hygiene through the use of virgin material and food-grade recycled materials and to avoid possible product contamination from cleaning agent residues

or migrated harmful substances from the last usage cycle. This makes the IQPAK® system primarily suitable for sensitive products. By using the content layer, which is always newly produced, as the sole contact surface with the filling product, the washing process typical in other reusable systems can also be replaced.

The possibility of complete digital integration of the system helps improve production planning and control of the pool (processors and fillers know where the packaging is located and what returns are to be expected and can therefore ensure the pool size is adequate with no reserves required for production peaks). It also serves to ensure high-quality recycling of the disposable components by storing the respective system specifications (the system knows which materials have been used so that the disposable components can be sorted directly into the appropriate recycling fraction).

[1] We recommend clarifying the question of whether IQPAK® can be legally classified as reusable packaging in a discussion with the Ministry of the Environment or the Federal Environmental Agency (UBA).

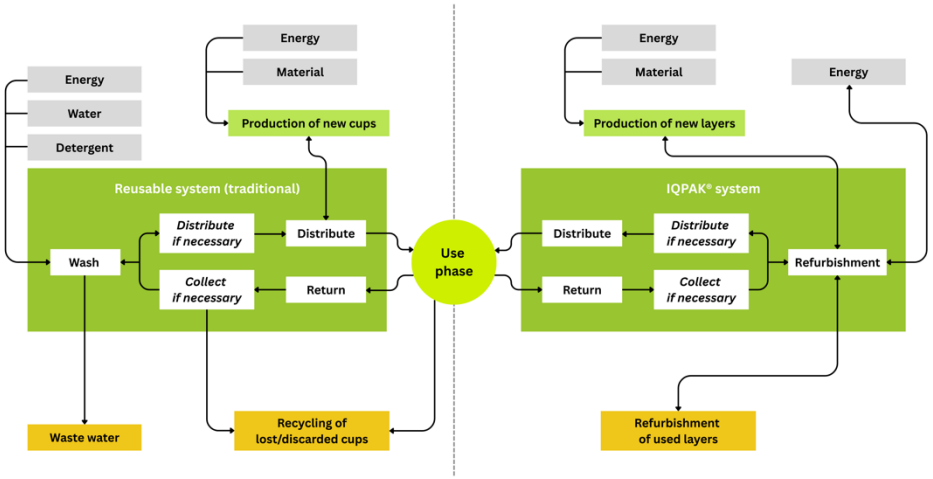

Fig. 2 Comparative system image reusable vs. IQPAK® in the application we investigated (own illustration)

Review of previous life cycle assessment assumptions

The project documentation specifies a use case IQPAK® vs. reusable cups for hot and cold drinks. In this example, the use of IQPAK® can reduce rinsing processes. One possible application would be in system catering or at an event, for example.

The indicative greenhouse gas balance from Fraunhofer LBF focuses on the environmental impact of reusable system rinsing (box "Washing" in the system image on the far left) and the production of the disposable components in the IQPAK® system (gray boxes "Production of new layers" and "Disposal of used layers" in the system image IQPAK® above and below). The production and disposal of the reusable components is not taken into account, nor are the handling processes in the systems accounted for.

The GHG balancing carried out thus reduces the scope of the two systems examined to the basic question of “rinsing vs. production of weight-reduced disposable components". This reduction serves to focus on the underlying research question and can be considered appropriate for an indicative balance.

We leave the reusable components in the systems out of the equation because we assume that these only have a very low impact on the system balance anyway due to the high circulation frequencies. While this is technically an appropriate approach, it does level out possible differences in the circulation frequency of the systems. Assuming that the IQPAK® system achieves higher circulation frequencies than a typical hot beverage cup, the above assumption can be considered conservative in terms of the comparison.

The focus on the production of disposable components is in line with the cradle-to-gate approach. This should be added to the text. In principle, cradle-to-grave balancing would be the more suitable approach for balancing the disposable components, taking into account the disposal routes and possible recycling benefits through the provision of secondary material. Because the IQPAK® system is expected to have a high to very high material recycling rate due to the product information stored in the system layer,

the recycling benefits will exceed the recycling costs. The chosen approach can therefore be regarded as conservative in terms of the comparison.

The environmental impacts of cleaning the reusable cups are taken directly from the UBA life cycle assessment study for hot beverage cups[2] and can be considered valid for the selected area of application.

The illustration of PP production is based on estimated values and proxy data. The Ecoprofiles published by PlasticsEurope should be used here. The processing data used from the PP granulate to the content or handling layer is considered valid.

Using PlasticsEurope data and process data from the ifeu database, the following GHG values can be calculated for the disposable components in the IQPAK® system:

- PP cradle to gate: 5.34 kg CO2e per 1,000 cups
- PP cradle to grave: 4.80 kg CO2e per 1,000 cups with a recycling rate of 90%
- rPP cradle to gate: 3.67 kg CO2e per 1,000 cups
- rPP cradle to grave: 3.14 kg CO2e per 1,000 cups with a recycling rate of 90%

The GHG emissions calculated by Fraunhofer LBF therefore tend to be on the high side and can be considered conservative for the purposes of comparison.

[2] Texts | 29/2019 Investigation of the ecological significance of disposable beverage cups in out-of-home consumption and possible measures to reduce consumption https://www.umweltbundesamt.de/publikationen/oekologische-bedeutung-einweggetra- enkebecher

Recommendations for action and outlook

Löning und Partner and the Fraunhofer LBF are recommended to communicate the existing limitations transparently when communicating the results of the indicative GHG calculation. These limitations are:

- The systems are not assessed in a comprehensive manner; the focus is on the comparison of rinsing vs. production of the disposable components in the IQPAK® system
- The system space of the disposable components in the IQPAK® system is restricted to a cradle-to-gate balance

The specifications and assumptions made as part of the indicative GHG calculation are comprehensible, the results are valid and can be regarded as reliable for the evaluation of the IQPAK® system.

Nevertheless, we would advise the client to supplement the balance in a further step and perhaps change the focus:

- For the purposes of a comprehensive analysis, it would be necessary to establish a balance for all system components in order to better identify the differences and special features inherent in the system (e.g. different circulation frequencies and recycling feed rates)
- A variant with green electricity in the rinsing process and in the production of disposable components should be assessed and discussed
- The system space should uniformly represent the system boundary "cradle to grave" for all system components
- A comparison with disposable systems should be included in order to present the advantages of the IQPAK® system more clearly
- A further study group comparing the IQPAK® system in the capped state with equally tightly sealed disposable and reusable systems could generate additional information.

The last point in particular is important and requires more in-depth classification. Many reusable systems use disposable components (e.g. caps, labels), so this cannot be a point of criticism of the IQPAK® system. In the public and political debate, however, the performance indicator "waste generation" is often used in addition to LCA results. Therefore, when designing the IQPAK® system, care should be taken to ensure that the disposable components only account for a small proportion of the system's mass.

Against this background, the question arises as to whether it is a good idea to pitch the IQPAK® system against reusable beverage cups (one of the few reusable systems without any disposable components). The inherent advantages of the IQPAK® system over commercially available reusable and disposable systems are likely to become clearer in other fields of application.

In principle, we consider the IQPAK® system to be predestined for the packaging of dairy products such as yoghurt, cream cheese, desserts etc. due to its design.

To date, there are only a few reusable alternatives in this product segment, which also only cover a specific filling size range (reusable 250ml and 500ml glass containers and

reusable 500ml and 1,000ml milk bottles) and are also each equipped with a disposable tinplate cap. The bottlers often criticize the hygienic condition of the deposit return (mould formation) and the associated effort for cleaning the containers. Common disposable alternatives for dairy product containers under 500ml are therefore plastic cups or 3K cups (plastic cups with paper coating) with an aluminum or plastic/paper composite liner as a closure. Above 500ml, composite beverage cartons are widely used as disposable packaging. As a system that is more or less freely scalable in terms of fill size, IQPAK® can offer a reusable alternative here that avoids the hygienic problems of deposit returns.

6/6 We therefore recommend that the client Löning und Partner consider marketing the system in this area and we also recommend carrying out a possible complete and comparative life cycle assessment of the system in this product segment.

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* Graphic changed from original version dated August 29, 2023

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