TECHNICAL REPORT: EXCERPT

REUSABLE FOOD SERVICE WARE

What are the environmental benefits of using reusable food service ware compared to single-use food service ware?

A summary report from a meta-analysis by:

Oregon State of Oregon Department of Environmental Quality

Franklin Associates, a Division of Eastern Research Group

State of Oregon
DEQ Department of Environmental Quality

November 2018

Summary findings for *reusable* food service ware

Background

DEQ's meta-analysis of food service ware life cycle assessments addressed four attributes: recycled content, biobased, recyclable and compostable. *Reusability* was not a primary focus of that research. However, DEQ's contractor, in the course of reviewing literature specific to the four in-scope attributes, found several assessments that also compared *reusable* vs. single-use food service ware. High-level results from these comparisons are summarized in this document. This does not constitute an exhaustive review of the literature addressing the environmental impacts of *reusable* vs. single-use food service ware. There is likely other relevant research that was not reviewed, because *reusability* was not in the scope of DEQ's research. What follows is a lightly edited excerpt from the longer technical report, which is available in full at https://www.oregon.gov/deq/mm/production/Pages/Materials-Attributes.aspx.

Considerations Related to *Reusable* Food Service Ware

While *reusability* as an attribute is outside of the scope of this work, and studies with quantitative results for *reusable* packaging were not identified during the literature review, *reusable* food service ware is well represented in LCA literature. Some of the studies included in the FSW review that considered one or more of the four main attributes also included quantitative results for *reusability* of FSW products as part of their analyses. Additionally, several studies were also found that focused exclusively on environmental aspects of *reusability* of FSW products (Garrido & Alvarez del Castillo, 2007; Woods & Bakshi, 2014). While studies that focused only on *reusable* food service ware and quantitative comparisons focusing of *reusability* of FSW from the studies included for other attributes were not performed and not included in the scope of this review, the prevalence of *reusability* in the literature suggests it is an active area of research for sustainability of FSW products. Below is a qualitative discussion of the findings for *reusable* FSW of the studies included in this review for one or more of the other attributes.

Five studies included in this review provide results for individual impact categories for *reusability* in their analysis of FSW products in addition to results for at least one other attribute. Additionally, Broca (2008) included aggregate environmental results for a comparison of *reusable* vs. incinerated plates. Results from these studies suggest that after certain number of cleaning cycles, reuse of FSW products is usually environmentally preferable when compared to disposable FSW options, though results depend on the specific comparisons considered. The exact number of uses needed for impacts of *reusability* to be less than the impacts of a functionally equivalent number of disposable FSW items varies by study, item type, and materials of the compared items. Select results for *reusability* from these studies are summarized below.

Reusability is usually preferable to most end-of-life options for disposable FSW. For example, the Pro.mo industry group (2015) compared the impacts of glass cups after 1,000 reuses against the impacts of 1,000 disposable cups, made from plastic (PS, PP) and biobased (PLA, cellulose pulp) materials. They also compared *reusable* porcelain dishes against disposable dishes of the same disposable materials as the cups. Both *reusable* options performed better than disposable alternatives for all 10 impact categories considered (the energy demand category was not included in the analysis). This result was consistent regardless of whether the

disposable products were landfilled, incinerated, recycled, or disposed with some combination of these methods. Most of the impacts for the glass cups and porcelain dishes are from the multiple machine-washing cycles, with water consumption and land use being the two categories with the highest impacts.

Though *reusability* is usually preferable, the way *reusability* is measured effected the results. Indeed, Potting and van der Harst (2015) compared PS cups disposed via incineration vs. *reusable* cups, both hand and machine-washed. However, the comparisons for this study focused on the impacts of reusing the cups a certain number of times before washing them. The authors considered this approach a more just comparison between the two types of cups, because the disposable cups can also be reused before being discarded, and the authors consider the washing phase of the *reusable* cup similar to the disposal of the PS cup. Results vary by number of reuses before washing of the cups. With only one use before washing, the *reusable* cup performs better in four of the eight impact categories measured when machined-washed, and worse in all categories when hand-washed. When used two or more times before washing, the *reusable* cups perform better than the disposable cups in all categories except ozone depletion (for which the study does not provide a break-even point) for both types of washing. However, the authors note that the results for the *reusable* cups are more uncertain than the results for the PS cup due to the larger uncertainty in the end of life for the *reusable* cups (modeling of the washing process) than for the PS cups (modeling of the disposal for PS cups).

Two of the studies included in this review analyzed the impacts of *reusable* vs. disposable cups at different types of events, where the results for *reusable* cups were not always clearly preferable. Pladerer and colleagues (2008) compared the impacts of PET, PS, PLA, and paperboard cups against *reusable* cups during two different soccer tournaments: a summer long international tournament that lasted three months, and a domestic league soccer season that lasted nine months. Results were favorable in all comparisons for the *reusable* cups, even in situations where the visitors took the *reusable* cups with them after the events. On the other hand, Vercalsteren and colleagues (2006) analyzed PE, PP, PLA, and *reusable* cups at both small and large events, defined as less than 2,500 people and greater than 30,000 people, respectively. Their analysis did not provide an overall superior cup system. The results were dependent on cup weight for the disposable cups and on distance shipped and washing method for the *reusable* cups, with various combinations of *reusable* cup shipping distance and washing methods performing worse or better than using disposable cups for the events.

Broca (2008) and Harnoto (2013) analyzed the *reusability* of FSW products other than cups, but likewise found that *reusable* materials usually perform better after a certain number of reuses. Broca compared ceramic vs. PLA plates, and while the study did not provide results for individual impact categories, aggregate results using *Eco-indicator 99* show that ceramic plates become environmentally preferable after 50 use cycles when compared to an equal number of disposed plates. Harnoto compared bagasse-based compostable clamshells vs. polypropylene based *reusable* clamshells for takeout. The study compared the average number of reuses of the PP clamshells before breaking (43, determined by testing at a pilot site) as well as for number of reuses specified by the manufacturer of PP clamshells (360, using several PP clamshells) against a like number of compostable shells. Overall, the PP clamshells performed

better for the global warming and energy consumption categories for both functional units while the compostable clamshells perform better for water consumption.

Reusability was not an attribute included in the scope of this work. As a result, a thorough literature review was not performed for *reusability*, and the results presented above represent only a qualitative description of the analyses performed in the studies mentioned. Additional literature review and more quantitative comparisons of the results of studies concerning *reusable* FSW should be performed before a definitive conclusion can be reached.

Select notes

- The key factors to gain maximum benefits of *reusable* systems are:
    - The number of reuses or trips before discard/replacement. This is a critical factor for any *reusable* item as they tend to be built to be more durable that single use alternatives.
    - The cleaning process (frequency, manual or machine wash, energy for heating water, water use and detergent use, etc.)
- *Reusable* tableware has impact categories values significantly lower than disposable tableware. Typically the most impacting phase proves to be the use phase, with the washing process.
- Results for *reusable* cups are highly uncertain due to widely varying user behavior, though they usually outperform disposable cups. Disposable cups that are reused have comparable impacts to *reusable* cups.

Specific studies

Vercalsteren, An, Carolin Spirinckx, and Theo Geerken. (2010). Life Cycle Assessment and Eco-Efficiency Analysis of Drinking Cups Used at Public Events. The International Journal of Life Cycle Assessment 15 (2): 221–230. https://doi.org/10.1007/s11367-009-0143-z

- *Reusable* polycarbonate cups: Impacts differ most between small and large-scale events
    - Differences caused by impacts of machine cleaning at large scale events (vs. manual cleaning) and trip rates to events
- At public events, *reusable* cups have a better environmental eco-efficiency score for small events, but higher cost score than the other cups. Results are inconclusive for large events.

Pladerer, Christian, Markus Meissner, Fredy Dinkel, Mischa Zschokke, Günter Dehoust, and Schüler, Doris. (2008). Comparative Life Cycle Assessment of Various Cup Systems for the Selling of Drinks at Events. Prepared for Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management and the Swiss Federal Environment Authority. http://www.meucopoeco.com.br/environmental_study.pdf

Cold cups at events (0.5 L cup used for beer or soft drink):

- All *reusable* cup scenarios show lower environmental burden compared to the examined disposable cup scenarios. Polypropylene cups performed best with subsequent reuse of the cups.
- An important factor on the results is the number of *reusable* cups that are taken home, their influence on the displacement of use of other cups

- Results are similar for short-term (summer) and long-term (yearlong) sport settings.
- The environmental burden of disposable PLA cups is comparable to that of disposable PET cups and much higher than that of disposable cups made of paperboard.
    - Composting of the cups does not result in a reduced environmental burden because composting of this type of plastic does not render any tangible ecological benefit. Also, the effects of disposal are marginal compared to the production of the cups.

Harnoto, Monica. (2013). A Comparative Life Cycle Assessment of Compostable and Reusable Takeout Clamshells at the University of California, Berkeley. Retrieved from https://nature.berkeley.edu/classes/es196/projects/2013final/HarnotoM_2013.pdf

Reusable takeout clamshell (polypropylene) compared to bagasse compostable clamshell

- Polypropylene clamshells perform better for the global warming and energy consumption categories for both functional units; PP performs better for material waste under the pilot program functional unit, and they are both assumed to produce no waste under the By Design functional unit.
- Compostable clamshells perform better for water consumption.
- The higher the number of reuses, the greater the water consumption by the PP clamshells.

References

Broca, Mita. 2008. “A Comparative Analysis of the Environmental Impacts of Ceramic Plates and Biodegradable Plates (Made of Corn Starch) Using the Life Cycle Assessment Tool.” Masters, New Delhi, India: TERI School of Advanced Studies. http://sustainability.tufts.edu/wp-content/uploads/LifeCycle AnalysisPlasticPlatevsCeramic.pdf.

Garrido, Nuria, and M. Dolors Alvarez del Castillo. 2007. “Environmental Evaluation of Single-Use and Reusable Cups.” *The International Journal of Life Cycle Assessment* 12 (4): 252–56. https://doi.org/10.1065/lca2007.05.334.

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Pladerer, Christian, Markus Meissner, Fredy Dinkel, Mischa Zschokke, Günter Dehoust, and Schüler, Doris. (2008). Comparative Life Cycle Assessment of Various Cup Systems for the Selling of Drinks at Events. Prepared for Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management and the Swiss Federal Environment Authority. http://www.meucopoeco.com.br/environmental_study.pdf

Potting, José, and Eugenie van der Harst. 2015. "Facility Arrangements and the Environmental Performance of Disposable and Reusable Cups." *The International Journal of Life Cycle Assessment* 20 (8): 1143-54. https://doi.org/10.1007/s11367-015-0914-7.

Vercalsteren, An, Carolin Spirinckx, and Theo Geerken. (2010). Life Cycle Assessment and Eco-Efficiency Analysis of Drinking Cups Used at Public Events. The International Journal of Life Cycle Assessment 15 (2): 221–230. https://doi.org/10.1007/s11367-009-0143-z

Woods, Laura, and Bhavik R. Bakshi. 2014. “Reusable vs. Disposable Cups Revisited: Guidance in Life Cycle Comparisons Addressing Scenario, Model, and Parameter Uncertainties for the US Consumer.” *The International Journal of Life Cycle Assessment* 19 (4): 931–40. https://doi.org/10.1007/s11367-013-0697-7.