



### Introduction

Packaging protects goods and diminishes losses of food, but also produces enormous amounts of waste. Mechanical recycling is one of the possibilities to get this post-consumer packaging waste into circularity. Nevertheless, it is challenging to meet the required decontamination, even more for food contact materials. Thus, this study concerns with volatile organic compounds (VOC) emitted from separately collected yoghurt cups to evaluate different washing programs of a recycling process.



### Materials and Method

#### Sample Preparation

- Two fractions of post-consumer yogurt cups:
  - Polypropylene (PP)
  - Polystyrene (PS)
- Materials were shredded and differently washed in a laboratory scale according to Table 1.

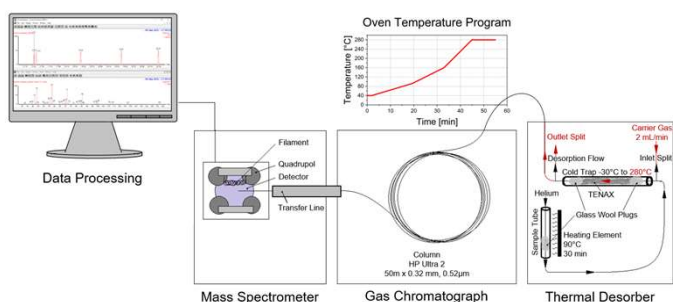
**Table 1:** Different washing parameters used for the analysis.

Washing Program	Temperature [°C]	Detergent
not washed	-	-
cold	20	-
hot	40	-
hot + soda	40	NaCO <sub>3</sub>

- The grinded materials were reprocessed into film sheets of approximately 100 µm thickness.
- Specimens of 10 x 30 mm were cut out of the film sheets.

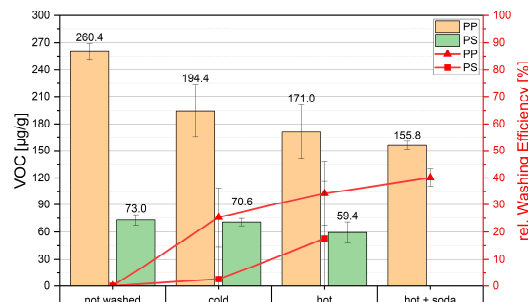
#### Method

- The analyses were conducted on a thermal desorber connected to a gas chromatograph which was equipped with a mass spectrometer (ATD-GC-MS, PerkinElmer, USA). A scheme and important parameters are depicted in Figure 1.
- Semi-quantitative evaluation was performed with toluene standards.
- Qualitative evaluation was done via database matching.



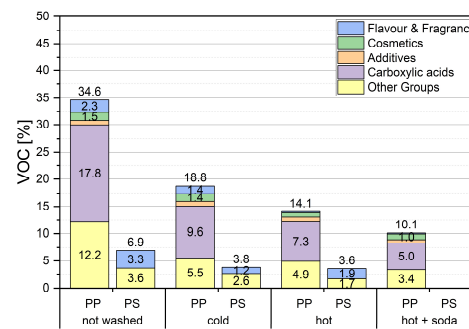
**Figure 1:** Scheme of the analyzing equipment including important parameters.

### Results



**Figure 2:** Quantitative results and relative washing efficiency of PP and PS sheets.

- The different washing programs have an effect on the VOC emissions as depicted in Figure 2.
- Samples of PP show significantly higher values than with PS.
- The relative washing efficiency increases with harsher washing conditions in both fractions.



**Figure 3:** Relative amount and composition of contaminations.

- Degradation products build the main part of VOC emission.
- Contaminations: Substances were identified via MS database which are classified according to the legend in Figure 3 above.
- Washing significantly reduces contaminations relative to the not washed samples.
- The PS fraction is generally less contaminated compared to PP.
- First estimations for food compliance show way lower values than the legally prescribed overall migration limits (OML) as compared in Table 2.

**Table 2:** Comparison of OMLs and calculations based on the analysis results.

OML (EU No. 10/2011)	PP not washed	PS not washed
10 mg/dm <sup>2</sup> material	0.13 mg/dm <sup>2</sup> material	0.03 mg/dm <sup>2</sup> material
60 mg/kg food	0.76 mg/kg food	0.20 mg/kg food

### Conclusion

- The developed method is suitable to support the improvement of the recycling process.
- It is possible to rank different washing methods.
- Direct thermal desorption is interesting to gain information about food compliance.

**Acknowledgment:** The authors acknowledge financial support through the COMET Centre CHASE