

# CSI Miele

## Circularity & Sustainability Investigations @ Miele



Material Meets Engineering | 15.06.2023

Dr. Tatjana Dänzer

# Agenda

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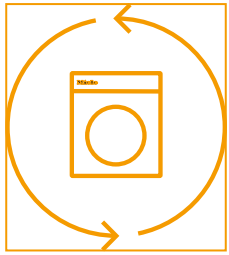
1. Miele's Sustainability Strategy in a Nutshell
2. Our Experiences With Plastic Recyclates So Far
3. Mechanical Recycling of Plastic Material From the WEEE Stream

Video:

**Miele - Quality Ahead of Its Time**

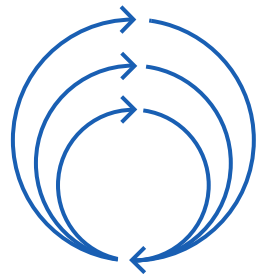
# Tradition & Innovation – For More Than 120 Years

- Company founded in 1899 by Carl Miele and Reinhard Zinkann
- Family-owned company with more than 80 family shareholders
- Six Executive Directors, including two founding great-grandsons
- Holding a consistent position in the premium segment
- Miele is considered the quality and innovation leader in its branch of industry



Make sustainability happen at every step

Make appliances that won't leave a mark

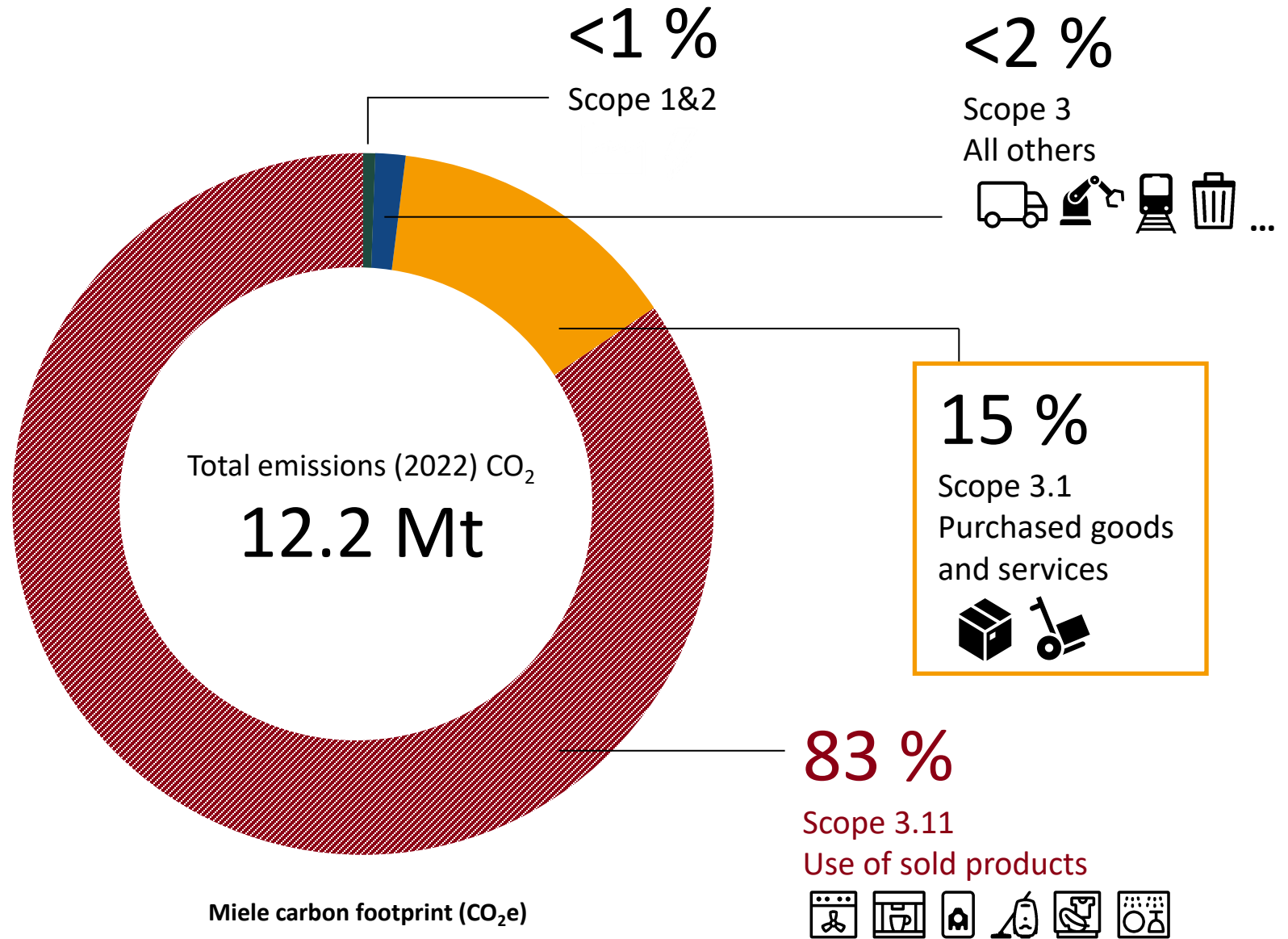


End waste by giving our appliances new life



Our decisions impact the lives of those who use our products.

So, we inspire and support people to make positive changes, to consume more responsibly and to live better everyday lives.



# End Waste by Giving Our Appliances New Life





We are working towards creating a circular value chain with net-zero waste for all materials used in our appliances to re-enter the loop at the end of their lifecycle

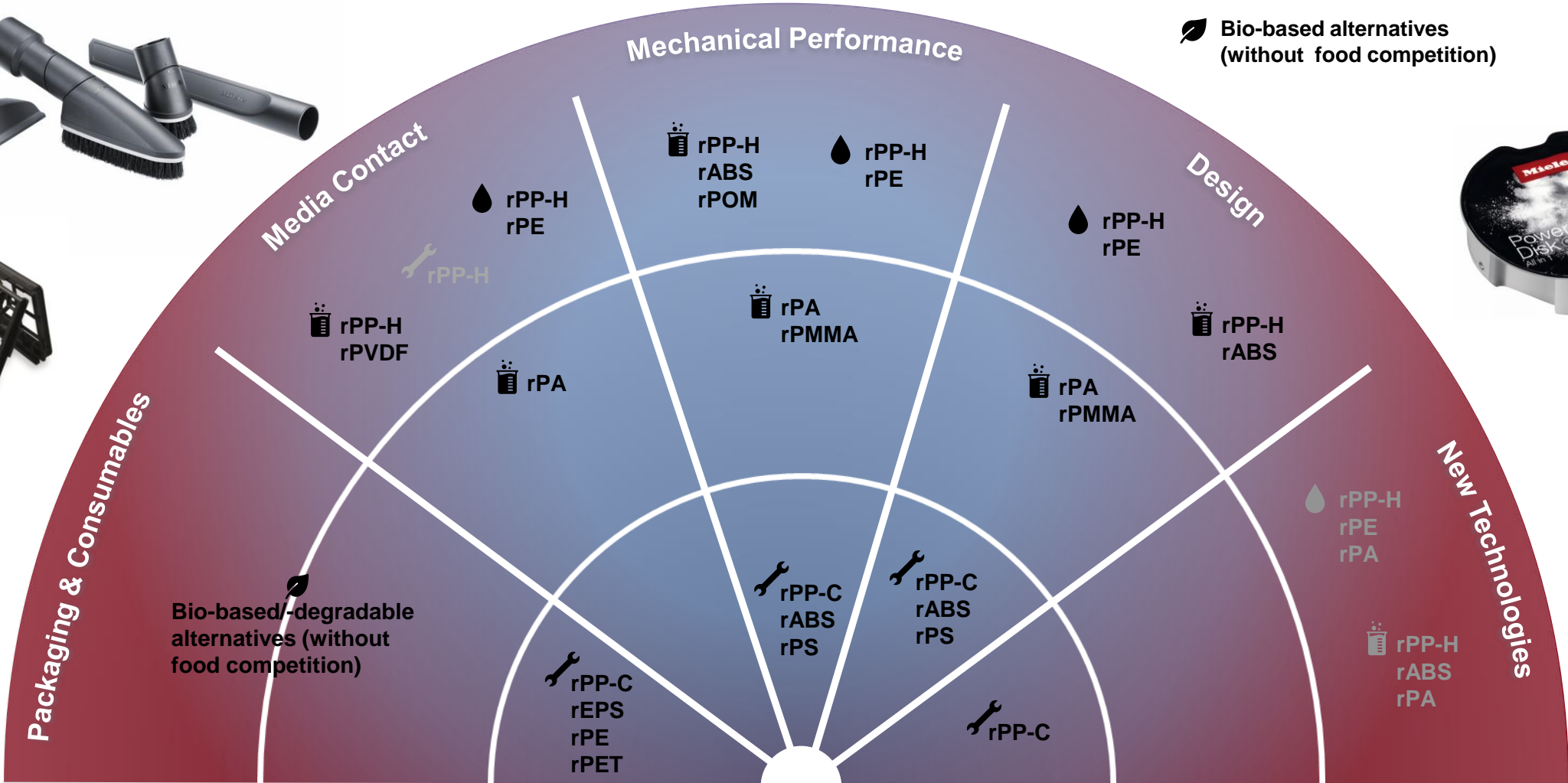
How can we join forces to promote circularity?

**Focus:**  
**PP and ABS**  
**Mechanical recycling**  
**Post consumer recyclates**



# The Many Facets of Plastic Recyclates

-  Mechanical Recycling
-  Solvent-based Recycling
-  Chemical Recycling
-  Bio-based alternatives (without food competition)



Far future

Medium term goals

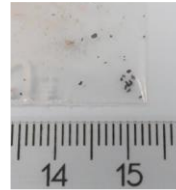
First successes



# The Challenges We Face to Substitute Virgin Plastics

## Sorting & purification of the raw material

- thorough sorting
- filtration (<math><100\mu\text{m}</math>)
- metal separation
- degassing
- color sorting
- what happens with „legacy substances“?



Lid base module  
>PP-T40<



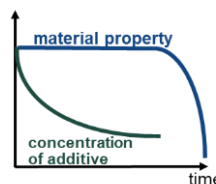
## Mold adjustments

- thicker walls
- additional supporting bars



## Sufficient recompounding

- “refill” consumed additives
- add fillers & color batches (& deodorizing agents)
- what happens with aged additives?



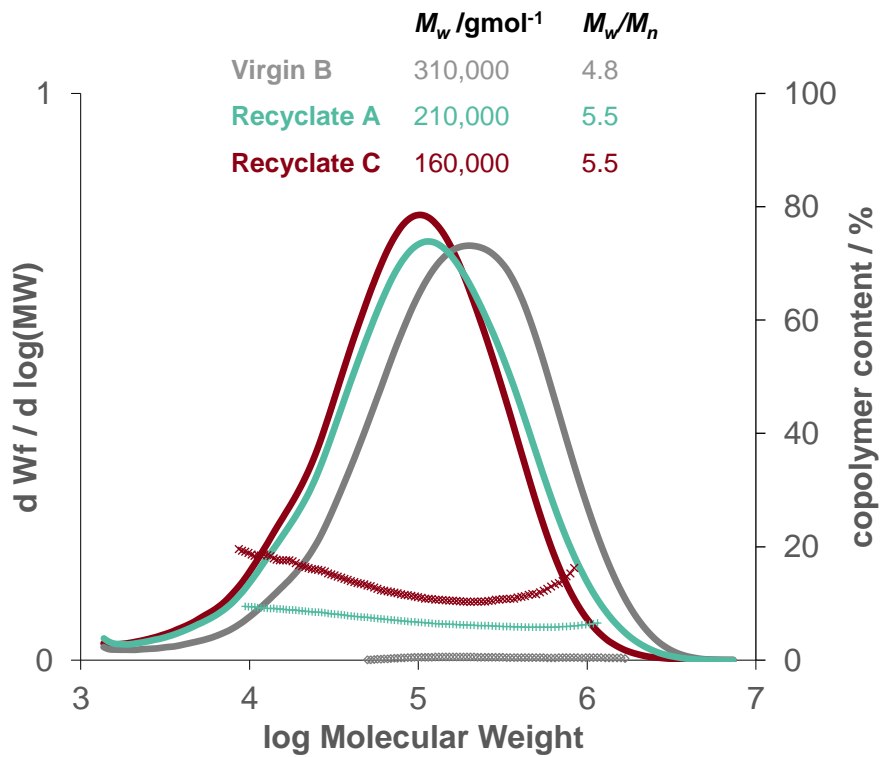
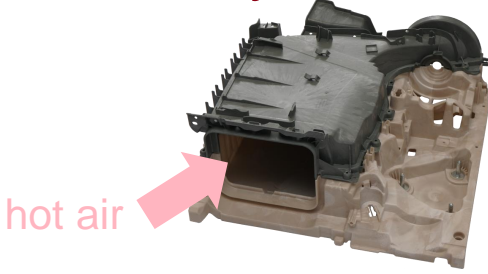
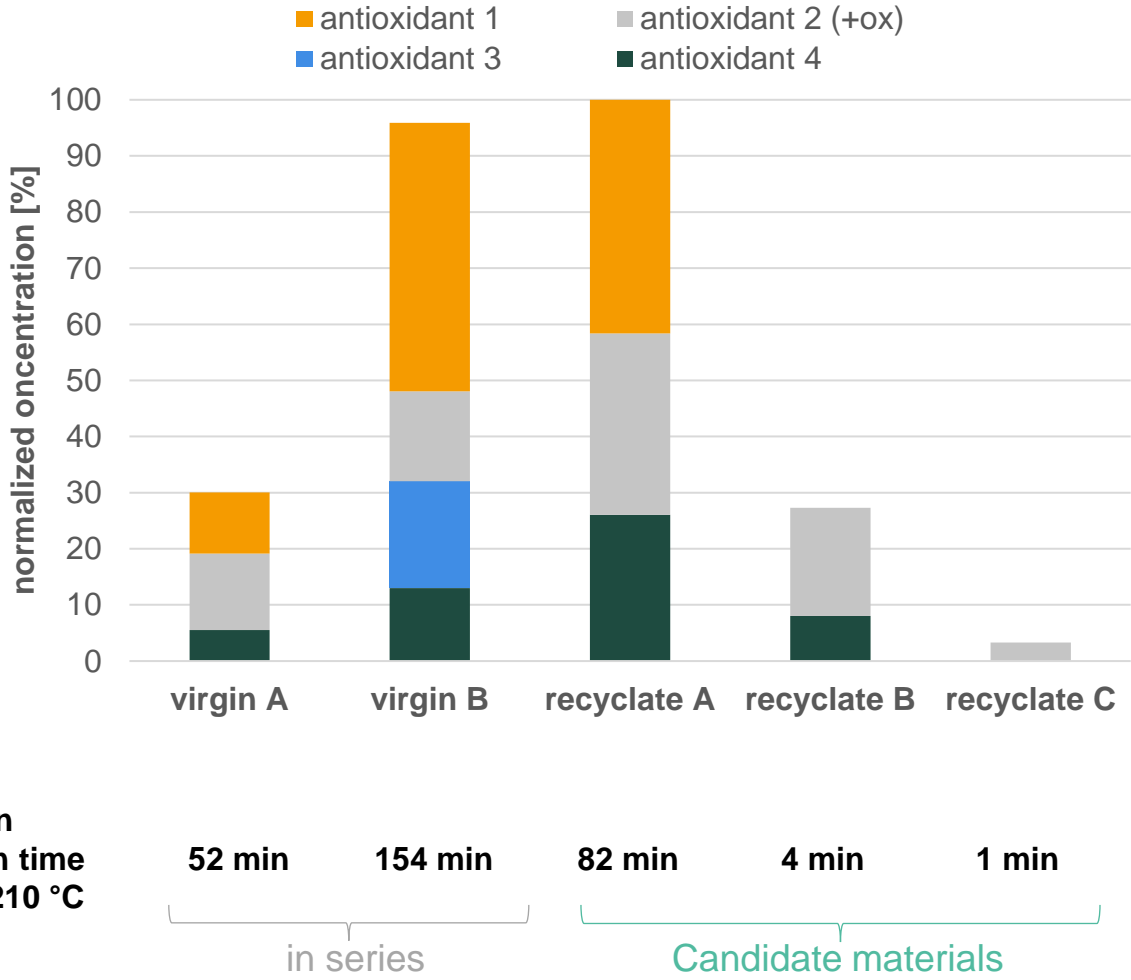
## Process adjustments

- filling time & temperature
- new production technologies („Mucell“ technology)
- rethink design elements



**REACH & RoHS certificates needed!**  
**In some cases: UL listing for US market needed!**

# Assessment of Candidates for the Base Module: Virgin vs. Recyclate Material



Oxidation induction time (OIT) at 210 °C

# Contaminants in Post Consumer Recyclates Indicate Material Origin

The Analysis confirms the „post consumer“ character of the recyclate!

## 1. Packaging

NX-8000  
Bis(2-ethylhexyl) adipate  
Tributyl citrate  
Tributyl citrate acetate



## 2. Pharma & Cosmetics

Octadecanamide  
1-Dodecyl-2-pyrrolidone  
Behenic acid  
Ethylene dioleamide



## 3. Cleaning & Painting

2-(2-Butoxy-ethoxy)ethanol  
Bis(2-ethylhexyl) sebacate



## 4. Food residues

Cinnamaldehyde  
Arachidic acid  
Stearic acid



# Where are High-Performance Plastic Materials for Miele Appliances?



- Scrap Metal
- Glass
- Harmful Substances
- Light Fraction (Plastics & Rubber)



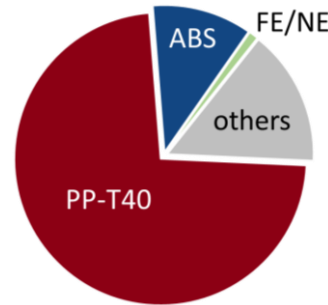
# Simulation of a Material-Closed Loop from WEEE



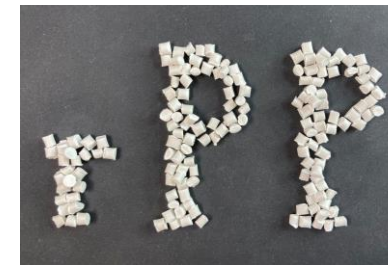
Disassembly of selected plastic parts from disposed Miele washing machines



Shredding and metal removal



Material sorting based on NIR-technology and colour

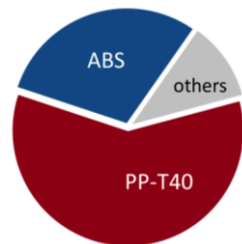


Recompounding and fabrication of test bars

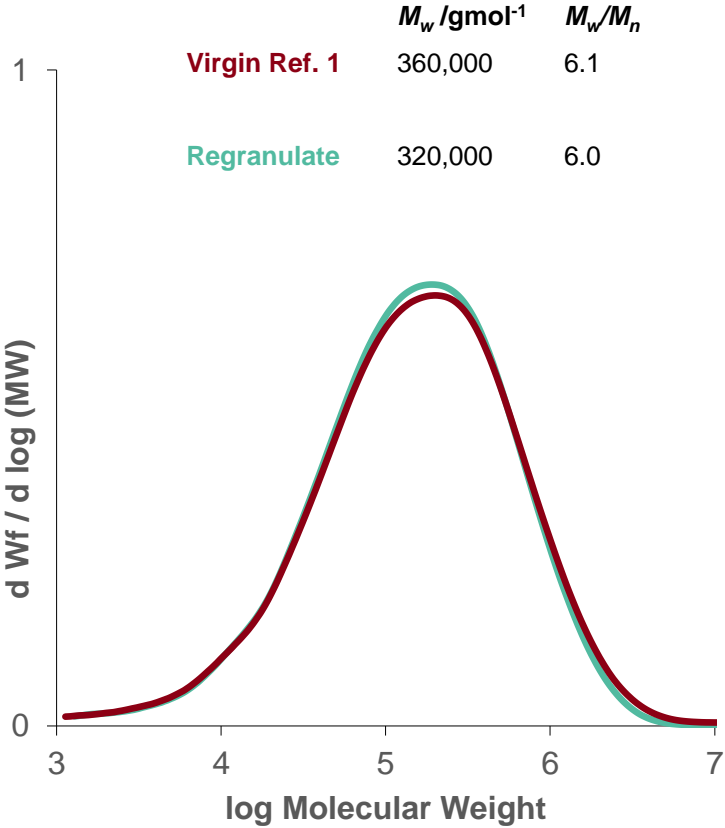
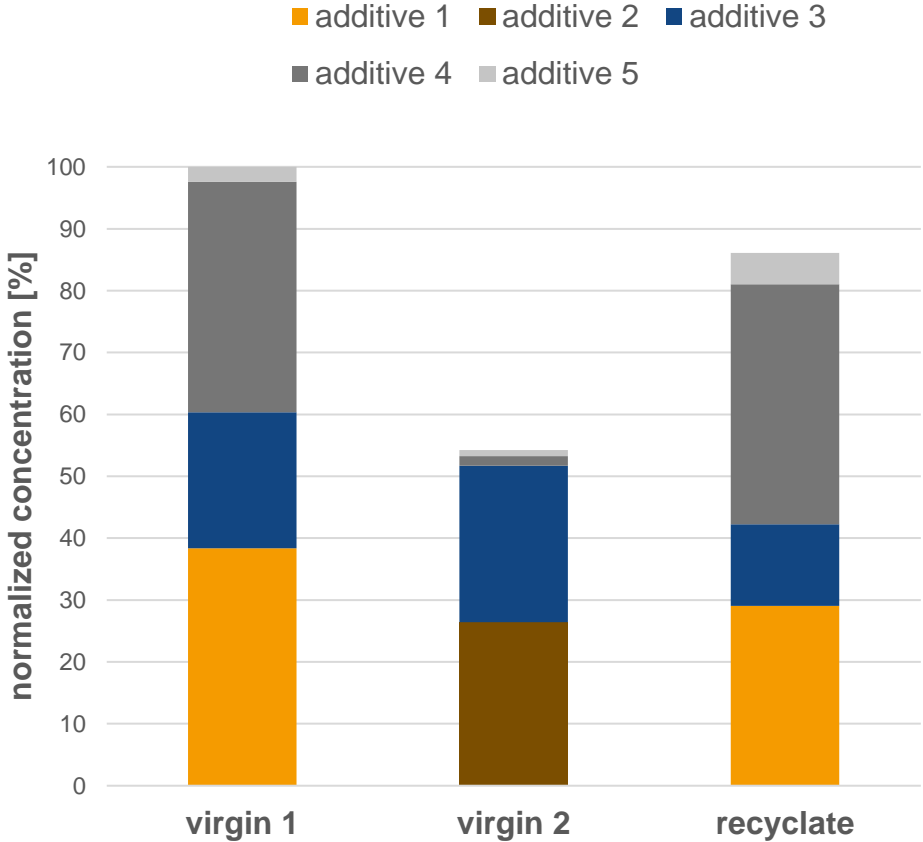


Aging study  
Chemical analysis  
Mechanical analysis

➤ **Properties comparable to virgin material!**



# Assessment of the Chemical Quality of the Soap Drawer Recyclate



# Lessons Learned & Consequences



### Availability

How can we meet our growing demand for recyclates from the WEEE stream?

**Let's act!**



### Transport of dangerous goods

What needs to change legally for easier cross-border cooperations?

**Let's talk!**



### Design 4 Recycling

How can we manufacture our appliances in a way that we can harness them after their EOL?

**Let's get aligned!**



### Technology-Gap

Who are strategic partners that can help us close the gap?

**Let's do it!**

**Miele**





## **Miele & Cie. KG**

Carl-Miele-Straße 29  
33332 Gütersloh

Postfach  
33325 Gütersloh

Telefon       +49 5241 89-0  
Fax            +49 5241 892090

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