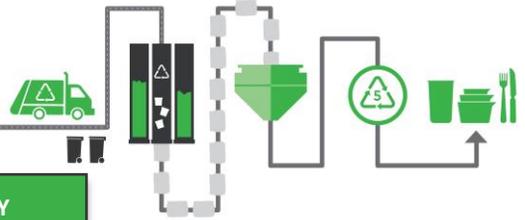


RECOVERING MORE VALUE

A SMALL FORMAT PLASTICS MRF CASE STUDY – APRIL 2018 UPDATE



BACKGROUND



Plastic reclaimers and leading brands want to see the supply of post-consumer polypropylene (PP) plastics increase to feed their manufacturing processes. It is often believed that small format polypropylene items will be lost through glass breakers and star screens, reducing potential for recovery. Keurig Green Mountain (Keurig) is collaborating with industry partners to help explore the potential to recover more small format plastics. A series of municipal recovery facility (MRF) tests were completed using RFID technology to map where small format PP plastic items would end up in the MRF. Key questions these studies intended to answer included:

- Can small format PP plastics make it to the container line?
- Will optical sorting technology capture small format PP plastic items?
- Will small format PP plastics impact the quality of other products at the MRF?

This recently updated 2018 case study summarizes the key learnings from these tests to date and explores the value proposition of recovering these type of small format PP plastics.

MRF TEST APPROACH

As a proxy for small format plastics, white, PP Keurig K-Cup® pods were tested at MRFs in full, empty, crushed, and uncrushed states. The testing MRFs expected that most pods would arrive crushed as they will likely be compacted during curbside collection. The MRF tests were designed to quantify the percentage of pods that make it to the container line* and the percentage that are captured into a bale where they would add value. Each test included a base case. Tests were run at multiple recycling facilities with varying set-ups and degrees of automation at each facility.

*The "Container Line" is defined by the main belt after any and all star screens and glass breaker sortation

RESULTS SUMMARY

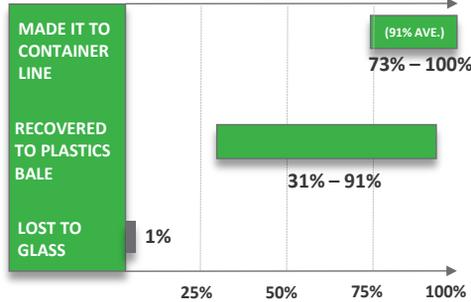
Small format PP plastics may have a stronger recovery potential and economic value proposition than previously believed. Tests showed:

- An average of **90% of all PP Keurig K-Cup® pods** made it to the container line;
- **<0.001% impact on paper quality**, with minimal loss to glass;
- A recovery potential of **up to 91% of incoming material** depending on sortation.

A strong case is brewing for an expansion of PP collection to include small items and to maximize the recovered value of that material in both tubs and lids bales as well as #3-7 mixed bales. Keurig would like to continue working with MRFs to explore the potential for acceptance of Keurig K-Cup® pods.

KEY FINDINGS

The chart below summarizes the percent of empty pods that successfully made it past the star screens and glass breakers to the container line, as well as the percent of empty pods that made it to a bale for potential recovery with the MRF running at normal operating conditions.



Empty Items: Testing demonstrated that **an average of 91%** of the empty PP pods made it successfully to the container line. Optical sorters were able to capture up to 91% of incoming PP pods which is significantly higher than original estimates. Some sorters performed better than others and optimization may be required.

Full Items: Testing demonstrated that **an average of 88%** of the PP pods made it successfully to the container line when full. Crushed full pods saw a 26% increase in capture rate by the optical sorters. Optical sorters have a more difficult time with full pods, likely due to their increased weight. Consumer instructions include emptying K-Cup® pods prior to recycling.

90%
ON AVERAGE

OF KEURIG K-CUP® PODS HAVE THE POTENTIAL TO BE PROCESSED AND CAPTURED IN A MRF

Losses: On average, 1% of incoming pods were lost to the glass stream. Also, at an expected recycling rate through a curbside program, pods lost to paper would not have a significant impact on the bale quality, as they would comprise <0.001% of the bales by weight.

DIVERSE TESTING SITES

MRFs with different sorting approaches and throughputs of recyclables were evaluated to understand the potential for recovery with a variety of technologies.

No Sites	MRF TYPE	MRF SIZE TONS/HR	SORTING APPROACH FOR PP
3	Manual Picking for Mixed Plastics	15-20	Included in 3-7 Plastics
4	Automated Facilities (US and Canada)	18-25	Optical Sorters for Polypropylene and/or 3-7 Plastic
2	Automated Facility (US)	30-60	Optical Sorter for 3-7 Plastics

ECONOMIC VALUE

Depending on the MRF throughput and the capture rate of small format PP plastics, each MRF is encouraged to evaluate if a business case exists for positive sortation of PP. Indicative MRF economics to recover PP are shown below for illustrative purposes.

NPV AND IRR FOR A DEDICATED OPTICAL SORTER FOR PP PLASTIC

