



PRELIMINARY FINDINGS: REPUBLIC SOUTH NEVADA RECYCLING CENTER EQUIPMENT TESTING

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SOUTHERN NEVADA RECYCLING CENTER

- State-of-the-art Republic Services MRF in North Las Vegas opened Nov 2015
- Two lines capable of sorting a combined capacity of 70 tons/hour, and 265,000 ton per year throughput
- **New optical sorter optimized to clean paper by ejecting all non-paper materials, including flexible plastics, rigid plastics and metals**
- Test date 8/2/17



TEST OBJECTIVES

- To understand and trace the FPP in the MRF
- To study the performance and response of optical sorter
- To estimate % of potential FPP capture in a MRF to create a FPP bale
- Finally, to optimize and recommend MRF design changes to recover FPP

TEST PROCEDURES

- Tag test FPP with RFID tags
- Place RFID readers at critical locations in MRF
- Conduct test during afternoon shift where only half of the system is utilized (35 tons/hr)
- Feed 438 lbs. of test FPP into system over 15 minutes (3% FPP concentration)
- Trace material through MRF and optical sorter with RFID

SAMPLE FPP MIX

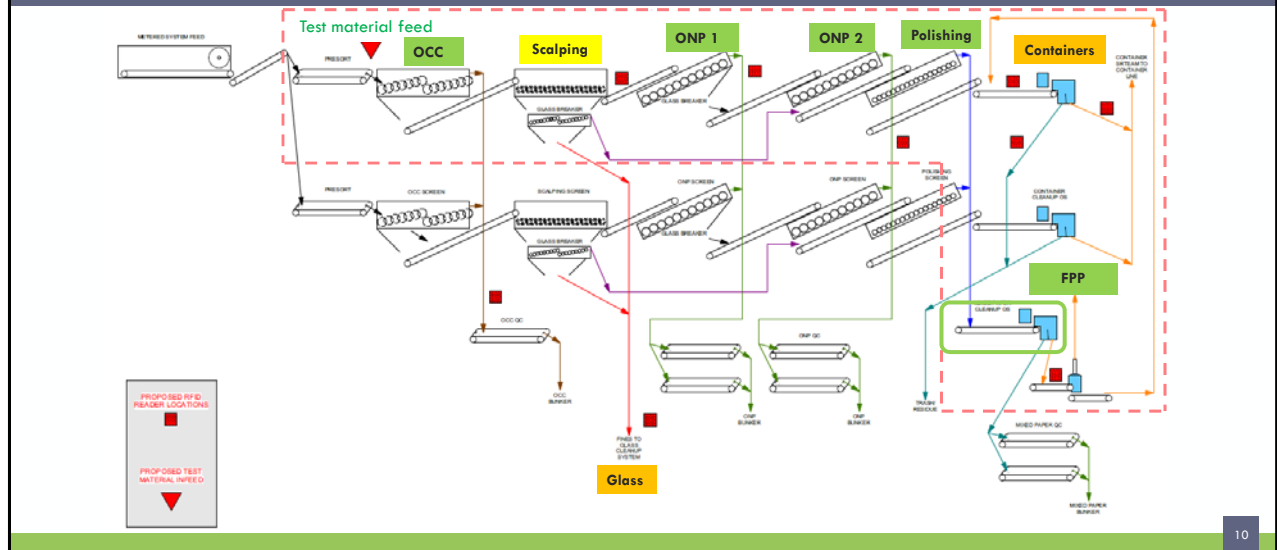
TEST MATERIAL DESCRIPTION	PERCENT	POUNDS	PIECE COUNT	# TAGGED
Bread Bags	16.2%	70.9	5,362	182
Diaper Wrap	2.0%	8.8	285	114
Air Pillows	2.0%	8.8	998	158
Bubble Wrap	2.0%	8.8	53	53
Dog Food Bags	2.8%	12.1	63	63
Cereal Bags	16.0%	70.2	3,979	179
Paper Towel Overwrap	4.0%	17.5	265	110
Yellow Chip Bags	2.5%	10.9	496	136
Black Chip Bags	0.5%	2.3	116	72
Blue Chip Bags	2.6%	11.4	2,586	175
Duckling Bags	0.7%	3.1	177	91
Roaster Chicken Bags	0.9%	3.8	156	86
Large Jerky Pouches	0.4%	6.5	280	280
Small Jerky Pouches	1.1%	4.9	279	113
Salad Bags	2.6%	11.4	574	142
Wipes Pouches	2.6%	11.4	860	154
Candy Pouches	1.2%	5.4	306	117
Baby Food Pouches	1.2%	5.4	489	136
Pet Treat Pouches	1.2%	5.4	61	61
Detergent Pouches	2.3%	10.1	287	114
Case Wrap	3.0%	13.1	170	90
Shrink Film	1.0%	4.4	497	137
Grocery Bags	18.0%	78.8	3,576	179
Retail Bags	7.0%	30.7	302	116
Storage Bags	5.0%	21.9	1,104	161
TOTAL	100%	438	23,320	3,217

- Percentages are based on the latest material characterizations
- ~3200 pieces of FPP tagged for the test
- Provides a statistically relevant sample size with minimal error



This slide shows the mix of material that was seeded into the MRF

TEST MATERIAL FEED AND RFID READER LOCATIONS



This slide shows a simplified layout of the MRF. The flexible packaging was expected to flow to the fiber lines off the OCC, ONP, and polishing screens. The optical sorter for fiber is located after the polishing screen. This optical sorter is used to clean up the mixed paper coming off the polishing screen by removing non-paper items such as flexible packaging.

SIZE DESIGNATION

Large >



~150 sq in.

≥ Medium >



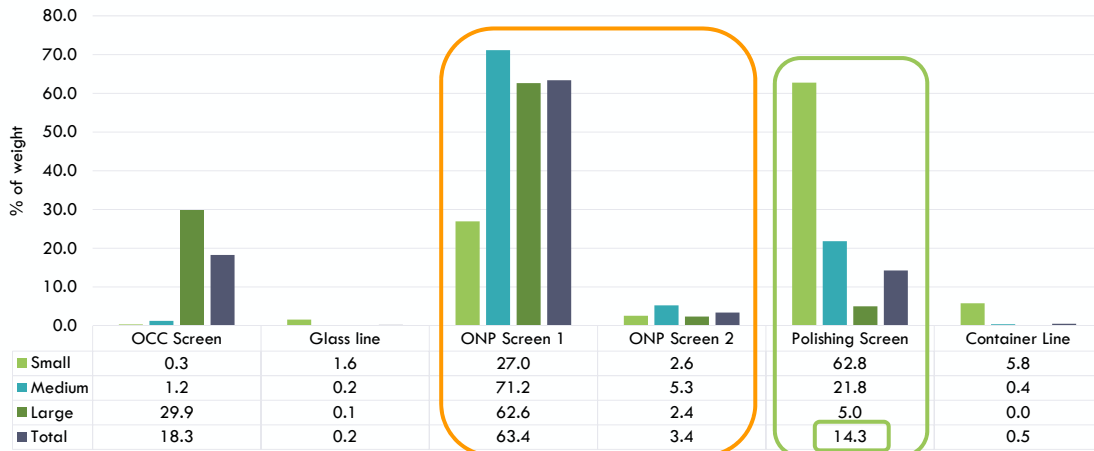
~51 sq in.

≥ Small

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Size is an important variable in determining where the packaging ended up in the system. This slide shows how we categorized the packaging by size. You will see these categories used in the graphs on the next two slides.

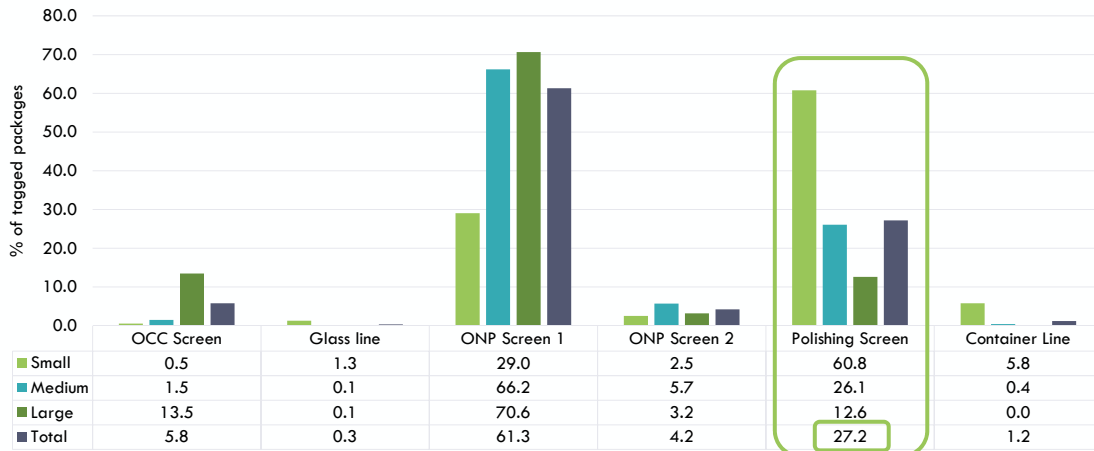
MATERIAL FLOW RESULTS BY WEIGHT



- Much more FPP was pulled off by ONP screen 1 than ONP screen 2
- Most of the FPP that made it to the optical sorter was small or medium sized

This chart shows that 99.3% of FPP flowed with fiber. Larger packaging tended to flow to ONP screen 1 while smaller packaging was more likely to pass the OCC screens and end up at the polishing screen. The material balance between ONP screens was not as expected; we anticipated it to be more equally balanced between screen 1 and 2.

MATERIAL FLOW RESULTS BY COUNT

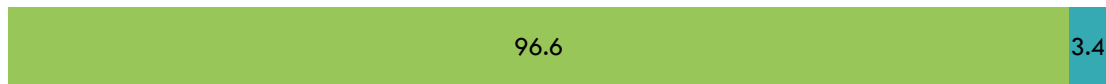


- FPP piece count to polishing screen is proportionally more than weight
- 27% of pieces went to optical sorter

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This chart shows the same results by piece count rather than by weight. Note that 27% of the pieces of FPP ended up at the polishing screen to be sorted by the optical sorter. Since this tended to be smaller packages, this represents only 14% by weight as seen on the previous slide.

% OPTICAL SORTER EFFICIENCY



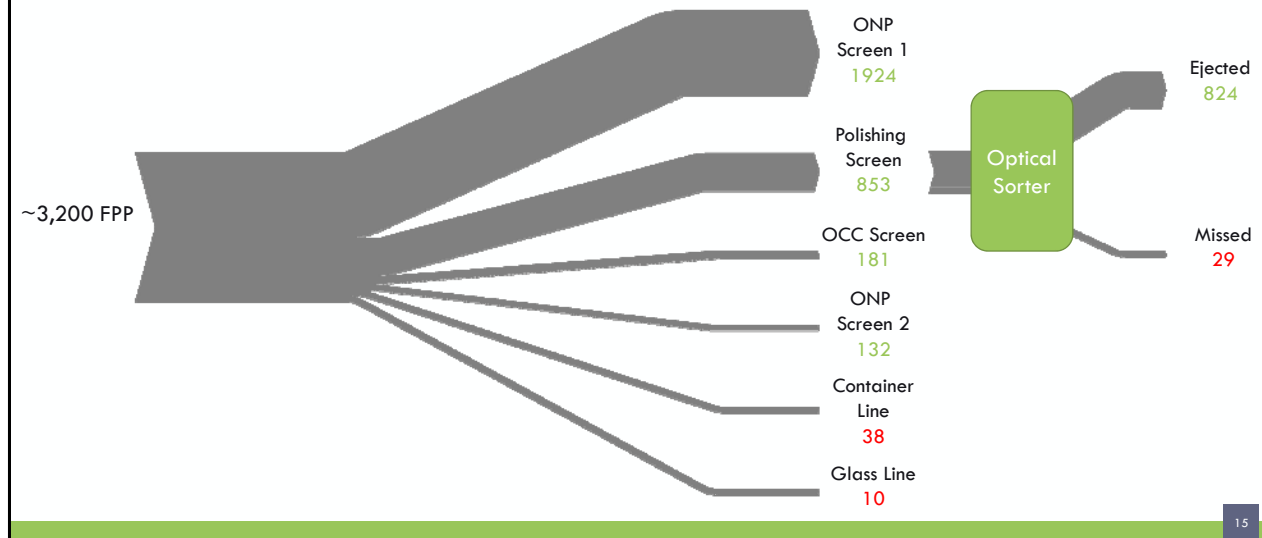
■ Ejected ■ Missed

- Sorter was performing at a very high level
- FPP concentration at polishing screen (Optical Sorter) was much less than at ONP Screen 1
- Optical sorter would have been overwhelmed at ONP screen 1

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The optical sorter successfully ejected 96.6% of material. This is the best performance we have ever seen, including tests in a laboratory setting.

MATERIAL FLOW SUMMARY BY TAG COUNT



Of the 3,200 pieces of FPP seeded into the system, 824 ended up successfully ejected by the optical sorter. Extending these findings to the pilot MRF, these results show that additional optical sorters would be needed on the other fiber screens to capture the FPP that ended up in those areas. The ONP screens would need to be adjusted to ensure that the amount of FPP flowing to each is more balanced. This would allow optical sorters on those lines to capture FPP without being overwhelmed.

SUMMARY

- Optical sorter is capable of sorting out FPP at a high level (best efficiency yet)
- Concentration limit still needs to be explored
- More than half of the paper and flexible packaging came out on the first ONP screen. This suggests that the screens were less than optimally adjusted.
- Amount of fiber in FPP product was not measured but appeared to be low, likely below the target of 30% by weight and maybe near 15%