



Evaluating Repulpability and Recyclability of a Blend of Post-Consumer Quick-Service Paper Packaging Material with Specified Fiber Grades at Readily Available Mill Types Utilizing Newly Developed Standards

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Presentation Overview

1. Introduction
2. Paper Packaging Recovery Overview
3. Standards Developed by WMU
4. Testing Process and Findings
5. Conclusions and Next Steps



Global Green USA

- US Chapter of Green Cross International
- Founded by President Mikhail S. Gorbachev to foster a value shift to a sustainable and secure future by reconnecting humanity with the environment. Over 30 national affiliates around the world.
- Global Green creates **sustainable urban environments** that combat global warming through a unique cross-cutting approach that merges innovative research, technical assistance, cutting-edge community based projects and targeted education and outreach
- 501c3 non-profit organization



Global Green USA's Coalition for Resource Recovery (CoRR)

- CoRR is an industry working group dedicated to combating climate change and **transforming waste into assets**, thereby assisting cities in reaching 70% waste diversion.
- CoRR conducts **pilots and related research** to identify and accelerate development of scalable, transferable waste diversion programs and technologies.

A Coalition of Members

Action Env' l Group

Baluchi's

BASF

Chemol

Clean River
Systems

DBB Partners

Design & Source

First Fiber

Green Bay Packaging

IESI/Progressive

Imerys

Interstate Container

Jamba Juice

LBP Manufacturing

N&V International

Pratt Industries

Pret A Manger

Spectra-Kote

Starbucks

Transtech, Inc.

Waste Management

Wastequip

Western Michigan
Univ.

Paper Packaging Recovery to Date

Paper Foodservice Packaging and GHGs

4.1 million tons of QSPPM (quick-service paper packaging material) landfilled annually in the US leads to:

- 15 million metric tons of CO₂e, equivalent to:
 - 3 million cars
 - 3 coal-fired power plants

Vision for Recovering Value

- Cost-effective for waste generators and haulers
- Operationally and environmentally sound
- Recovers high quality long fibers for recycling
- Relies on commonly used mill technologies
- Helps waste generators improve brand value

Process for 2009-2012 CoRR Pilots

- Worked with restaurant to identify packaging needs
- Pre-tested pre-consumer packaging for repulpability and recyclability
- Deployed bins for material collection
- Did waste sorts and waste characterizations
- Tested post-consumer material for repulpability and recyclability
- Released results at conferences and as reports to members

Findings from 2009-2012 CoRR Pilots

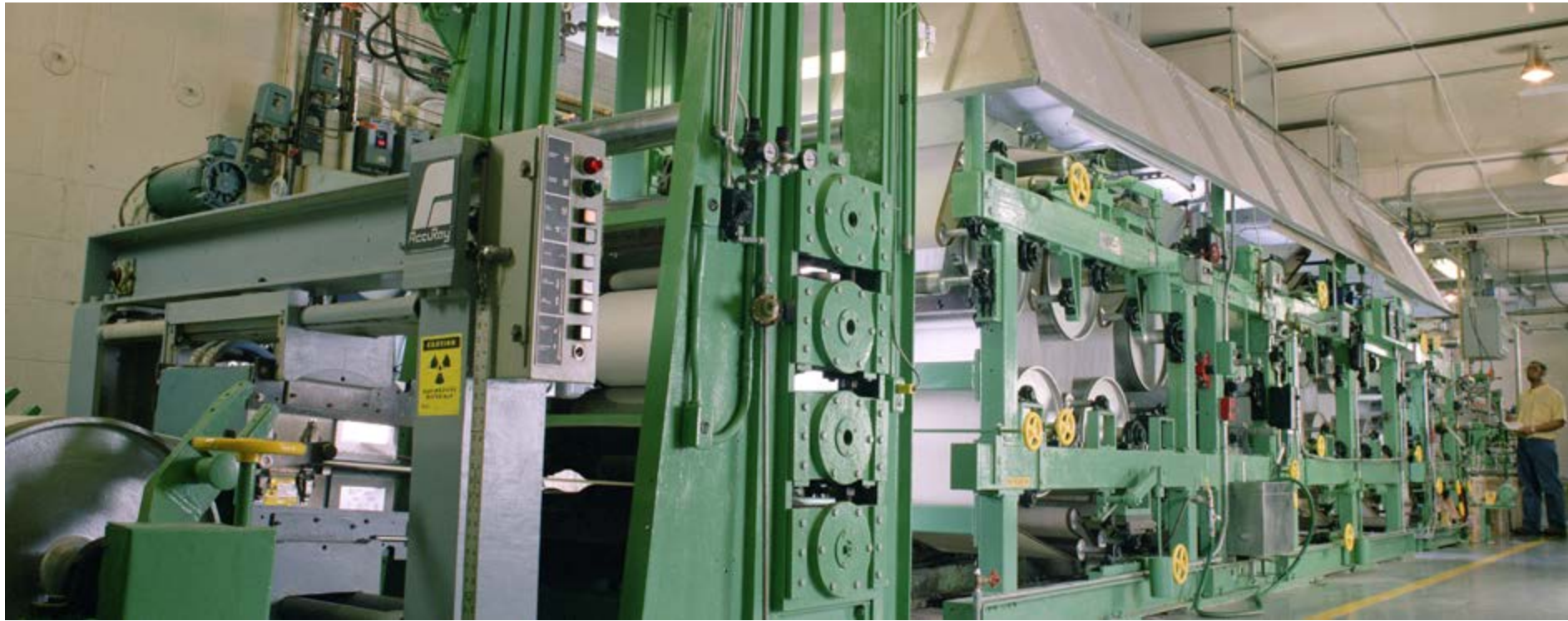
- Customers will sort
 - 75-95% stream purity observed at Pret and Starbucks
- Restaurants want to recycle
 - NRA surveys demonstrated this
- Food residuals and coatings are not barriers to recovery
 - Mississippi River Pulp recycled cup-to-cup
 - Recyclable coatings would be a game-changer

Standards Developed by WMU

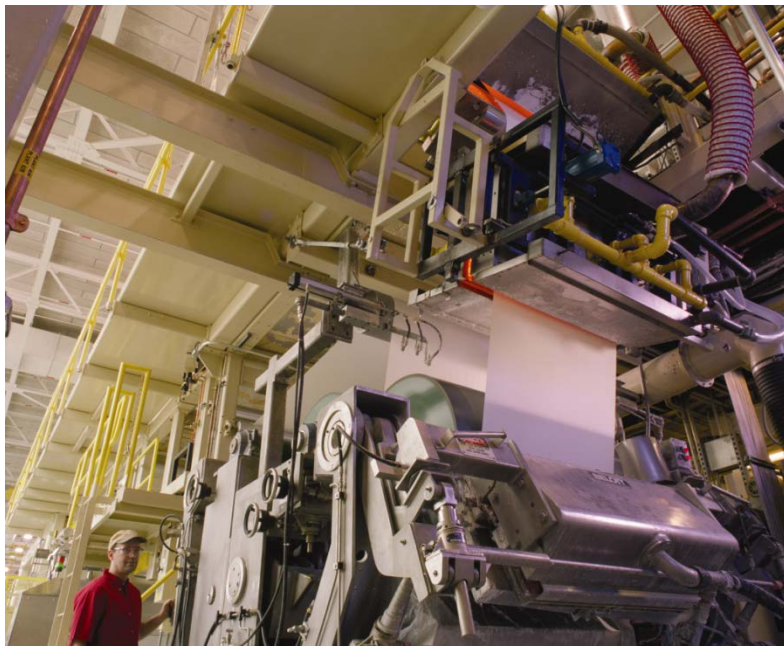
About WMU's Pilot Plant

- Research - Academic
- Product Development – Paper Manufacturers, Suppliers and Equipment Manufacturers
- Sales Tool - suppliers
- Transitional - papermakers
- Toll – papermakers
- Printing – QC before shipment

Pilot Paper Machine



Coating Facility



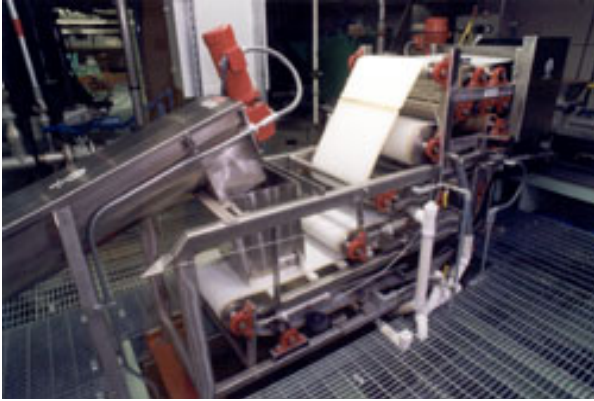
Printing Facility



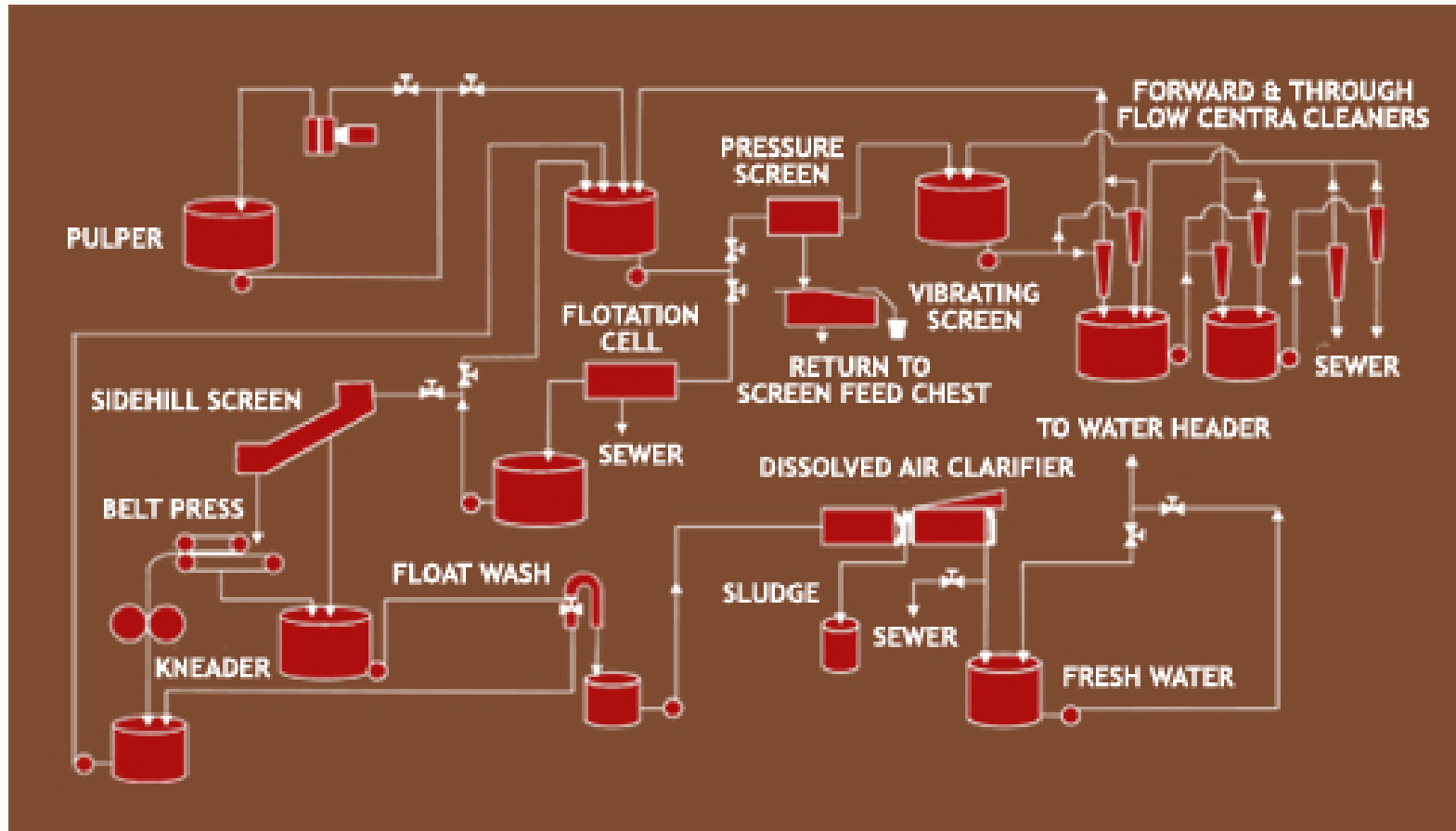
Fiber Recycling



Fiber Recycling



Recycling Plant Equipment



Recyclability and Repulpability Protocols

- They DO...
 - Establish repeatable methods for future tests
 - Evaluate the impact of including QSPPM as a paper recycling input at certain levels with certain processes
 - Indicate in which existing paper commodity grades QSPPM could be included

Recyclability and Repulpability Protocols

- They DO NOT...
 - Substitute for safety or performance tests
 - Substitute for a full analysis of environmental impacts

Recyclability and Repulpability Protocols

- Modified FBA Protocol and *new* SOP/UOP protocol
 - Measure Repulpability, including fiber yield
 - Measure Recyclability, including operational and end-product quality factors

Modified FBA Protocol

- Based on Fibre Box Association's *"Voluntary Standard For Repulping and Recycling Corrugated Fiberboard Treated to Improve Its Performance in the Presence of Water and Water Vapor"*
- Tests performance of QSPPM at 20% (80% OCC) against a 100% OCC control
 - Includes operational and end-product-quality measures

New SOP/UOP Protocol

- Evaluates the material's usefulness as an input for tissue/towel products
- Compares to SOP/UOP, often used to make tissue/towel
- Tests performance of QSPPM at 15% (85% bleached northern hardwood) against a 100% bleached northern hardwood control
 - Includes operational and end-product-quality measures

Recyclability and Repulpability Tests: Methodology and Performance Criteria

Repulpability Test Methods

	OCC-E	New Test for SOP or UOP
Pulper Consistency		1.6 %
Pulping Temperature		125°F ($\pm 10^\circ$)
Pulping Time		20 minutes
Pulping pH		7 ($\pm .05$)
Screens		Slotted Screen: 0.010" slots

Repulpability Performance Criteria

	OCC-E	New Test for SOP or UOP
Fiber on Fiber Yield	At least 80% yield based on the total weight, or 85% based on the bone-dry fiber charge to the pulper.	At least 75% yield based on the total weight, or 80% based on the bone-dry fiber charge to the pulper.

Repulpability Performance Criteria

	OCC-E	New Test for SOP or UOP
Fiber on Fiber Yield	At least <u>80%</u> yield based on the total weight, or <u>85%</u> based on the bone-dry fiber charge to the pulper.	At least <u>75%</u> yield based on the total weight, or <u>80%</u> based on the bone-dry fiber charge to the pulper.

Repulpability Performance Criteria

	OCC-E	New Test for SOP or UOP
Operational Impact	<ul style="list-style-type: none">• The procedure must be completed without using acid wash to clean the flat screen or dismantling the pressure screens to clean them before finishing the test.• No visible deposition on any part of the disintegrator or in the pulper during the recyclability test.	

Recyclability Test Methods

	OCC-E	New Test for SOP or UOP
Percent of test material as part of blend	20% test material, 80% OCC	15% test material, 85% bleached northern hardwood
Pulper Consistency	3%	18%
Pulping Temperature	125°F (±10°)	180°F (±5°)
Pulping Time	20 minutes	45 minutes
Pulping pH	7 (±0.5 pH)	8.5 (± .03)
Screens	<ul style="list-style-type: none"> • Pressure screen 1: 0.062" holes • Pressure screen 2: 0.010" slots 	<ul style="list-style-type: none"> • Johnson vibrating screen: 1/8" holes • Pressure screen 1: 0.010" slots • Pressure screen 2: 0.006" slots

Recyclability Test Methods

	OCC-E	New Test for SOP or UOP
Additional screening, cleaning, bleaching, and washing steps	Reverse cleaners (final stage)	<ul style="list-style-type: none">• Flotation• Reverse low density cleaners• Forward high density cleaners• Sidehill washing 0.9% - 5% consistency• Dewater to 30% consistency

Recyclability Test Methods

	OCC-E	New Test for SOP or UOP
Additional screening, cleaning, bleaching, and washing steps	Reverse cleaners (final stage)	<ul style="list-style-type: none">• Dispersion with peroxide bleach liquor at 195°F, 3.5 minutes retention time. bleach retention 30 min. @10 PH• Sodium hydrosulfite bleaching at 5% consistency, pH 5.5 for 45 minutes

Recyclability Test Methods

	OCC-E	New Test for SOP or UOP
Additional screening, cleaning, bleaching, and washing steps	Reverse cleaners (final stage)	<ul style="list-style-type: none">• Post flotation with chemistry at pH 7.5• Hydrosieve washing 1.3% - 6% consistency (final stage)

Recyclability Performance Criteria

	OCC-E	New Test for SOP or UOP
Appearance/Stickies		<ul style="list-style-type: none">• No substantial difference from that of the hand sheets made from the control.• Spot count is ≤ 15 counts, or not exceeding 30% greater counts than the control, with an area $\geq 0.4 \text{ mm}^2$, averaged over 3 sheets.

Recyclability Performance Criteria

	OCC-E	New Test for SOP or UOP
Brightness T-452	N/A	TAPPI brightness between 78-83%
Color (Lab) T-524	N/A	L, a, b
Slide Angle T-815	<ul style="list-style-type: none">• Slide angle of hand sheets• $\leq 15\%$ of that of the control	N/A

Recyclability Performance Criteria

	OCC-E	New Test for SOP or UOP
STFI T-826 Burst strength T-810	≤ a 10% decrease from the respective values for the control	N/A
Water drop penetration T-831	Must not exceed the water drop penetration of the control hand sheets by more than 200 seconds	N/A
Dirt Count T-563	N/A	Count ≤ 70-100; PPM ≤150-250

Recyclability Performance Criteria

	OCC-E	New Test for SOP or UOP
Tensile Index T-220	N/A	≤ a 10% decrease from the respective values for the control
Optional bacterial analysis	N/A	Third party analysis

2009-2012 Test Results

Results of Recyclability and Repulpability

Year	Organization	Material Tested	OCC-E	SOP/UOP
2009	Starbucks	Pre-consumer coffee cups with 10% post-consumer recycled content & brown paperboard coffee cup sleeves	Pass	NA
2010	Starbucks	Sorted post-consumer coffee cups with 10% post-consumer recycled content & brown paperboard coffee cup sleeves	Pass	NA

Results of Recyclability and Repulpability

Year	Organization	Material Tested	OCC-E	SOP/UOP
2010	Pret A Manger	Pre-consumer coffee cups, brown paper board cup sleeves, paper bag, sandwich & salad containers, oatmeal cup and lid	Pass	NA
2011	Pret A Manger	Sorted Post-consumer packaging that had passed FBA test during pre-screen	Pass	NA

Results of Recyclability and Repulpability

Year	Organization	Material Tested	OCC-E	SOP/UOP
2012	Pret A Manger	Post-consumer sorted mix of packaging that passed the OCC-E protocol and materials that did not pass.	NA	Pass (brown/ unbleached)

New UOP/SOP Test Results

Test Results Detail (new SOP/UOP test)

	SOP/UOP Test Recyclability and Repulpability Performance Criteria	Post-Consumer Pret A Manger Paper Packaging Materials
Fiber-on-Fiber Yield	At least 75% yield based on the total weight, or 80% based on the bone-dry fiber charge to the pulper of dispersed usable fiber	95% yield; rejects predominantly filmic material PASS

Test Results Detail (new SOP/UOP test)

	SOP/UOP Test Recyclability and Repulpability Performance Criteria	Post-Consumer Pret A Manger Paper Packaging Materials
Operational Impact	<ul style="list-style-type: none"> The procedure must be completed without using acid wash to clean the flat screen in the repulpability test or dismantling the pressure screens to clean them before finishing the test. No visible deposition on any part of the disintegrator during the repulpability test or in the pulper during the recyclability test. 	<ul style="list-style-type: none"> Pressure screen operations performed with no plugging or operational issues on course or fine screens. Low density centrifugal cleaning operated satisfactorily and cleaning results were excellent. Floation operations were normal Bleaching operations were normal for both the peroxide and sodium hydrosulfite. <p style="text-align: center;">PASS</p>

Test Results Detail (new SOP/UOP test)

	SOP/UOP Test Recyclability and Repulpability Performance Criteria	Post-Consumer Pret A Manger Paper Packaging Materials
Appearance/Stickers T-277	<p>No substantial difference from that of the hand sheets made from the control.</p> <p>Spot count is ≤ 15 counts, or not exceeding 30% greater counts than the control, with an area $\geq 0.4 \text{ mm}^2$, averaged over 3 sheets.</p>	<p>Final stickies count: 0</p> <p>Kraft serving tray fiber still showed residual faint brown fiber in the final hand sheets after the bleaching process.</p> <p>PASS</p>

Test Results Detail (new SOP/UOP test)

	SOP/UOP Test Recyclability and Repulpability Performance Criteria	Post-Consumer Pret A Manger Paper Packaging Materials
Dirt Count T-563	Count \leq 70-100; PPM \leq 150-250	Final dirt results: 205 PPM - PASS
Brightness T-452	TAPPI brightness between 78-83%	76.89 NO PASS
Color (Lab) T-524		L*93.52, a*1.01, b* 4.92
Tensile Index T-220	\leq a 10% decrease from the respective values for the control	Hardwood control = 11.257 Nm/g Pret A Manger mix = 10.802 Nm/g - PASS

Conclusions and Next Steps

Conclusions

- Pret's post-consumer QSPPM was entirely satisfactory for part of the furnish for a top liner of a coated paperboard where the top liner is 45 to 60 brightness prior to bleaching
- Was also entirely satisfactory for use in unbleached towel and napkin.
- Pret's QSPPM was not satisfactory for use in the manufacture of white tissue or towels

Next Steps and Further Research

- Bleaching steps such as Chlorine Dioxide, Hypochlorite or Ozone may address the lignin content
 - Would restrict the use of the material to those mills with this bleaching technology
- The concentration of post-consumer QSPPM for required level of brightness could be identified



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New UOP/SOP Test: Material Tested

Material Tested

Material Tested	Waste Sort Results		Composition Tested by WMU
Recyclable paper (material that passed the OCC-E protocol)	Average Percent of Composition Observed	Standard Deviation	85%
	72.65%	9.8%	

Material Tested

Material Tested	Waste Sort Results		Composition Tested by WMU
Trash paper (napkins: and material that was determined would not pass the OCC-E protocol)	Average Percent of Composition Observed	Standard Deviation	6%
	20.74%	9.0%	

Material Tested

Material Tested	Waste Sort Results		Composition Tested by WMU
Untested Paper (material sold at the store that has not been tested or had specifications reviewed)	Average Percent of Composition Observed	Standard Deviation	9%
	3.48%	3.42%	

Material Tested

Material Tested	Waste Sort Results		Composition Tested by WMU
Off-site recyclable paper (Material not sold in store but discarded onsite which generally is considered recyclable, such as newspapers)	Average Percent of Composition Observed	Standard Deviation	0%
	0.33%	2.19%	