

The Impact of RFID Tags on the Recycling of Corrugated Containers

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Introduction

Smurfit-Stone Container Corporation



- Largest producer of corrugated containers and containerboard in the U.S.
- One of the largest collectors of paper for recycling
- Our business depends on a closed loop, sustainable fiber source

Fibre Box Association



- Members ship over 90% of all the corrugated containers in the U.S.

What is the issue?

Corrugated Containers have a strong sustainable position

- **Made from a renewable resource**
- **Recyclable – 76.6% recovery rate**
- **Contains on average 43% recycled fiber**
- **Flexible designs result in efficient use of materials**
- **Corrugated is reused in many applications**
- **Recyclable wax replacement now available**

RFID Impacts on Sustainability

New materials could impact sustainability position

- Broad interest in the use of RFID tags
 - Major Retailers
 - DoD
- Metal levels in various vectors are regulated
 - EPA
 - FDA
- No incentive to recover tags

How might the recycling process be impacted?

Primary concern is the introduction of metals

Vector	Potential Impact
Air	No
Whitewater	Yes
Whitewater solids	Yes
Cleaning Rejects	Yes
Finished Product	Yes

Initial Investigation

Computer model using gross assumptions

- Evaluated most common metals used – Cu, Al, Ag
- All metal goes into either whitewater or solids
- Assumed 1/3 of all boxes were tagged

Preliminary results

- Copper and Aluminum would likely not cause an issue
- Silver might be a problem if more than 6% of the metal from the RFID tag remained in the water phase

Additional work to refine the model was necessary

Pilot Studies – Refine Model

Evaluated two types of RFID tags

- Laminated – solid metal antenna
- Non-laminated – printed antenna



Results used to refine distribution of metal to the individual vectors

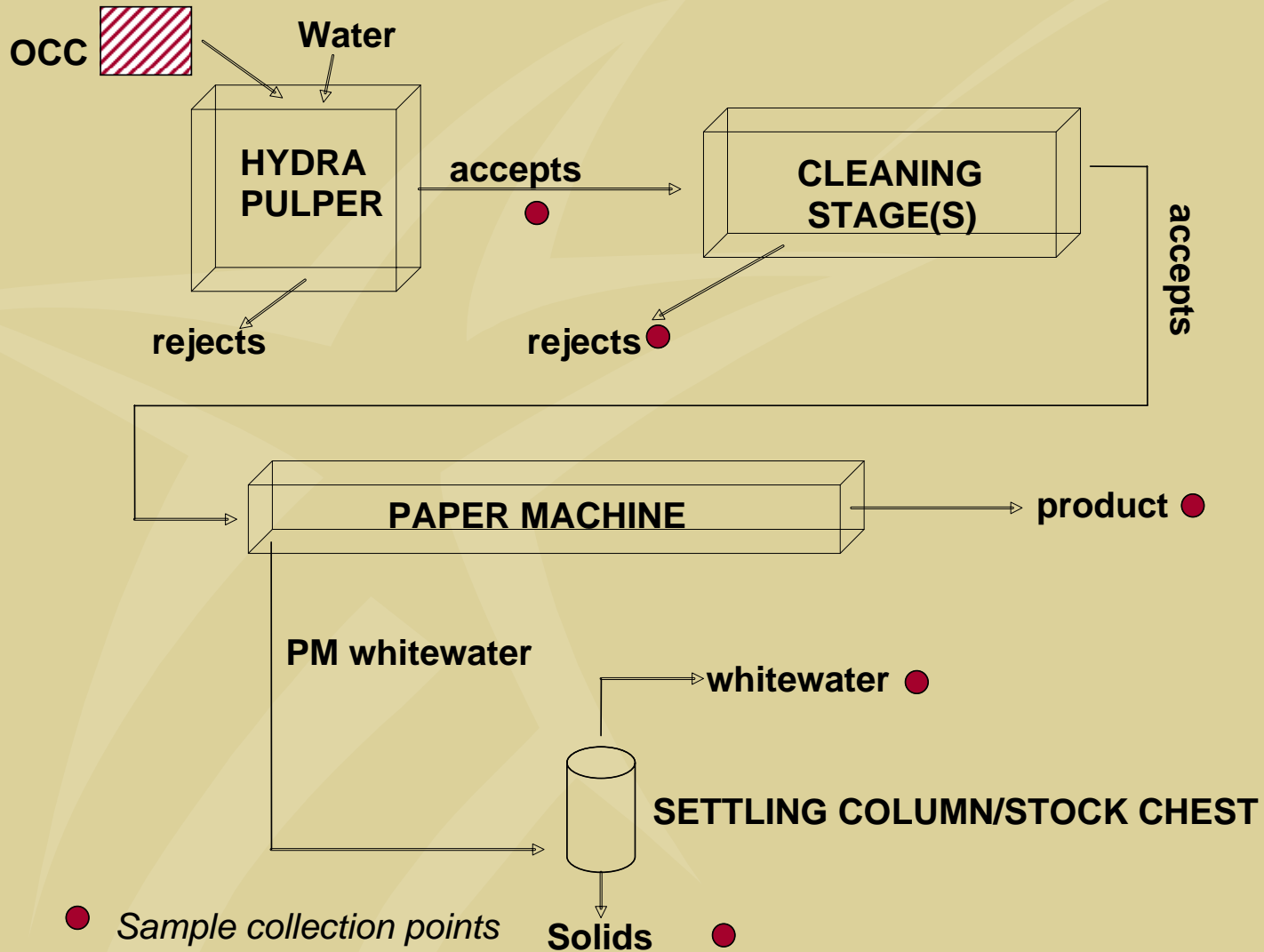
Pilot Studies – Methods

Laminated tags pulped in bench top equipment

Evaluated low and medium consistency pulping

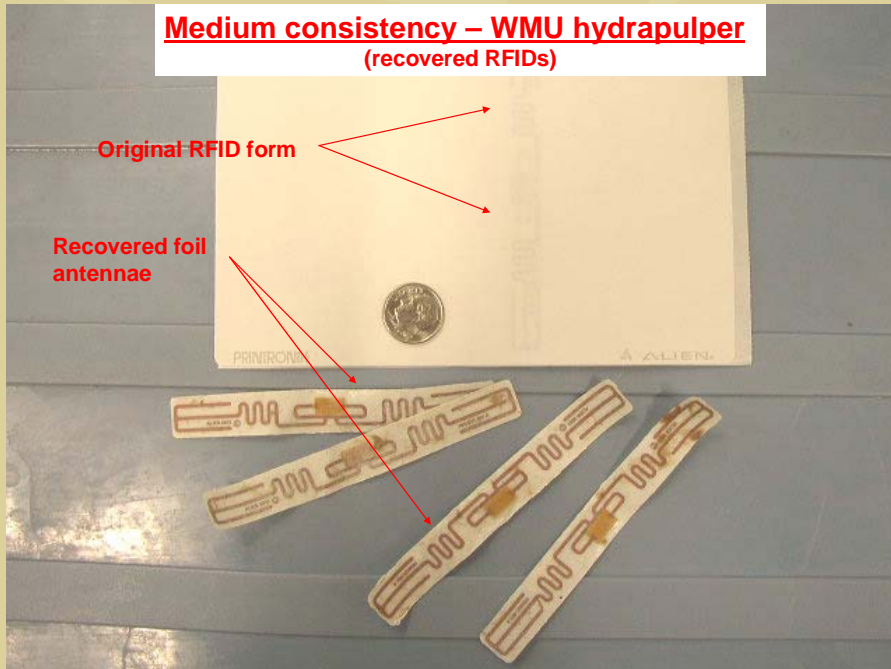
Printed tags run in pilot pulp plant at Western Michigan University

Pilot Plant



Results - Laminated

Foil tags were removed early in the process resulting in minimal downstream impact



Results – Non-laminated

Silver ink disintegrated in the process

Distribution of silver in various streams

Media	Percent Observed	Percent adjusted¹
Cleaning Rejects	63% ± 10%	4.1% ± 0.6%
Whitewater solids	3.4% ± 1.1%	8.9% ± 1.4%
Whitewater	1.3% ± 0.4%	3.4% ± 0.7%
Product	32% ± 8.8%	84% ± 1.9%

¹Adjusted to reflect 25th percentile low water use mill

Model vs. Regulatory Limits

Media	Modeled Silver Concentration, ppm	Limit Value, ppm	Model percent of limit	Limit Type
Cleaning Rejects	0.0237	5	0.47	TCLP
Whitewater Solids	0.0067	5	0.13	TCLP
Whitewater	0.1751	.0032	55¹	WQC
Product	9.65	0.3	Note 2	ADI_{CSR}

¹Based on lower 25th percentile for in stream dilution

²Extraction testing of product showed virtually no movement of silver from product

General Conclusions

Laminated foil tags are not likely to result in regulatory issues

Model produces a conservative result assuming 1/3 of all boxes are tagged and near worst case mill conditions

Printed silver tags not a near term concern. As they become more prevalent in the market, additional evaluation may be necessary

Study Limitations

Model has not been validated

Based on hypothetical mill design

Difficulty with analytical determination of elemental silver in vectors

Provides general understanding of partitioning but not a definitive standard

Impact on Metal Detection

Evaluated pilot plant samples

Samples and controls were both roughly 100 units above background

- Not a significant difference from background
- A 0.8 mm ferrous ball registered about 3000 units above background

Very limited evaluation on a single metal detector

Study Credits

**Jointly funded by Fibre Box Association and
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**Study conducted by National Council for Air and
Stream Improvement**

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Foil RFID tags provided by Alien Technologies

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