Lithium Ion Batteries in the Solid Waste System
SBWMA MRF Survey

Michael R. Timpane
Vice President/Principal
Lithium Batteries are Part of Us

Compared to 2010, Lithium Batteries Are...

- 60% more powerful
- 55% lighter
- 40% cheaper

Growing at a rate of 1.63 per person, per year
Lithium Batteries Solving Storage Riddle for Green Energy

- Wind, sun, tides can’t be turned on and off at will
- Excess energy goes to waste during production
- Batteries collect and store energy to be used in between production
- Reliability during disruption
- May reach household use within 10 years
The li-on (battery is) the backbone of the mobile electronics revolution, with some calling its impact as big as the transistor’s.

— Fortune

Lithium-ion battery technology is not intrinsically safe. Short circuit, overcharge, over-discharge, crush, and high temperature can lead to thermal runaway, fire, and explosion.

— UL Laboratories
Lithium ion batteries have significant advantages...highest electrochemical potential and the flattest discharge curve.” Oregon RFID, Battery Mfr.

“The mobile world depends on lithium-ion batteries — ultimate rechargeable energy store.” Supplying “…power-hungry laptops, cameras, mobile phones and electric cars”, Nature

“It is the best battery technology anyone has ever seen,” George Crabtree, Director of the US Joint Center for Energy Storage Research (JCESR)

“Battery technology has outpaced thermal protection…” Jabil Circuits, Inc., $18.3 B manufacturer for HP, Xerox and IBM (WSJ, July 22, 2017)

“Six months ago, none of us had ever heard of this. Now we're hearing about it over and over and over again (about Lithium Battery Fires)” Nitash Balsara, University of California, Berkeley

“Lithium-ion battery technology is not intrinsically safe. Short circuit, overcharge, over-discharge, crush, and high temperature can lead to thermal runaway, fire, and explosion” UL Laboratories
Potential for Lithium Batteries Fires in the Residential Recycling System

The International Air Transport Association (IATA) calls lithium batteries “dangerous goods… requiring special handling”.

Reported Fires 400°-1300°F. Explodes under pressure.
Lithium Batteries are easily damaged in the Residential Refuse and Recycling System.

**Collection**
- Dropping
- Blade Scraping
- Crushing +1,800# PSI compression ram
- Puncturing by sharp objects, glass, metal
- Unloading and running over with tires
- Push material with container bodies

**Material Recovery Operations**
- Pushing into piles
- Scraping with Blade
- Puncturing by sharp objects and metal
- Running over with tires
- Loading onto conveyor belt
- Dropping through screens
- Dropping to storage

7
Video of Brown County Lithium-Based Fire

This is why you should dispose of your lithium batteries properly.

How? Well, luckily.

Brown County - Recyclables in.
Battery Industry – LI batteries will cause hot fires in MRFs

Problem is only going to grow

Batteries collected at curbside … “is asking for trouble”
- 2017

Batteries “should be banned from the curb”
Fires in the Solid Waste System directly linked to Li Batteries

Recycling Truck Explosion
East Northhampton
Mar. 2017

Baler Chamber
Li-based battery contained explosion
Northern Calif
Feb. 2017
Recent Other Media Reports

Waste Management urges public to 'recycle right' this holiday season
On Monday, December 19, the Materials Recovery Facility (MRF) in Little Rock were able to extinguish a fire caused by a lithium ion battery. The

Fires Continue to Threaten Recycling Center
CINCINNATI – Oct. 3, 2016 – Since the beginning of the year, local fire departments have responded to six fires at Rumpke’s Cincinnati Recycling Facility in St. Bernard. The cause is likely something that many residents continue to toss into recycling containers – lithium ion batteries.

Plano Resumes Recycling After December Recycling Plant Fire
FDNY: Lithium battery caused 5-alarm fire that disrupted LIRR service

By Jesse Coburn
jesse.coburn@newsday.com  @jesse_coburn
Updated March 17, 2018 5:55 PM

The blaze that started outside a Queens recycling plant Friday afternoon was finally brought under control Saturday morning, the FDNY said.
Secondary Glass Plant - Colorado

- Solely MRF 3-mix glass feedstock
- 5 minute test revealed two LG batteries in mixed glass in metal recovery bin
1. Initial test Over 1000 Lithium Batteries captured in <5 weeks
2. Only reported batteries are those captured
LI Batteries Mixed with Recyclables

RRS/SBR Preliminary Study

5.48 Batteries/Hr.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>PRE SORT</td>
<td>9.38%</td>
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<tr>
<td>QC STATION ON THE RESIDUE LINE</td>
<td>4.79%</td>
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<tr>
<td>BELT 180</td>
<td>3.19%</td>
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<tr>
<td>MAGNETIC HEAD PULLEY</td>
<td>82.63%</td>
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</table>
LI Batteries Mixed with Recyclables

Continuing Audit and “Hardening the Facility”

Hilary Gans to Report at Waste Expo 2018

• Continuing Data-build from counts
• Train on identification, KPI’s
• Increased Fire Watch
• Suppression System
• Causes Counting of Incipient Fires
Industry Value Chain Surveys

MRF Survey

**Purpose:** To gain insight LI issues & current preventative measures

**Target Audience:** Public and privately-owned, single-stream MRF operators in CA and across the U.S.

**Process:** Telephone qualitative interviews with MRF operators – 5 questions

**Survey Results:** Serves to create an effective SOP including best practice & resource recommendations
National MRF Survey

Lithium Ion Batteries are Causing Fires

- 50% Fires Increasing
- 64% Most Prevalent Cause of Fires are Lithium Ion Batteries
- 78% Batteries are being found in MRFs (38% say a great deal)
81% do not accept batteries in their curbside collection

50% Customer Municipalities who advertise other disposal programs for batteries

58% Suggested that a lack of education on battery recycling caused Lithium batteries to enter MRFs and collection vehicles

*Attitudinal; needs deeper, repeated look in the future*
RRS/SBWMA National Survey

Interviews on Executive Perceptions

- Executives representing over 429 Residential MRFs, including Dual Stream and Single Stream
- Publishers of Recycling Today & Resource Recycling
- SWANA, ISRI, NWRA
- WM, Republic, Pratt, Rumpke, Casella CalWaste, Emterra

Pouch lithium polymer battery is favored for its lightness but is damaged easily.
Confidential Responses – Remarkably Uniform

• Batteries, Propane tanks & unspecified Truck “hot loads”, which could be battery-ignited, biggest cause of fires in MRFs

• Not as big an issue as field operators say, concern was muted

• Over the years fires have increased

• All except 1 had personal experience with a fire in the last 12 months. All had personal experiences over 2 years

• Recycling Symbols on batteries very confusing, Needs work

What we know is tip of the iceberg. Many fires are never reported. It will take a major event to sway folks to seriousness

– National Recycling Executive
Labeling on Batteries Confusing

1. 31,000 configurations and sizes
2. European symbol for don’t put it curbside does not work here
3. Recycling Symbol plus no can symbol leads to confusion

Could be construed as ‘do not put in the garbage but instead put battery in the recycling bin.’

Appears more prominently than other warnings on many batteries. And sometimes without No Garbage Can Symbol. Users may mistakenly put batteries in recycling bins.
Anne Germaine’s (NWRA), PRBA organized a national working group of industry executives

Surveys, Webinars, Outreach through ISRI, ANSI, SWANA, CRB, PRBA, CALL2Recycle, and NWRA garnered interest

New Call2Recycle Training (released day of meeting)

Workgroups gathering best practices and uniform communications plan
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<th>Sector</th>
<th>Issue</th>
<th>Remedy</th>
<th>Stakeholder</th>
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<tr>
<td>Municipalities/</td>
<td>Batteries are showing up in curbside recyclables because of confusing</td>
<td>□ Educate households on how to identify, and properly prepare all batteries for proper disposal (bag and tape)</td>
<td>1. Recycling Coordinator, Public Works Department, Solid Waste Department</td>
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<tr>
<td>Solid Waste Authorities</td>
<td>symbols</td>
<td>□ If curbside already in place, place their lithium-ion batteries for curbside collection properly</td>
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<td></td>
<td>Batteries collected at curbside are not properly prepared or placed in</td>
<td>□ If curbside not already in place, municipalities provide promotion of existing battery depots within range of household (through either Solid Waste or Public Health depending on city)</td>
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<td>appropriate location for recycling.</td>
<td>□ Municipalities should consider not establishing a curbside program for lithium-ion batteries.</td>
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<td>Collection Companies</td>
<td>Batteries collected at curbside and placed in the truck, may catch the</td>
<td>□ Educate households on how to identify, and properly prepare battery.</td>
<td>□ Corporate Safety Managers</td>
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<td></td>
<td>truck on fire</td>
<td>□ Enforcement tool for hauler use if batteries are found in curbside recycling or improperly packaged batteries found on top of cart.</td>
<td>□ Field District Managers</td>
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<td></td>
<td>□ For existing curbside battery programs, POS tools for placing lithium-ion batteries for curbside collection on top and not in the cart (if the contractual responsibility of the hauler).</td>
<td>□ Route Managers</td>
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<td>□ Municipalities should consider not establishing a curbside program for lithium-ion batteries- promotion for public</td>
<td>□ Drivers</td>
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<td>□ Public Sector managers for private</td>
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<tr>
<td>Material Recovery Facilities (MRF)</td>
<td>If the residential recyclables placed on the MRF sort line contains</td>
<td>□ Educate households on how to identify, and properly prepare and place their lithium-ion batteries for curbside collection.</td>
<td>□ Corporate Safety Managers</td>
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<td></td>
<td>lithium-ion batteries, it increases the probability of a fire that can</td>
<td>□ Municipalities should consider not establishing a curbside program for lithium-ion batteries.</td>
<td>□ MRF managers</td>
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<td>cause significant damage. This</td>
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<td>□ Sorters, loader and forklift operators, and baler operators</td>
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<td></td>
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<td>□ Public Sector Managers</td>
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