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GUIDE FOR DEVELOPING LITHIUM BATTERY MANAGEMENT PRACTICES AT MATERIALS RECOVERY FACILITIES

This guide has been written to assist materials recovery facilities (MRFs) in developing management practices to properly manage and dispose of lithium batteries when spotted, to take precaution in case of a fire and to manage a fire if one does break out.

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Introduction

As the number of annual fire incidents at waste and recycling facilities continues to rise, one of the main reasons highlighted is the increase in the popularity of lithium-ion batteries (LIB) as they become cheaper commercially.^[1] Lithium batteries are found in everyday items such as phones, tablets and hearing aids, among other products. There is a lack of awareness and education between consumers and battery recycling.^[2] Labeling is not standardized and can be very confusing. Thus, they are appearing more frequently in the municipal waste stream and are often incorrectly placed in blue recycling bins as well. Lithium batteries may unknowingly catch fire and sometimes explode, causing injuries to workers and equipment and potentially destroying an entire facility.^[3]

To lower the risk of potential fires caused by lithium batteries, this guide has been written to assist materials recovery facilities (MRFs) in developing management practices to properly manage and dispose of lithium batteries when spotted, to take precaution in case of a fire and to manage a fire if one does break out. Guidelines to help better educate consumers also are provided.

➤ **Contractual Language**

Issues and points to consider when developing contracts include:

- Clear language that batteries, especially LIB, are not accepted in a residential waste or recycling bin, or from trucks delivered to the facility.
- Responsibility and ownership for batteries found during the unloading of trucks (i.e., MRF, municipality, truck operator) and the protocols for proper management and removal.
- A material classification system (i.e., household hazardous waste, hazardous, damaged) for LIB found in inbound recyclables.
- Responsibilities for the removal and proper recycling/disposal of LIB found in inbound recyclables, as well as information on who will bear the cost.
- Roles and responsibilities for a curbside education program and inclusion of LIB as unacceptable and/or handled separately.
 - Fliers
 - When batteries are found or improperly packaged on the curb
 - Website, including information on where to recycle/dispose of batteries and phone numbers
 - Public engagement
- Language requiring a monthly report on batteries found, in inventory and disposed (i.e., count, tons or pounds for documentation of issue).

➤ **Inbound Material Control**

When developing operational procedures and controls, companies and facilities should consider the following principles:

- At earliest detection, establish a program for identification of LIBs for drivers so they are sensitized while unloading full trucks and when on routes (if not automated).

- Develop a program and training for material inspection upon arrival at the MRF that includes battery identification, safe removal and proper storage. Typically, this program would include:
 - Training for employees who are engaged in the inspection and acceptance of inbound materials on how to identify and properly handle batteries
 - Availability of safe removal supplies (i.e., storage, terminal tape)
 - Scheduling and rotation of battery management in regular toolbox safety meetings
- Develop metrics to raise awareness and identify potential trends such as periodic battery counts (found batteries per hour).
- Manage batteries between sorting and proper storage. For example, consider placing batteries in 5-gallon metal buckets containing vermiculite or sand on the line from which materials are being pulled, similar to an ash bucket.
- Employers should make available plastic tongs, welding gloves and heat/spark masks to all employees handling batteries.
- Develop a written list of materials that are prohibited at the facility and materials that will be accepted but require special handling procedures. Ensure language is consistent with contracts (see Contractual Language above) and includes consequences for what happens when prohibited materials are brought to the facility.
- Establish dedicated temporary short-term and long-term storage options for batteries—include signage, barriers and painted identification of areas (demarcations).

➤ **Battery Recovery Locations**

Based on industry experience, batteries are most often recovered at MRFs from the following locations:

- Inbound stream
 - Tip floor
 - Manual sorting (i.e., pre-sort, quality sorts, aluminum and glass sorts)
 - Magnet
 - Baling

➤ **Battery Identification: Soft-sided Battery**

Certain batteries produce their own oxygen.

Lithium Primary (button, cylindrical)

- Chemistries: Li-MnO₂ (CR), lithium iron sulfide.
- Uses: AA/AAA, medical devices, security, backup power, watches, hearing aids, calculators, non-consumer uses.
- Sizes: Including but not limited to 9v, AA, AAA, C, D, coin/button cell.
- Markings: It may be marked “lithium” or “lithium cells;” it may be marked as (CR###); it may include a recycling symbol.

Lithium-ion

- Chemistries: Lithium cobalt oxide (Li-cobalt or LCO), lithium manganese oxide (Li-manganese or LMO), lithium nickel manganese (NMC), lithium iron phosphate (Li-phosphate or LFP), lithium nickel cobalt aluminum oxide (Li-aluminum or NCA), lithium titanate (Li-titanate or LTO).
- Uses: Grid storage, electronics, e-bikes, e-cigarettes, hoverboards, power tools.
- Markings: It may be marked “rechargeable;” it may have a battery chemistry name (Lithium ion) or abbreviation (LI-ION, Li-ion, LiPo (lithium polymer)); it may have a button/coin cell (LIR#####); it may just have a battery seal or other mark. See below.



➤ Removal

Once identified, frontline employees should inspect and extract any batteries from the inbound material stream.

- Tip floor: Secure tip floor and idle all rolling stock while employees remove the battery.
- Sorting stations: Idle the conveyor system.

The employee should inspect the battery for damage. If undamaged:

- The employee should tape the battery terminals and place it in a dedicated temporary storage container (typically a metal, 5-gallon ash can).
- Once placed in the can, the employee should scoop vermiculite on top of the battery.

➤ Damaged Battery Protocol

Damaged batteries should not be stored with other undamaged batteries.

- Batteries that are swelling, smoking, leaking or overheating should be treated with extreme caution.
- Immediately place them in an absorbent, non-flammable material in a cool, dry place.
- Store outdoors away from structures, vehicles and equipment.
- Store in a noncombustible structure.
- Recommended storage materials include sand or vermiculite.

➤ **Material Storage**

At the end of each day, batteries should be moved to a long-term storage location from their temporary location.

- Must be stored in a remote location.
- Must have a stormwater plan, where required. (See: www.epa.gov/npdes/stormwater)
- Battery terminals must be protected or isolated to avoid spark or heat from a residual charge.
- The positive (raised) terminal must be protected either by packing, duct or electrical tape. Alternatively, each battery can be placed in its own clear, sealable bag.
- Batteries that have been individually taped or bagged can be stored in a UN Rated steel drum (1A) with a plastic liner or a UN Rated polyethylene drum (1H).
- Batteries must be stored in a cool, dry location.

➤ **Facility Inspections and Maintenance**

- Maintain fire suppression for inspections.
- Dry system inspection.
- Ensure you have the right quantity and size of fire extinguishers.

➤ **Fire Suppression**

Hopefully the measures taken above reduce the potential for fires to a minimum. However, in the event of a fire from a LIB, review the following items.

➤ **Housekeeping**

- Regularly inspect unprocessed and processed material storage (i.e., tip floor, bales, loaded trucks), handling and transfer areas.
 - Have an action plan and time frame for completion
- Conduct routine preventative maintenance of equipment.
- Use checklists to maintain a consistent inspection program.
- Be sure that fire extinguishers and suppression systems are adequate and in proper working order.
- Access and egress routes must be clearly marked and kept clear at all times.
- Follow fire safety and watch requirements during all hot work procedures.
- Ensure all fire suppression systems are maintained to National Fire Protection Association standards.
 - Manage low point drains in dry systems in cold climates
- Ensure fire extinguishers are the proper size and type for the area.

➤ **Facility Operations**

- The employer should have written plans and training in place to identify and mitigate battery fires safely in conjunction with their emergency action plan and fire prevention plan based on the circumstances, while obtaining the appropriate level of outside assistance.
- Consider designating responders in your emergency action plan and providing them with specific training to implement your site-specific response procedures to battery incidents. These designated responders should have quick response availability to identified areas of concern for the ignition of batteries.
- Consider monitoring daily operations for potential hot spots, keeping fire prevention measures in mind at all times.
- Areas of concern for ignition of LIB are:
 - Waste reception area
 - Shredder
 - Truck load dumping
 - Tipping floor storage
 - Feed conveyor and drum
 - Paper screens and glass breaker impact points
 - Loose storage bins
 - Baler
 - Bale storage
 - Truck storage
 - Secondary fires
 - Off-gassing
- Any point where materials come into contact with machinery or friction can be an area of concern, including being moved by a front-end loader, being loaded onto a conveyor belt, dropping through screens and dropping to storage.
- Have a stormwater program in place, especially for response, where required.
- Develop a “one fire extinguisher” attempt, call 911 and evacuate.
- Train employees in the PASS (pull, aim, squeeze, sweep) fire extinguisher method.
- Be aware of the batteries off-gassing and the dangers of smoke inhalation.
- Ensure evacuation plans are written and communicated with employees. Then, ensure training is provided to all employees.

➤ **Response Plan: Properly Labeled Storage Location**

- Have a written fire prevention and response plan in place.
- Ensure the “meeting point” is clearly communicated and signage is posted at the facility.
- Try to identify the following evacuation types:
 - Shelter in place
 - Move to another structure onsite
 - Onsite outdoor evacuation locations

- Offsite evacuation locations for large events
- Consider inviting first responders to your facility for familiarization purposes.
- Have a Knox Box or similar device in place to hold an entry key to the facility.
- Educate and train employees on the fire prevention and response plan, and ensure they have proper personal protection equipment, non-flammable gloves (all leather), safety glasses, appropriate cotton long-sleeved shirt, etc.
- During the extinguishment of a baler fire, there is the possibility of another flash fire as the baler pushes the material out, flammable cans are crushed and the heat of the baler acts as the ignition source.
- If a battery is observed beginning to react, it can be pulled out using tongs, placed into a lidded metal container containing sand and then taken to an isolated location.
 - Certain batteries produce their own oxygen
 - Quantity of batteries
- Fire response should conform to the [Emergency Response Guidebook](#).
 - Lithium Primary Battery Fire Response – Emergency Response Guide (ERG) 138
 - Lithium-Ion Battery Fire Response – Emergency Response Guide (ERG) 147

Consumer Awareness Messaging

Batteries are not safe in residential solid waste or recycling systems

- Special handling for disposal is required to eliminate health and fire threats.
- It's hard for consumers to tell the difference between batteries.
- It's hard to enforce lithium-only bans.

Power comes with responsibility

Spent batteries aren't dead and can be dangerous

- Used lithium batteries can often maintain 80 percent-plus of their original charge.
- Other chemistries also cause fires.

Don't remove non-removable batteries

- Lithium polymer batteries, without hard cases, are susceptible to damage.
- If it's hard to get out, leave it in.

Tape or bag

- The positive (raised) terminal or the charging terminals must be protected either by packing, duct or electrical tape. Alternatively, the whole battery can be individually placed in a clear, sealable bag.

Batterywise: Curbside is seldom wise

- Most municipal governments lack a battery management plan; however, more local governments are beginning to mitigate safety issues.
- Engage your local officials about improving the safety of the waste stream.
- Find a dedicated collection container or site in your area.
- Note: The U.S. and Canadian Special Permit allows for no more than 4.4 pounds (2 kilograms) of lithium cells and batteries to be contained in a single package. However, a single cell or battery may be shipped within one package provided the cell or battery has a mass of 5 kilograms or less.

References

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