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Fact Sheet: Lithium-ion Batteries

The Compliance Monitoring and Enforcement (CME) Task Force within the ASTSWMO Hazardous Waste Subcommittee and the Sustainable Materials Management (SMM) Task Force within the ASTSWMO Materials Management Subcommittee collaborated to produce a series of three fact sheets on emerging wastes from renewable energy sources: lithium-ion batteries with a focus on electric vehicle batteries; photovoltaic modules; and wind turbine blades. The fact sheets are intended to be living documents to be periodically updated with new information.

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Lithium-ion Batteries

Lithium-ion batteries are one of the most commonly used types of batteries in a wide range of consumer products, including in electric vehicles (EV). These batteries' prevalence has increased in recent years, in part because of the growth of the number of products that require such a power source. As demand for EV increases, it is important to identify the proper disposal procedures for these batteries. In order to recycle these batteries, workers must be trained to safely handle the compounds found inside the battery. However, most of these batteries were not constructed with end-of-life in mind. Therefore, stripping the battery and recycling certain parts is difficult and labor intensive. This fact sheet is intended to be a quick guide as to the construction, end-of-life handling, and current legislation regarding lithium-ion-batteries.

Lithium-ion Battery Construction

The battery is constructed using an anode, cathode, electrolyte, and separator. Within the electrolyte one can find both positively and negatively charged lithium ions. These ions are moved from anode to cathode creating an electric energy current that can then be used to power the vehicle. Most batteries use a powerful glue that holds the cells together. However, separating this glue is difficult and can be dangerous when attempting to recycle the battery. Currently, some lithium-ion batteries installed upon vehicle manufacture are reaching their end-of-life prior to the rest of the vehicle itself. As lithium-ion vehicle batteries remain a relatively

new technology, knowing exactly when the battery will expire is difficult. However, experts estimate that the average lithium-ion vehicle battery can last anywhere from 8-10 years depending on externalities and care of the battery.

End-of-Life Handling

Lithium-ion batteries, as currently constructed, contain valuable materials that can be recycled if properly removed. Recyclable materials include lithium, aluminum, copper, and (most importantly) cobalt. Cobalt increases battery life and energy density, which are important qualities for vehicle performance. The element makes up to 20% of the total weight within the cathode section of the battery. However, cobalt is expensive to mine and its prolific use means that natural supplies of cobalt are dwindling. This makes cobalt the most valuable element to recover from lithium-ion batteries in the recycling process.

Lithium-ion Battery Recycling

Availability of lithium-ion battery recycling facilities is limited. Batteries in need of recycling must be sent to a specialized recycling facility. Currently, there are a few recycling facilities dedicated to electric vehicle batteries in North America, although current capacity is small. Volkswagen has a new facility in Germany where batteries are crushed and precious metals are sorted for reuse. The EV industry can help by designing batteries with recycling in mind. This means using glue that can be easily stripped in the recycling process, utilizing designs which limit the dangers to workers when recycling batteries, and eliminating the use of non-recyclable materials.

Federal Regulation

Lithium-ion vehicle batteries are not uniquely regulated by the U.S. Environmental Protection Agency (USEPA). Rather, they are handled like any other waste stream. Consequently, when a lithium-ion battery becomes a solid waste, it is subject to the same hazardous waste determination standards as any other material. No lithium-ion battery should be discarded in household trash or recycling bins that are not specifically designated for battery waste. Further, the U.S. Department of Transportation (USDOT) lists lithium-ion batteries as hazardous materials. Therefore, transportation of used lithium-ion batteries is subject to Hazardous Materials Regulations (HMR).

State Approaches

Currently State approaches to the recycling of lithium-ion batteries are limited. California has been a leader in battery recycling policy and legislation. As 42% of the nation's EV are located in California (reported in 2021), the State feels a unique responsibility in ensuring the proper handling of the waste. The State, following the passage of Assembly Bill 2832 (Dahle, 2018) created a Lithium-Ion Battery Recycling Advisory Group whose stated goal is that 100% of the materials used within the batteries are reused or recycled at their end-of-life.

Many States have battery recycling regulations in regard to the lead-acid batteries found in traditional vehicles. Some States also require that manufacturers have a recycling program for the batteries that they produce.

Additional Resources:

California Lithium-ion Car Battery Recycling Advisory Group:

<https://calepa.ca.gov/lithium-ion-car-battery-recycling-advisory-group/>

Colorado Department of Public Health and Environment/Colorado State University
“Final Report: Colorado EV Battery Recycling Study”:

<https://drive.google.com/file/d/1F14bk1Gisx42UiOGfP4nmrybaus0SeA4/view>

call2recycle - Current State recycling policy regarding batteries:

<https://www.call2recycle.org/recycling-laws-by-state/>

U.S. Environmental Protection Agency:

Used Lithium-Ion Batteries:

<https://www.epa.gov/recycle/used-lithium-ion-batteries>

The Importance of Sending Consumers’ Used Lithium-ion Batteries to
Electronic Recyclers or Hazardous Waste Collection Facilities:

<https://www.epa.gov/recycle/importance-sending-consumers-used-lithium-ion-batteries-electronic-recyclers-or-hazardous>

U.S. Department of Transportation, Pipeline and Hazardous Materials Safety
Administration:

<https://www.phmsa.dot.gov/lithiumbatteries>

U.S. Department of Energy National Renewable Energy Laboratory (NREL) homepage:

<https://www.nrel.gov/>

NREL Renewable Energy Technology News:

<https://www.nrel.gov/news/features/2019/your-renewable-energy-technology-is-growing-old-whats-next.html>