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Is It a REC? – Batteries

The ASTM International E1527-13 Standard Practice for Environmental Site Assessments does not mention them specifically, but it is not uncommon to encounter batteries when performing some aspect of an environmental site assessment (ESA). One way to categorize their use, relevance to an ESA, and whether they should be considered as a recognized environmental condition (REC) is to determine if batteries or battery wastes have been dumped in the past. In present use, it is important to know if a battery will leave a facility as a waste or will be recycled. Finally, the proliferation of battery use in electric vehicles and energy storage systems may create an additional challenge for assessment in the future.

Batteries in the Past…

Just like other types of hazardous electronic wastes that make their way into the solid waste stream (television & computer monitors; fluorescent light tubes; ballasts containing polychlorinated biphenyls (PCBs); appliances with chlorofluorocarbon refrigerants; etc.) batteries can cause a measurable and widespread impact to the environment when dumped. Lead acid battery wastes in particular have been associated with lead smelting operations that also included battery recycling facilities. Many with poor management practices have been placed on the National Priority List (NPL). A thorough ESA involving a site with past battery waste activity, or located within an applicable radius to your subject property, should consider the following:

- Did the site involve battery breaking (i.e., physical breaking or separation to reclaim lead) or thermal processes to melt the scrap lead?
- Consider other liquids and metal alloying agents such as cadmium, copper, arsenic, antimony, nickel, selenium and tin.
- Consider types of contamination such as air emissions, smelting & refining agents, and process by-products.
- Investigate acid contamination from bulk sulfuric acid in tanks or lagoons, as well as discharge to ground.

An important consideration for battery waste sites is spilled sulfuric acid. Where lead and other heavy metals can be fairly immobile in soil, lowering the pH from acid contamination will increase the solubility, and the mobility, of metals in the environment and increase the impact and risks of metals contamination.

In the past battery manufacturers also used mercury to prevent the buildup of internal gases that can cause the battery to bulge and leak. This practice has declined sharply, and especially in the U.S the only types of batteries that contain mercury are some button cell batteries and mercuric oxide batteries (see Table 1). The EPA's Mercury-Containing and Rechargeable Battery Management Act of 1996 prohibits the use of mercury in all other types of batteries. With the passage of this act, mercury-free alkaline batteries became the national standard for most types of batteries.

Batteries in the Present

When asking "Is it a REC," first ask yourself, and the facility or property representative, "Is it a waste?"

As detailed in Title 40 of the Code of Federal Regulations (CFR), Part 273 – Standards for Universal Waste Management, certain batteries may not need to be regulated as hazardous wastes. Section 273.9 of the Universal Waste regulations defines a battery as "a device consisting of one or more electrically connected electrochemical cells which is designed to receive, store, and deliver electric energy…" The term battery also includes an intact, unbroken battery from which the electrolyte has been removed. Some batteries meet this definition but are not Universal Wastes.

These include spent lead-acid batteries that are being managed under the requirements of 40 CFR Part 266 Subpart G (Spent Lead-Acid Batteries Being Reclaimed), i.e., batteries that are not waste because they have not been discarded. Spent lead-acid batteries can be exempt from hazardous waste management requirements if they are being reclaimed. However, if the batteries are stored before being reclaimed they are subject to hazardous waste regulations, for example 40 CFR Part 260 – Hazardous Waste Management Regulations.

Universal Wastes regulations pertaining to batteries, as for fluorescent light tubes, certain pesticides, and other mercury-containing equipment, will impact how a facility must manage its batteries. Check 40 CFR 273 and 260 carefully, as well as state regulations, when deciding if battery use, handling, and storage at a facility may be considered a REC. As discussed in previous *Is It a REC?* issues, a Phase I ESA is not an environmental compliance audit. However, improper handling of battery wastes can raise the specter of environmental conditions and potential for future violations pertaining to on-site generation and accumulation limits; storage time limits; whether an EPA identification number is needed; and requirements for manifesting and personnel training.

More Batteries in the Future

The future is now when considering how recent advances in battery technology have allowed virtually every automobile manufacturer to offer a hybrid or total electric vehicle (EV) for any model, as well as the availability of not only utility-scale but also consumer-level energy storage options for homes and businesses.

Automobiles have overtaken consumer electronics as the biggest users of lithium-ion batteries. The Institute for Energy Research predicts that with the proliferation of electric vehicles, the global stockpile of batteries, which need to be replaced every 3-10 years depending on vehicle size and use, will exceed 3.4 million by 2025. Compared to about 55,000 for 2018, that's a greater than 60x increase in just 7 years. Seemingly as much a business opportunity as a waste problem, recycling and recovery of lithium, cobalt, nickel and other reusable materials in EV batteries is expected to increase.

A growing circular economy offers another option to battery disposal. Because EV batteries that are considered spent for vehicle use still may have up to 70% of their power capacity left, used EV batteries are increasingly being repurposed for energy storage in solar panel systems and homes.

Should we include energy storage batteries in our facility Phase I reports? Much as you would for electrical transformers, hydraulic equipment, and emergency generators, when conducting your building walk though, be ready to document lead acid, lithium ion, and other types of batteries that are being used to store energy. Such systems are already in place as part of rooftop solar panels, and running elevators, lights in common areas and backup power systems.

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Table 1: COMMON BATTERY TYPES

Household , Office & Institutional

Rechargeable

Lead Acid Gel 	**Lithium Ion** 	**Nickel-Cadmium** 	**Nickel Metal Hydride** 
Dry cell in a sealed case, common in wheel chairs, scooters, golf carts, ride-on toys, boats, RVs, military aircraft, portable tools and instruments. Non-spillable gelled electrolyte contains lead; can cause fire if short-circuited.	Dry cell in a sealed case, common in cell phones, laptop computers, other hand held electronics, power tools. Non-spillable, non-toxic, contains recyclable metals (nickel, iron, cobalt, etc.)	Dry-cell in rechargeable small-cylinder formats, poly-wrapped cell packs or hard case. Common in cell phones, laptop computers, power tools, toys, medical equipment. Cadmium can produce toxic vapors if incinerated.	Small dry-cell in AAA, AA, C, D, 9 volt, 12 volt formats, poly-wrapped cell packs or small-cylinder. Common in cell phones, laptop computers, power tools, hybrid automobiles, handheld electronics and R/C hobby vehicles. Non-spillable, non-toxic.

Non-Rechargeable

Alkaline & Carbon Zinc 	**Lithium (Primary)** 	**Button Cells** 
Dry cell sealed in AAA, AA, C, D, 9-volt, button cell formats in wide range of uses, non-toxic. Can be recycled for zinc, paper, plastic, brass, steel.	Dry-cell sealed in AAA, AA, 9-volt, button cell formats, common in watches, cameras, handheld electronics, tire-pressure sensors, alarms, memory backup, high-temperature applications, pacemakers, remote car locks. Non-spill-able & non-toxic, although can overheat or explode if short-circuited.	Sealed dry cells in small sizes for cameras, medical devices, watches, etc. Silver Oxide & Zinc versions are non-toxic; Mercuric Oxide versions produce toxic vapors if incinerated.

Industrial Batteries

Absolyte 	**Large Flooded Cell** 	**Nickel Iron** 	**Wet Nickel Cadmium** 
Lead Acid & Cadmium, often in steel racks of telecommunications systems, railroad switchgear, solar arrays. Contain lead and corrosive acid.	Lead acid in a hard case, used for stationary power. Contain lead and large quantity of corrosive acid electrolyte.	Large flooded cell, used in mining operations and railroad signals, declining use due to cheaper lead acid batteries.	Flooded cell in hard case, used in emergency power supplies, telephone systems, solar arrays, marine & aviation. Cadmium produces toxic vapors if incinerated.

Steel Case 	**Uninterruptible Power Supply (UPS)** 
Large flooded lead acid cell in steel casing, used in forklifts, industrial machinery, motive power. Contain lead and corrosive acid.	Medium to large flooded lead acid cell often occurring in multi-cell racks used as a stationary power source. Contain lead and corrosive acid.

Vehicle Batteries

Hybrid & Electric Vehicle (EV) 	**Lead Acid** 	**VRLA** (Valve-regulated lead-acid), aka "sealed lead-acid" or "maintenance free" 
Large dry cells containing nickel and lithium in racks of individual sealed cells, non-spillable and rechargeable. May be re-purposed as backup energy storage after useful life in EVs.	Lead acid in a hard case, most common in vehicles. Contain lead and corrosive acid but are 99% recyclable. This technology also used for energy storage.	Lead with small amounts of acid electrolyte in sealed case, common in automobiles, motorcycles, boats, and also in wheelchairs, emergency lighting. Contain lead and some corrosive acid.