# IMERC Fact Sheet
# Mercury Use in Batteries

This Fact Sheet summarizes the use of mercury in all of the batteries that contain mercury, including button-cell batteries. It includes information on the total amount of mercury in all products that were sold in the U.S. in 2001, 2004, 2007, 2010, 2013, and 2016.

The information in the Fact Sheet is based on data submitted to the state members of the Interstate Mercury Education and Reduction Clearinghouse (IMERC), including Connecticut, Louisiana, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The data is available online through the IMERC Mercury-Added Products Database.

## Types of Mercury Batteries

There are a variety of button-cell batteries that contain mercury, including zinc air, silver oxide, and alkaline manganese oxide batteries. Button-cell batteries are small, thin, energy cells that are not rechargeable. They are most commonly used in watches, toys, hearing aids, and other small and portable electronic devices. The availability of button-cell batteries enables small electronic devices to function.

Examples of button-cell batteries
Image courtesy of Wikipedia

**Zinc Air miniature batteries** are mostly used in hearing aids because of their high energy concentration and their ability to continuously discharge energy. This type of battery uses oxygen from the air to produce electrochemical energy. A hole in the cell allows the surrounding air to enter the battery and react with the cathode. They are also used in other small devices, such as wristwatch pagers and ear speech processors.

**Silver Oxide batteries** come in a variety of sizes, including larger ones and the button-cell size; however, the availability of the larger batteries is limited due to the high price of silver. Silver oxide button-cell batteries are used in various devices, such as hearing aids, watches, cameras, and clocks. In these button-cells, silver oxide makes up the cathode, and powdered zinc provides the anode in these batteries. Usually sodium hydroxide or potassium hydroxide is added as an alkaline electrolyte.

**Alkaline Manganese Oxide button-cell batteries** are used in toys, calculators, remote controls, and cameras. In these batteries, the cathode consists of manganese dioxide, which is produced through an electrolytic process, and the anode is made up of powdered zinc metal. The electrolyte typically used in this type of button-cell battery is potassium hydroxide.

Gas can form in all of these types of batteries due to the corrosion of zinc. Zinc in the battery gets corroded into the electrolyte as the battery is used. This corrosion can cause electrolysis and can cause the generation of hydrogen gas in the canister. Build-up of hydrogen gas can cause the battery to leak, limiting the ability of the battery to function. Mercury suppresses this zinc corrosion, which is why it is added to button-cell batteries. These batteries may contain mercury in the insulating paper surrounding the battery, or mercury may be mixed in the anode itself.

All of the different button-cell batteries can contain up to 0.005 grams (5 milligrams) of mercury in a single unit. Stacked button-cell batteries (i.e., units that contain multiple button-cells stacked on top of one another) may contain a larger amount of mercury.

**Mercuric Oxide batteries** contain mercury as the electrode and are useful in applications that require a high energy density and a flat voltage curve. In the past, mercuric oxide button-cell batteries were used in hearing aids, watches, calculators, electronic cameras, and other personal electronic items requiring a small battery. However, mercuric oxide button-cell batteries were banned in 1996 in accordance with the "Mercury Containing and Rechargeable Battery Management Act" and are no longer sold in the U.S. Larger mercuric oxide batteries may still be used in such applications as military, medical, and industrial equipment. The IMERC-member states have not received any Notification Forms for mercuric oxide batteries.

**Other batteries**, such as AAA, AA, C, and D alkaline, general purpose, and carbon-zinc; lead-acid; lithium-ion; and nickel metal halide and nickel-cadmium, do not contain mercury.

## Mercury Use in Batteries

Table 1 presents the total amount of mercury sold in batteries in 2001, 2004, 2007, 2010, 2013, and 2016 in the U.S.[1] Fifty-four manufacturers have submitted Mercury-added Product Notification Forms to IMERC-member states for one or more reporting years. However, at least 51 companies have since phased out their use of mercury in batteries or as a product component, and therefore, no longer report to IMERC. As of December 2018, one company has not yet submitted required data for the 2016 reporting year – although they did certify to IMERC that they phased-out the manufacturer and sale of mercury-added batteries in July 2017.

As shown in Table 1, the 2016 data analysis includes data from 16 companies. To estimate the 2016 total of 61 pounds of mercury sold in the U.S., IMERC assumed that the company that did not report for that year used the same amount of total mercury as in 2013. One company included in the analysis does not manufacturers and sell the traditional button-cell batteries, but instead sells specialty batteries used in government, military, and aerospace operations. 13 companies

[1] More detailed information on the 2001 and 2004 data can be found in the report, *Trends in Mercury Use in Products: Summary of the IMERC Mercury-added Products Database*, June 2008. (www.newmoa.org/prevention/mercury/imerc/pubs/reports.cfm)

reported to IMERC that they phased-out their mercury use prior to January 1, 2016 and, therefore, their mercury totals were zero. As a result, the total mercury data reported to IMERC consists of contributions from three companies. IMERC expects that these remaining companies will have completely phased-out their mercury use by the next reporting year in 2018.

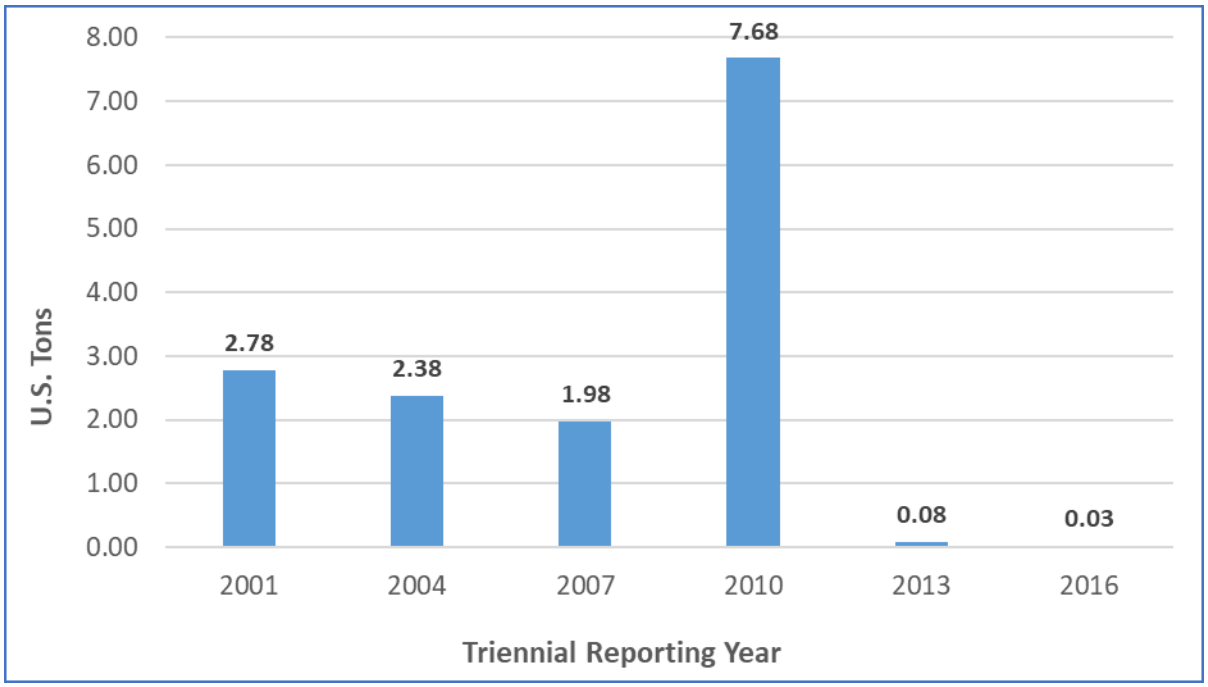
**Table 1: Data on Mercury Sold in Batteries in the U.S.**

| Triennial Year | 2001 | 2004 | 2007 | 2010 | 2013 | 2016 |
|---|---|---|---|---|---|---|
| **Total lbs. Mercury** | 5,561 (2.78 tons) | 4,752 (2.38 tons) | 3,952 (1.98 tons) | 15,362 (7.68 tons) | 163 (0.08 tons) | 61 (0.03 tons) |
| **Companies Reporting** | 43 | 48 | 43 | 44 | 43 | 16 |
| **Companies Out of Compliance** | 0 | 0 | 7 | 8 | 1 | 1 |
| **Companies Phased-Out** | 1 | 5 | 2 | 2 | 28 | 13 |

[Note: 453.6 grams = 1 pound; 2,000 pounds = 1 ton. All numbers are rounded to the nearest whole number.]

Overall, mercury use in batteries decreased significantly between 2001 and 2016 – from 2.78 to 0.03 tons, which is a reduction of more than 98 percent. It is important to note that this may be actually be an over-estimate. As noted above, Table 1 assumes that the mercury total for the one non-reporter in 2016 was the same as their most recently reported year, even though IMERC's experience indicates that companies' mercury totals have often decreased over time – especially since this same reporter stated that they phased-out as of July 2017.

Table 1 and the figure below show that mercury use in batteries increased during the 2010 reporting year over use in 2007. Much of this increase was accounted for in the report submitted through IMERC by the National Electrical Manufacturers Association (NEMA) on behalf of its members. NEMA represents five of the major battery manufactures, including Duracell, Eastman Kodak, Energizer, Renata, and Rayovac. This subset of manufacturers reported a difference of 1,991 pounds in 2007 versus 13,795 pounds in 2010 – an increase of almost 600 percent. In contrast, the non-NEMA reporting companies reported a decrease of 59 percent during this timeframe. Between the 2010 and 2013 reporting years, both NEMA and all other manufacturers reported a significant decrease in mercury use of more than 92 percent.




It is also important to note the overall decrease in the number of reporting companies. Since 2001, 54 unique manufacturers have reported at least once, with a high of 48 companies submitting notifications in 2004. In 2016, only 3 companies were continuing to sell mercury-added batteries, which is a decrease of more than 94 percent. As of December 2018, IMERC is aware of only two manufacturers of mercury-added batteries – and one of these companies only sells specialty (non-consumer) battery products. Many states have passed legislation restricting the sale of mercury-containing button-cell batteries and/or products that contain these batteries, such as toys and other novelty items. Given the laws and recent market trends, IMERC believes that mercury use in this product category will continue to decline in future years.

## Phase-Outs & Product Bans on the Sale of Mercury Batteries

As stated above, mercuric oxide button-cell batteries are no longer sold in the U.S. for personal or commercial use in accordance with the Mercury Containing and Rechargeable Battery Management Act of 1996. Research indicates that larger mercuric oxide batteries may still be used in limited applications (i.e., military, medical, and industrial). Federal law (and some state laws, including Maine) allows these mercuric oxide batteries to continue to be sold, but only if the manufacturer has established a system to collect waste batteries and ensure that the mercury is properly managed. To date, the IMERC-member states have not received any Notifications for mercuric oxide batteries.

The following IMERC-member states currently have restrictions on the sale and/or distribution of other mercury-containing batteries: Connecticut, Louisiana, Maine, and Rhode Island. Illinois also bans the sale of mercury-added zinc-air button-cell batteries only.

In response to the mercury product bans and phase-outs, many companies have ceased manufacturing mercury button-cell batteries and/or stopped selling products in which mercury

button-cell batteries are a component. As of the 2016 reporting period, 51 companies have confirmed to IMERC a complete phase-out of these products with additional companies actively working towards phase-out.

## Collection & Recycling Programs for Mercury Batteries

Mercury-added button-cell batteries have a shelf life of up to 10 years, so it is possible that there are still many in use that may end up in the waste stream in the coming years.

In 2014, the State of Vermont became the first state to enact extended producer responsibility (EPR) legislation requiring household battery manufacturers to establish collection programs for recycling primary (i.e., single use or non-rechargeable) batteries at their end-of-life. The law covers both mercury and non-mercury batteries. Examples include: alkaline, zinc carbon, lithium, silver oxide, and zinc air. Manufacturers of these batteries were required to set up a collection system by January 1, 2016.[2]

Collection and recycling of mercuric oxide dry cell batteries has been happening since the passage of the Federal Mercury Containing and Rechargeable Battery Management Act of 1996 (described above).

## Non-Mercury Alternatives

Some of the large battery manufacturers, including Sony Corporation, New Leader, and Energizer, manufacture non-mercury zinc air, silver oxide, and/or alkaline manganese button-cell batteries. However, many of these models are more expensive than their mercury counterparts and some may not be commercially available in the U.S.

Lithium button-cell batteries and non-miniature cylindrical alkaline batteries do not contain mercury. These may be a suitable alternative to mercury-containing button-cell batteries, depending on the end product and its power needs.

For more information on non-mercury alternatives for button-cell batteries, see: http://sustainableproduction.org/downloads/MaineDEPButtonBatteryReportFinal12-17-04.pdf.

## Data Caveats

A number of important caveats must be considered when reviewing the data summarized in this Fact Sheet:

- The information may not represent the entire universe of mercury-added batteries sold in the U.S. The IMERC-member states continuously receive new information from mercury-added product manufacturers, and as a result, the data presented in this Fact Sheet may underestimate the total amount of mercury sold in this product category.

[2] Vermont Product Stewardship & Extended Producer Responsibility: www.anr.state.vt.us/dec/wastediv/wasteprevention/productstewardship.htm

- In contrast, the data presented in this Fact Sheet may overestimate the total amount of mercury sold in this product category. In some cases, manufacturers supplied data for earlier reporting years but are out of compliance for one or more years. Rather than assuming that this non-reporting is a result of a company phasing-out its mercury-added batteries, IMERC takes a more conservative approach and assumes that the mercury total for non-reporters for 2016 is the same as its most recently reported year.

- The Notification requirement only applies to manufacturers and distributors of mercury-added batteries that are allowed to sell into one or more of the IMERC Notification States: Connecticut, Louisiana, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

- The information summarizes mercury use in batteries sold nationwide since 2001. It does not include products sold prior to January 1, 2001 or exported outside of the U.S., or products sold in-between triennial reporting years.

- Reported data includes only mercury that is used in the product, and does not include mercury emitted during mining, manufacturing, or other points in the product's life cycle.