Recycling used lead-acid batteries:

Brief information for the health sector
Introduction

The manufacture of lead-acid batteries accounts for about 85% of the global demand for refined lead metal (1). Much of this demand is met by recycled lead and a key source is, in fact, the recycling of lead-acid batteries (2). Lead recycling is an important cause of environmental contamination and human exposure (3,4). This is a concern because of the significant and long-lasting impacts of lead exposure on human health.

Lead is a cumulative toxicant that affects multiple body systems including the neurological, haematological, gastrointestinal, cardiovascular, reproductive and renal systems (5). Infants and young children are particularly vulnerable to lead exposure and toxicity. Frequent hand-to-mouth activity means that young children ingest lead in dust. Moreover, they absorb proportionately more lead from the gastrointestinal tract than do adults (6). The brain and nervous system are still developing during early childhood and can be damaged by lead exposure, which can result in impaired neurocognitive development, reduced intelligence quotient (IQ) and increased risk of behavioural problems (6). Chronic lead exposure is associated with an increased risk of hypertension and renal disease. Severe lead poisoning, whether from acute or chronic exposure, can be fatal.

It is estimated that, in 2015, lead exposure accounted for 495 550 deaths and the loss of 9.3 million disability-adjusted life years (DALYs) due to long-term impacts on health, the highest burden of disease being in low- and middle-income countries (7). The economic costs of impaired neurocognitive development alone were estimated to amount to 1.2% of global gross domestic product in 2011 (8).
What are lead-acid batteries?

Lead-acid batteries are used in motorized vehicles, for storage of energy generated by photovoltaic cells and wind turbines, and for back-up power supplies. Where power supplies are unreliable, lead-acid batteries are used domestically for lighting and electrical appliances.

The batteries are made up of a plastic or ebonite case containing positive and negative plates, which are separated by porous plastic, resin or microfibre sheets and bathed in a sulfuric acid electrolyte solution. The plates are lead grids coated with metallic lead paste (positive plates) and lead oxide paste (negative plates) (9). The average amount of lead in automotive batteries can range from 2 to 13 kg, depending on the size of the vehicle (10).

Steps in the lead-acid battery recycling process and lead exposure risks

Almost all parts of a lead-acid battery can be recycled. The process involves collecting and transporting the batteries to a recycling facility, separating the component parts of the batteries, and smelting and refining the lead components. The plastic components may be washed then shredded or melted to make new products. The sulfuric acid electrolyte may be purified or treated, then disposed of or recycled (9).

Lead can be released at all stages of the recycling process. Draining the lead-contaminated electrolyte, or its leakage, can contaminate soil and water bodies. Breaking up the battery mechanically or manually releases lead particles and contaminated mist and dust. Smelting the lead components generates hazardous lead fumes.
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Lead contamination of soil & water

Toxic smoke including sulfur dioxide, dioxins, dibenzofurans. Lead–contaminated waste

Lead fragments and lead oxide dust dispersed into air and settle on soil, other surfaces and workers’ hair & clothes. Surrounding environment contaminated with lead

Lead fumes dispersed in air and inhaled by workers. Fumes condense as particles that settle on soil, other surfaces and workers’ hair & clothes

Lead dust carried home and contaminates domestic environment
The movement of battery components around the recycling site and the sifting of ashes to retrieve lead particles also release lead fragments and dust (9,11). Other toxic substances can be released during the recycling process, such as arsenic, antimony, barium, cadmium and sulfur dioxide. If the rubber and plastic components are burned rather than recycled, they will release toxic gases, including dioxins (9).

Without the necessary engineering and process controls to prevent lead emissions, as well as appropriate occupational hygiene measures, even licensed recycling operations can cause significant occupational exposure and environmental contamination. These risks are particularly high with unregulated, informal recycling practices, which occur in many countries. These are sometimes family-run enterprises where children also work, thus becoming heavily exposed to lead (4). If people engaged in recycling return home without changing their clothes and washing they can bring lead into their homes and expose household members.

Lead fumes and dust released during the recycling process can be inhaled, and are transported in air to deposit onto soil, water bodies and other surfaces, contaminating the area around recycling plants (9,12,13). If not adequately treated and disposed of, waste materials from lead processing will also contaminate land and water bodies. Lead can enter the food chain through crops growing on contaminated land, from direct deposition onto crops, through food animals foraging in contaminated areas and consuming lead particles, and from fish and shellfish living in lead-contaminated water.
Case study: Senegal

Between November 2007 and March 2008, 18 children died from an aggressive central nervous system disease in a suburb of Dakar, Senegal (14). A subsequent investigation found that informal lead recycling had been taking place in the area over many years. In the months prior to the deaths, local residents had started sifting lead-enriched soil and bringing it to their homes to separate and sell fragments of lead. Lead intoxication was therefore suspected and 81 members of the community were examined. All were found to have high blood lead concentrations, with levels in children ranging from 39.8 μg/dL to 613.9 μg/dL (levels above 45 μg/dL indicate serious poisoning). Extremely high levels of environmental contamination were also found. In order to prevent further lead exposure, homes were cleaned, contaminated soil replaced with clean soil, and a public awareness campaign was carried out to encourage a change in lead-acid battery recycling practices.
Control measures

The prevention of lead exposure and environmental contamination from lead-acid battery recycling requires that the process only takes place at facilities that are equipped with engineering controls to minimize lead emissions, including fully automated and enclosed operations, adequate exhaust systems with air filtering technology, and effluent treatment systems (10). Workers at recycling facilities should be trained and provided with appropriate personal protective equipment, and facilities for washing and changing into clean clothes. There should be a programme for monitoring workers’ exposure and the application of corrective measures if exposure standards are exceeded (10).

Recycling lead-acid batteries should be a regulated industry, with standards set, monitored and enforced for the location and operation of recycling plants (4,15). Informal or unlicensed battery recycling should be prohibited. Ways for discouraging informal recycling include promoting the collection of used batteries by licensed retailers when replacement batteries are being bought, manufacturer take-back schemes, and informing communities about the hazards of informal lead-acid battery recycling (15).

Role of the health sector

While much of the responsibility for ensuring the sound management of used lead-acid batteries lies with the environment sector, the health sector also has a part. Measures include ensuring that health-care practitioners have training on, and resources for, the diagnosis and management of lead poisoning, educating local communities on the health hazards of lead, and taking action to inform the responsible authorities when lead poisoning associated with recycling is discovered.
Furthermore, health ministries should aim to ensure the availability of blood lead testing capacity and work with industry to reduce employee exposures.

Source of additional information

This document is a summary of a more detailed WHO publication called Recycling used lead-acid batteries: health considerations, which is available at:

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