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The Association of Electrical and Medical
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Sound Environmental Management of Spent Primary Batteries

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EXECUTIVE SUMMARY. The landfill disposal of alkaline and zinc carbon batteries does not pose a significant health or environmental risk based on over 20 years of battery industry experience and the results of various scientific studies. *Thus, there is no basis to require the mandatory collection and recycling of household alkaline and zinc carbon batteries based on any alleged health or environmental risks.* In addition, effective recycling technology is not currently available for these batteries, and the negative environmental impacts of special collection systems may be greater than the environmental benefit to be gained from recycling.

Governments should focus their current efforts at collecting and recycling batteries that contain significant quantities of hazardous materials, such as nickel cadmium, mercury and lead acid batteries. This is the current approach of the United States, Japan, Brazil, and some European countries. Effective recovery or recycling technology is generally available for these types of batteries.

BACKGROUND. Consumer alkaline and zinc carbon batteries are sold in all popular sizes (AA, AAA, C, D and 9 volt) and are used to power many different consumer devices, such as flash lights, radios, beepers, cameras, clocks, toys, etc.

SPECIFIC COMMENTS.

1. Alkaline and zinc carbon batteries contain "no added" mercury¹. By the end of 1993, all alkaline and zinc carbon batteries manufactured in the US, Europe and Japan contained no added mercury. This voluntary initiative by the world's leading battery manufacturers represents a major environmental achievement and has been applauded by the US Environmental Protection Agency, the European Union and by many other governments.

2. Alkaline and zinc carbon batteries are composed primarily of two common metals -- zinc and manganese. These common metals do not pose a risk to health or to the environment under anticipated use or disposal conditions.

* Zinc. The metal zinc is used as the negative electrode in alkaline batteries and consists of approximately 20 percent of the total weight of the battery. As the batteries are discharged, the elemental or "free" zinc is chemically converted into zinc oxide. Zinc oxide is a stable compound.

¹ Alkaline manganese button cells contain small amounts of added mercury. These and other specialty batteries that contain small amounts of added mercury generally "pass" the EPA's test for hazardous waste. As a result, US EPA regulations permit these batteries to be discarded with normal trash.

According to the US Geological Survey, batteries constitute less than 2 percent of total zinc consumption in the US. The majority of zinc is used as a galvanized zinc protective coating of steel (54 percent), as well as in die-cast alloys (21 percent) and brass alloys (14 percent). US pennies are approximately 98 percent zinc.

Zinc is generally considered to be non-toxic to humans and mammals. The US Food and Drug Administration (FDA) has listed several zinc compounds as "Substances Generally Recognized As Safe" when used as dietary supplements and nutrients. In fact, zinc is an essential nutrient for humans, and many people would be mineral deficient if they did not take zinc in some supplemental form. Zinc is provided as a human dietary supplement in the form of zinc tablets, in breakfast cereals, and in additives. Zinc oxide is also widely used as the active ingredient in diaper rash ointments, skin creams and foot powder, where it often constitutes up to 20 percent of the ointments and creams.

Zinc micronutrients are also essential to the proper growth of many plant crops, including corn, cotton, broccoli, cabbage and peanuts. Zinc is applied to these crops both to improve quality and to increase yields.

Although considered to be non-toxic to humans and mammals, zinc in the form of elemental or "free" zinc is known to be toxic to some aquatic life, such as fishes and invertebrates, in surface water. Although this property of elemental zinc has long been recognized, any aquatic exposure resulting from the use of alkaline batteries should be extremely rare. Several studies (see Point 4) show that the zinc from batteries does not leach out of the batteries when landfilled. However, even if the assumption is made that some leaching would occur, the minute quantities of zinc are chelated shortly after going into a solution in a landfill.

In 1994, the Belgian Battery Association contracted the Environmental Toxicology Unit of the University of Liege Faculty of Medicine in Liege, Belgium to investigate the environmental impact in Western Europe of zinc from household batteries. The study focused on the effects of zinc on aquatic and plant life. The study concluded that the disposal of household batteries in municipal solid waste (which are either directly landfilled or landfilled after incineration) does not pose any significant risk to human health or to the environment. Researchers further added that the quantity of zinc added to the environment through landfilling of batteries is "quite acceptable" in view of: i) the current sources of zinc in the environment; ii) the low solubility at neutral pHs of zinc compounds adsorbed on soil material; and iii) the near absence of toxicity of zinc at the level of concentrations presently observed in the soils and rivers of Western European countries.

* Manganese. Manganese, in the form of manganese dioxide, is used as the positive electrode material in alkaline and zinc carbon batteries. As the batteries are

discharged, the manganese dioxide is chemically reduced to a lower state of oxidation. Manganese dioxide is highly insoluble in water across a wide range of pH.

Manganese is generally considered to be non-toxic to humans by ingestion. The US Food and Drug Administration (FDA) has listed several manganese compounds as "Substances Generally Recognized As Safe" when used as dietary supplements and nutrients. In addition, the FDA has listed several manganese compounds as "Direct Food Substances Affirmed As Generally Recognized As Safe." In fact, manganese is an essential nutrient for humans, being required in trace amounts in the diet for good health. Manganese micronutrients are also essential to the proper growth of many plant crops, including cotton, lettuce, onions, cabbage, tomatoes, grapes and rye. Manganese dust or fume has moderate toxicity to humans by inhalation; however, there is no potential for inhalation of manganese dust or fume during the use of alkaline batteries or in the landfilling of spent alkaline batteries.

3. The US Environmental Protection Agency (EPA) does not regulate alkaline and zinc carbon batteries as a hazardous waste. Alkaline and zinc carbon batteries "pass" the EPA's test for hazardous waste. This test, referred to as the "Toxicity Characteristic Leaching Procedure" (or TCLP) demonstrates that alkaline batteries are not a hazardous waste under the stringent EPA regulations. As a result, US EPA regulations permit alkaline batteries to be discarded with normal trash.

4. Research studies of landfilled batteries have demonstrated that alkaline and zinc carbon batteries do not pose a risk to the environment under actual landfill conditions.

* Waterloo Risk Assessment Study. In 1991, the Canadian Battery Manufacturers Association contracted the Institute for Risk Research at the University of Waterloo in Canada to conduct an independent study into household battery disposal alternatives. Using risk assessment methodology, the study evaluated the impacts on the environment of mercury reduction on used household batteries. The study considered landfill leachate, degradation of batteries in landfills, and the variables of landfill management practices. Based on the study results that were released on March 30, 1992, Dr. Murray Haight and his team concluded that alkaline, carbon zinc and zinc chloride batteries could be landfilled without significant environmental risks.

* Fukuoka University Landfill Study. In 1987, the Japan Battery and Appliance Industries Association (JBAA) commissioned Fukuoka University in Japan to conduct long-term landfill experiments with alkaline and zinc carbon batteries. Fukuoka University was selected because of its recognized expertise in studying landfills, something it has been doing for many years. The study, which has now passed the 10-year mark, is evaluating degradation of alkaline and zinc carbon batteries in landfills under various conditions. The study is focusing on the formation and composition of leachate from the various metals found in the batteries, including zinc and manganese. Although the study is not complete, the researchers have found no evidence of any significant increase in the concentration of zinc or manganese in the leachate. For example, over 99.9 percent of the zinc in the batteries has not shown up in the leachate after 10 years of study. Thus, consistent with the Waterloo study, this comprehensive Japanese study supports the conclusion that alkaline batteries do not pose a significant environmental risk when landfilled.

* University of Liege Study of the Health and Environmental Effects of Zinc from Land Disposal of Alkaline Batteries. Refer to discussion on the University of Liege Study in Section 2, Page 3.

5. Systems for collecting consumer batteries may have a greater detrimental environmental impact than the environmental benefits gained from recycling these batteries, and carry a significant financial burden. A study conducted for the UK Department of Trade and Industry used a Life Cycle Assessment approach to evaluate the environmental tradeoffs and costs associated with various models for collecting and recycling consumer batteries. The study concluded that while recycling does divert metals from the waste stream, these benefits are outweighed by the detrimental environmental impacts of collection and transport (e.g. emissions, energy consumption, etc.). The study also concluded that there is little evidence to suggest that there are significant environmental impacts associated with primary batteries in the municipal waste stream, and the financial costs of collection and recycling systems are significant.

6. Members of the worldwide battery industry are playing a leadership role in developing recycling technology for alkaline and zinc carbon batteries. Although alkaline and zinc carbon batteries are non-toxic (no added mercury) and can be disposed of safely with normal trash, battery manufacturers recognize the importance of conserving resources for future generations. Accordingly, members of the worldwide battery industry have been working together since the early 1990's to develop recycling technology that is safe, cost-effective and environmentally sound. Although much progress has been made, technology meeting these requirements is not available.

7. Governments should focus their current efforts at collecting and recycling batteries that contain significant quantities of hazardous materials, such as nickel cadmium, mercury and lead acid batteries. This is the current approach of

the United States, Japan, Brazil, and some European countries. In addition, recovery or recycling technology is generally available for these types of batteries.

SUMMARY. The landfill disposal of zinc carbon and alkaline batteries does not pose a health or environmental risks based on over 20 years of battery industry experience and the results of various scientific studies. (Studies referenced in this paper are available on request). Although these batteries can be safely disposed of with normal trash, the worldwide battery industry is developing technology that may allow these batteries to be recycled in the future for purposes of resource conservation. However, this effective technology is generally not available today. Until effective technology is available, and collection systems are available that do not add a disproportionate environmental burden, governments should not require that zinc carbon and alkaline batteries be collected separately.