

Environmental Impact of Batteries: Green House Gas Emissions and Solid Battery Waste from Alkaline Batteries

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Greenhouse Gas Overview

Gases that trap heat in the atmosphere are often called greenhouse gases. Some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases (e.g., fluorinated gases) are created and emitted solely through human activities. The principal greenhouse gases that enter the atmosphere because of human activities are:

- **Carbon Dioxide (CO₂):** Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Carbon dioxide is also removed from the atmosphere (or “sequestered”) when it is absorbed by plants as part of the biological carbon cycle.
- **Methane (CH₄):** Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.
- **Nitrous Oxide (N₂O):** Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
- **Fluorinated Gases:** Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons). These gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as High Global Warming Potential gases (“High GWP gases”).

Impact of Alkaline Battery Production

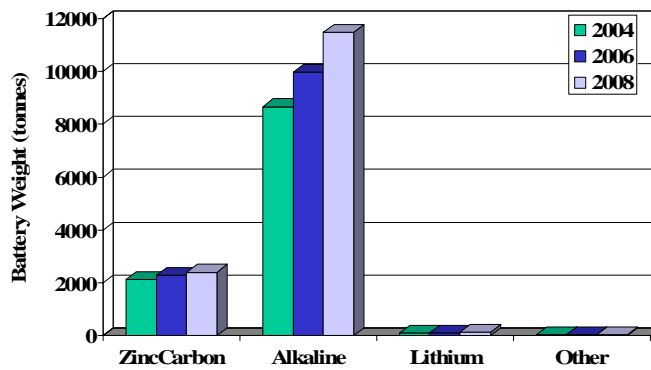
Batteries store electrical energy in form of chemical energy. Some, like conventional flashlight and toy batteries, are used until they are empty and then thrown away; these type of batteries are referred to as ‘Primary Batteries’. Others like Car, Laptop Computer, Cell Phone or Cordless Phone batteries can be used over and over again; these types are referred to as ‘Secondary’ or ‘Rechargeable Batteries’. The chemical energy is converted into electrical energy when a device needs it for power.

Primary batteries are in use for over 135 years now and are in ever growing demand as our modern devices become more and more portable without being connected to an electrical plug for power. Portable/wireless power has become an essential ingredient in our modern on-the-move world. Battery technologies have been improved over the years to provide the portable power needed for an unplugged society. As a result, huge numbers of batteries are sold and thrown away after use each year.

In the United States alone an estimated 3 billion (3,000,000,000) primary alkaline batteries are being sold and thrown away every year. This translates into approx. 100,000 tons of solid battery waste going to the dump. Worldwide, the total amount of solid waste from alkaline batteries would be approx. 10 times higher or 1,000,000 tons.

In Canada, according to the “Canadian Consumer Battery Baseline Study” submitted to Environment Canada February 2007 by RIS International Ltd., approximately 2,300 tonnes Zinc-Carbon and 10,000 tonnes Alkaline batteries were sold in 2006 (Figure 1).

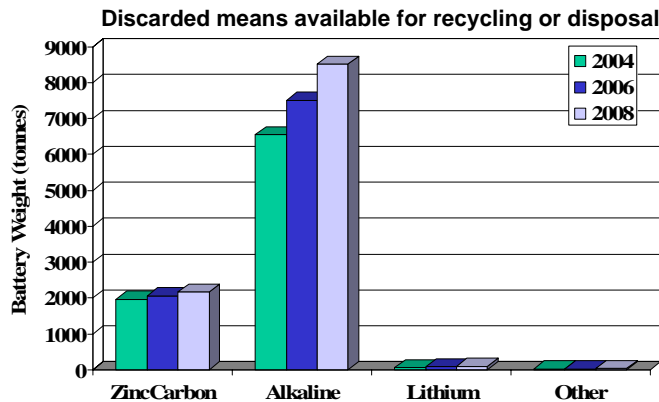
Consumer Battery Weight Sold – Canadian Market – Primary Batteries



Source: Canadian Consumer Battery Baseline Study by RIS International Ltd. Submitted to Environment Canada February 2007

FIGURE 1

Consumer Battery Discarded – Canadian Market – Primary Batteries



Source: Canadian Consumer Battery Baseline Study by RIS International Ltd. Submitted to Environment Canada February 2007

FIGURE 2

In the same year, approximately 7,500 tonnes of alkaline and 2,000 tonnes of Zinc-Carbon batteries were discarded (Figure 2). The difference in batteries sold to batteries discarded is attributed to battery hoarding. Discarded would mean that these batteries are available for recycling or disposal. However, no effective recycling is in place for primary cells, hence, these batteries end up in landfills.

While the concept of portable power is a great convenience and everybody appreciates wireless devices, nobody much talks about the huge amount of waste that is generated along the way. Further to the solid battery waste generated, green house gas emission waste generated from producing batteries has not been considered at all.

Pure Energy did an internal study of the amount of green house gases (GHG) generated during the production of alkaline batteries (AA and AAA size). The study included only the energy used to manufacture the batteries, not the raw materials needed to produce them and also not the transportation of the raw materials to the plant and the batteries to the retailers. It should be noted that the Pure Energy production line is capable of producing rechargeable and single-use alkaline batteries; hence, the same GHG footprint applies to one rechargeable and single-use alkaline battery.

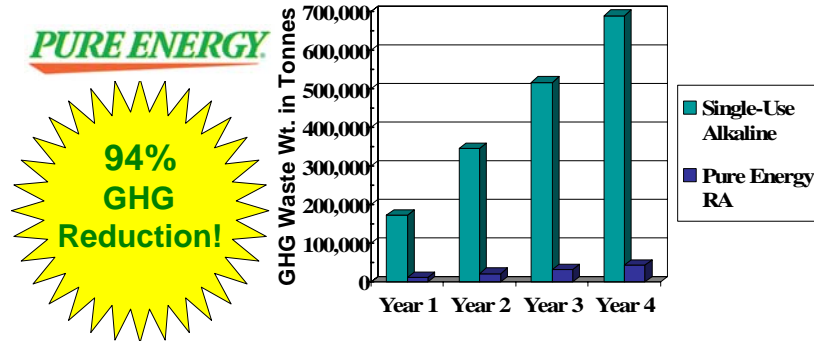
Based on energy generation figures issued by Environment Canada for Nova Scotia, the location of Pure Energy's manufacturing plant, each kilowatt-hour of electricity consumed produces approximately 729 grams of greenhouse gas emissions. Because Nova Scotia produces most of its electricity from burning coal, greenhouse gas emissions per kilowatt-hour of electricity consumed are relatively high. However, this figure is not out of line when considering the national average for US electricity production, which is 1.37 pounds per kWh (Source: EPA, Energy Information Administration, Oct. 2006) or 623 grams of green house gas emissions for each kilowatt-hour of electricity consumed. Heating of the plant is done with oil, which produces 2,500 grams of green house gas emissions per liter of oil. The total energy consumed for a one year period was recorded and applied to the total combined cell production quantity for that year. As a result of this calculation, one AA or AAA cell produced in Nova Scotia produces a green house gas emission value of 132g! Note again that this value applies equally to single-use and rechargeable alkaline batteries produced.

Next, an application case study was calculated for MP3 audio players operated by single-use alkaline batteries vs. Pure Energy XL Rechargeable Alkaline batteries (Figure 3). In this case study, the number of cells required to play 1,100 hours of music per year was calculated and the associated green house gas emissions were computed. As can be seen quite clearly, the use of rechargeable alkaline cells has a profound positive impact on GHG emission reduction, resulting in a 94% reduction!

Green House Gas Generation for MP3 Players from 10,000,000 People Playing Songs

Listening to 20 hrs. per week; 1100 hrs. per year each

- MP3 player runs a total of 8.4 hrs. on 1AAA Alkaline
 - 131 AAA Primary Alkaline needed per year, per person
 - 8 AAA Rechargeable Alkaline needed per year, per person



Note: Based on Nova Scotia GHG emissions values from Environment Canada, 2005

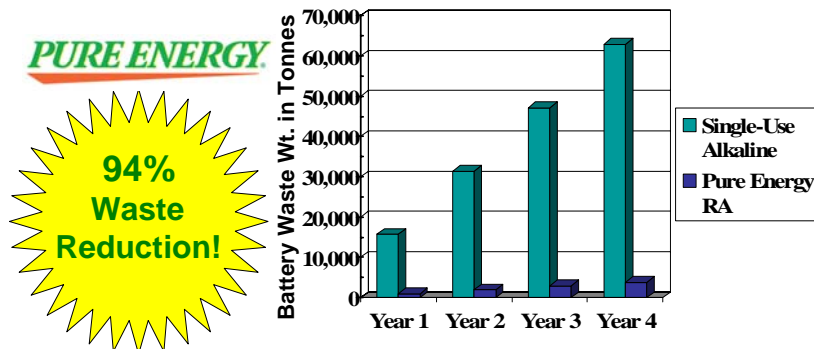
FIGURE 3

The solid battery waste reduction of this case study is shown in figure 4, which demonstrates a 94% battery waste reduction over single-use alkaline batteries from the use of rechargeable alkaline batteries.

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Note: Based on Deep Discharge in each Use, which is not recommended. More frequent recharge will further reduce battery waste due to extended life.

FIGURE 4

Health Risk of Batteries

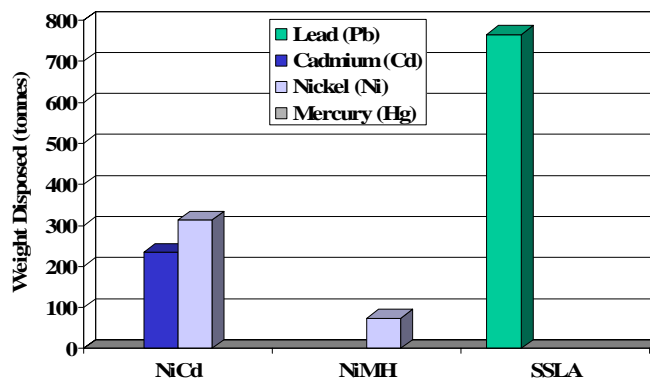
The Canadian Environmental Protection Act (CEPA) lists 4 toxic materials and their health concerns as follows:

1. **Lead** - Lead is a problem for both human and animals. It is a neurotoxin and is a particular concern for pregnant women and very young children where exposure can result in neurological impairment;
2. **Cadmium** - In humans, cadmium causes adverse effect in the kidney when ingested and can cause lung cancer when inhaled. Environmentally cadmium is a problem for aquatic and terrestrial receptors;
3. **Nickel** - Some forms of nickel are considered to be carcinogenic in humans, also dermal exposure can lead to a hypersensitivity reaction (skin rash). Nickel also can have an adverse effect on both aquatic and plant life.
4. **Mercury** – Mercury is a neurotoxin and accumulates through the food chain. There have been a number of high profile mercury poisoning episodes in industrialized countries in the last 30 to 40 years.

Solid battery waste reduction can be accomplished by other rechargeable battery chemistries, such as NiCd, NiMH or Lead-Acid. However, these rechargeable battery chemistries use materials that are toxic and pose health risk when entering the waste stream.

According to the “Canadian Consumer Battery Baseline Study” submitted to Environment Canada February 2007 by RIS International Ltd., approximately 235 tonnes of Cadmium, 386 tonnes of Nickel and 766 tonnes of Lead were disposed in 2004 from rechargeable batteries in Canada (Figure 5).

Consumer Batteries Health Risks – Canadian Market 2004 – Rechargeable Batteries Toxic Materials¹ from Batteries Disposed in 2004



¹) As per Toxic Substances List of CEPA 1999 – Schedule 1 updated Dec. 27, 2006

Source: Canadian Consumer Battery Baseline Study by RIS International Ltd. Submitted to Environment Canada February 2007

FIGURE 5

Rechargeable Alkaline cells on the other hand contain no toxic materials, do not pose a health risk and are therefore the preferred choice.

Let's not wait longer to do something about the effect batteries have on our health and environment. We must explore the alternative methods now that promote a “Green” solution wherever technically possible, such as the use of rechargeable alkaline batteries.

Environmental Choice

Rechargeable alkaline batteries selected to power consumer devices can reduce the solid battery waste and green house gas emission waste by more than 90%! Once Rechargeable Alkaline batteries reach the end of their useful life, disposal does not generate any health risks as no toxic materials are being used.

Due to these characteristics, Rechargeable Alkaline batteries are the only batteries to receive the prestigious EcoLogo™ certification, provided by Environment Canada's Environmental Choice Program.

The Environmental Choice Program is North America's leading benchmark of environmentally responsible products and services. Environment Canada's Environmental Choice Program provides consumers with a level of assurance that the product bearing the EcoLogo, ECP's symbol of environmental excellence, meets stringent environmental criteria. The mark also tells the consumer that the manufacturer of the product has been audited by a credible third party.

Rechargeable Alkaline Batteries... The Environmental Choice...

– Only battery with EcoLogo™ certification



PURE ENERGY