

Life Cycle Analysis and solid waste management: *household batteries*

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Household batteries

- **Classification**
 - Primary (single use)
 - Secondary (rechargeable)
- **Types**
 - Alkaline-manganese
 - Zinc-carbon
 - Mercury oxide
 - Zinc/air
 - Lithium
 - Nickel/cadmium

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Alkaline-manganese batteries: structure

1. Positive terminal
2. Steel can
3. Outer jacket
4. Separator
5. Electrolyte (alkaline solution)
6. Cathode (manganese dioxide)
7. Anode (zinc)
8. Anode collector
9. Seal/vent

QuickTime™ and a Photo - JPEG decompressor are needed to see this picture.

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Alkaline batteries - composition

- **Steel: 37%**
- **Manganese dioxide: 22%**
- **Zinc: 14%**
- **Graphite: 3%**
- **Plastic/paper: 4%**
- **Heavy metals (Hg, Cd, Pb)**
- **Alkaline solution (KOH, NaOH)**

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Disposal of spent batteries

- **subject of discussion**
- **presence of *heavy metals***
 - harmful to people and environment
 - even at low levels
 - potential to magnify their amount

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Disposal of spent batteries

Releases and contributions of harmful substances to the environment depend on the disposal method

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Portugal

- most batteries are disposed of with municipal solid waste
 - sent to landfill
- collection by voluntary activities
 - stored
 - sent for recycling
- two municipal solid waste incinerators starting up

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Portugal

- Clarify
 - Relative benefits
 - Potential environmental consequences

It is important to understand the suitability of the batteries disposal options

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Household batteries: case - study

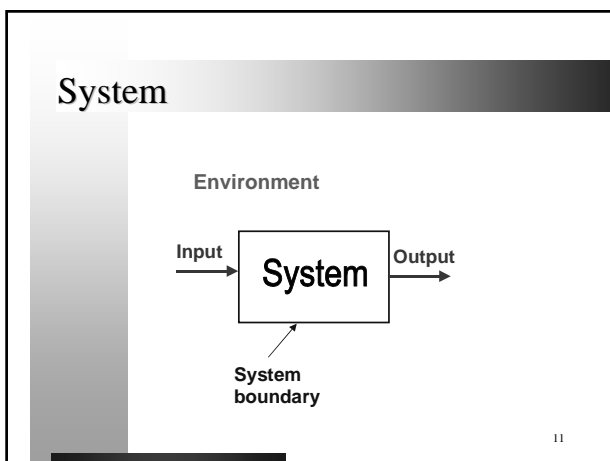
- Comparison
 - Landfilling
 - Incineration
 - Recycling
- Life Cycle Assessment

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Life Cycle Assessment

- Technique for assessing the environmental aspects and potential impacts associated with a system by:
 - Compiling an inventory I/O
 - Evaluating the potential environmental impacts
 - Interpreting the results

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System

- Environment
 - Surrounds the system
 - Source of inputs
 - Sink of outputs
- System boundary
 - Interface
- I/O elementary flows

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Life Cycle Assessment

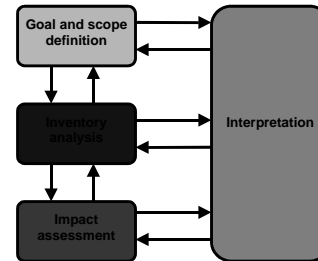
- Goal and scope definition
- Inventory analysis
- Impact assessment
- Interpretation of results

Life cycle analysis

Include goal and scope definition, inventory analysis and interpretation of results

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Life Cycle Assessment



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Definition of goal and scope

- Goal of the study
- Function and functional unit
- Initial system boundaries

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Goal of the study

- Compare environmental burdens associated with three different disposal options for spent alkaline household batteries:
 - Landfilling with MS W
 - Incineration with MSW
 - Recycling with zinc recovery

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Goal of the study

- Should help decision-makers on:
 - Predicting environmental performance
 - Demonstrate environmental sustainability
 - Define benefits and handicaps of each option

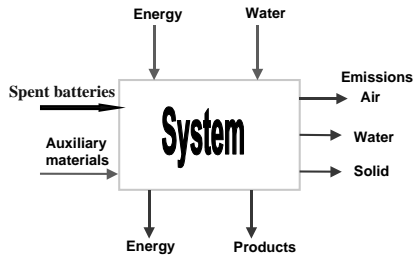
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Function and functional unit

- Function
 - Disposal of spent household batteries
- Functional unit
 - Amount of batteries disposed of inside the geographical area under study during 1 year

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Initial system boundaries



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Inventory Analysis

- **Systems modelling**
- **Data collection**
- **Batteries behaviour prediction**
 - Estimated
 - Experimentally determined

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Incineration with MSW

- **Process:**
 - Combustion on furnace
 - Flue gas cleaning
 - Energy recovery
 - Fly ash stabilisation
 - Bottom ash use
 - Stabilised fly ashes landfilling

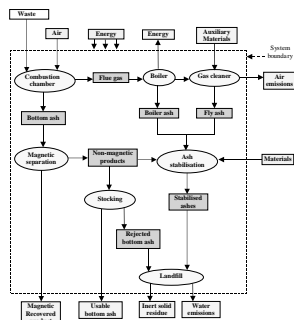
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Incineration with MSW

- **Emissions**
 - Product derived
 - Heavy metals
 - Process derived

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Incineration with MSW



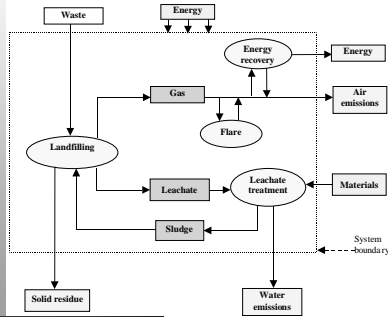
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Landfilling with MSW

- **Time perspective**
 - Short term
 - Long term
- **Emissions**
 - Product emissions

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Landfilling with MSW



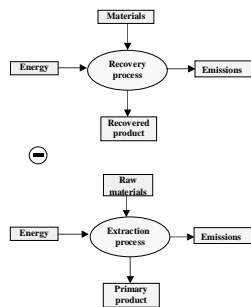
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Recycling

- **Metal recovery**
- **Processes**
 - Pyrometallurgical
 - Imperial smelting
 - Hydrometallurgical
- **Secondary function**
 - Zinc production

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Recycling



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Current situation and next steps

- **Laboratory experiences**
 - Alkaline batteries incineration
 - Batteries decomposition on landfiling
- **Data collection from industry**
 - Recycling process
- **Calculations**
- **Impact Assessment**
- **Interpretation of results**

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