REEE CYC’LAB: Assessing and improving the recyclability of Electrical and Electronic Equipment

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[avniR] Conference
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Eco-systèmes: a leading WEEE take-back system

The major European WEEE compliance scheme, since 2005

- 2000 producers members
- >1,000,000 tonnes of EEE put on the market in 2015
- 460,000 tonnes collected and treated in 2015

Selection of collection and treatment operators through call for tenders

R&D → plastics, critical raw materials and Urban Mines Chair of research (ParisTech)

Shareholders:

Manufacturers:
- atlantic
- BaByliss
- beko
- BRANDT FRANCE
- B/S/H/
- GROUPE CANDY-HOOVER
- COGIA
- DeLonghi Group
- EF
- FRANKE
- gorenje
- LG
- magimix
- Miele
- Panasonic
- PHILIPS
- SAMSUNG
- Smeg
- STIEBEL ELTRON
- Whirlpool

Retailers:
- Auchan
- BUT
- Carrefour
- Casino
- CENTRALE PRO
- Conforama
- Cora
- DAKY
- EURONICS
- Ex&Co
- H.T.M.
- LEONARD
An operational system displayed on the whole territory

Eco-systèmes contracts with operators and ensures traceability and performance assessment

- **Collection**
- **Logistics**
- **De-pollution and treatment**

- **Research programme to analyse the composition of WEEE collected**
- **Batch campaigns on each treatment site, once a year**
- **Downstream traceability and search for local outlets**

- **Material recycling**
- **Energy recovering**
- **Controlled elimination**
A role to play in the promotion of eco-design

Building a bridge between design and end-of-life of electrical and electronic equipment

- Recycling operators
  - Monitoring and flow analysis
  - Operational feedbacks

Eco-systèmes

EEE Producers
  - Eco-design good practices
  - Closed-loop projects
  - Life-cycle assessment
How to integrate recycling in eco-design projects?

Some needs...
- Get reliable, representative and up-to-date information
- Understand the background and share a common language
- Get quantitative indicators to compare & choose
- Obtain practical guidelines
- Get individual support to solve new questions

Some obstacles...
- Complexity of WEEE recycling
- Geography/organization: distance from R&D depts
- Data collection on product design (from suppliers)
Eco-systèmes launches REEECYC’LAB, a tool designed for producers

Available for designers since March 2016

https://reeecyclab.eco-systemes.com/
What is product « recyclability »?

Its capacity to be easily recycled thanks to the techniques in use in the current recycling industry

3 key parameters

- **Input materials used in the product**
  - Quality/quantity of fractions, existence of industries for recycling these materials

- **Materials assembly**
  - Ability to separate materials

- **Access to pollutants**
  - Ease of extraction of components or controlled substances
An iterative process controlled by each product designer

**Producers’ technical datasets**

- Input materials used in the product
- Materials assembly
- Access to pollutants

State of the art of the recycling

Ecodesign criteria identified

Evaluation of a theoretical recyclability

Identification of areas of improvement
REEECYC’LAB : demo

Assess the recyclability of your electrical and electronic equipments, test the alternatives and identify areas for improvement with Eco-Systèmes’s simulator REEECYC’LAB.

Register
REEECYC’LAB : demo

Evaluation

Product reference

To start the simulation, fill in the reference and the type of product evaluated below. The “Reference” will enable you to identify the product evaluated with your own internal codes. The “product type” filled in allows REEECYC’LAB to personalize the criteria, questions and explanations provided based on the device that you want to assess.

(*) Mandatory fields

ENTER YOUR PRODUCT REFERENCE *

SELECT THE PRODUCT TYPE BELOW*

Filter by Family

NEXT STEP
Nomenclature (ملف): Washing machine (front loading) - demo

Name: Printed circuit board assembly
Reference: 
Part requiring specific recycling: Printed circuit board (poor)

Material Family: Non-ferrous metal
Material: Other non-ferrous metal
Mass: 97.74 g
Filler: No filler
Surface Treatment: No coating
Connections

In your product, are there connections between materials that correspond to the following case(s)?

**CLING OR OVERMOULDING BETWEEN DIFFERENT PLASTICS?**

The use of processes to glue or overmould different plastics to each other disrupts their automatic sorting, prevents their proper separation and leads to deterioration in the purity of the recycled materials.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>I don't know</th>
</tr>
</thead>
</table>

Indicate below the cases listed in your product, selecting the 2 parts concerned for each connection. If one part is bonded with several other parts, add a line per bond in the table.

<table>
<thead>
<tr>
<th>MATERIAL N°1</th>
<th>RATIO (%)</th>
<th>MATERIAL N°2</th>
<th>RATIO (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation foam</td>
<td>100.00%</td>
<td>Drum</td>
<td>10.00%</td>
</tr>
<tr>
<td>Other foam - textile</td>
<td></td>
<td>PP-6012.0(g)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Perforated metal parts into plastics?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>-----</td>
</tr>
</tbody>
</table>
De-pollution

Certain products contain substances or parts considered as pollutants and that require specific management.

If you are not in a position to answer a question, it will be saved as information that still requires filling in. You can then update your answers later.

N.B.: the results of this evaluation do not guarantee the product’s conformity with current regulations.

**Electrolytic capacitors** are among the components requiring specific treatment according to the WEEE Directive (2012), and must accordingly be removed from the WEEE. Removal target rates are set in the GENELEC treatment standards. To this end, operators carry out an initial manual removal of these capacitors prior to shredding of the device, then a secondary sorting on the output conveyor belts. For this second sorting, the use of brightly-coloured capacitors makes it possible to optimise the effectiveness of the de-pollution.

Are the capacitors a colour that makes them easy to identify visually (e.g. fluorescent colours)?

- Yes
- No
- N/A to this product
- I don’t know

**Printed circuit board(s) separation**

Can the printed circuit board(s) be easily separated from the rest of the device (absence of overmoulding, limitation of irreversible fixing points)?

- Yes
- No
- N/A to this product
- I don’t know

**Capacitors location**

Are the capacitors always found in the same place, or is there external labelling on the device to make it possible to find them quickly?

- Yes
- No
- N/A to this product
- I don’t know
Results
Congratulations! You'll find below the results of your evaluation.
Your whole evaluation is now saved and accessible in the "My workspace" section, in "My evaluations" tab.
You can modify the information entered in the previous tabs and view their impact on the different indicators.

PRODUCT RECYCLABILITY: WASHING MACHINE (FRONT LOADING) - DEMO

Recyclability rate

78.7%

7 parts difficult-to-recycle

Product composition

- Plastics: 76.3% of the plastics used in the device could be recycled from WEEE.
- Critical metals: 1 part potentially containing strategic metals has been identified.
- De-pollution: 2 axes for improvement potentially facilitating decontamination or treatment of certain parts have been identified on the product.

Total mass: 67.569 (kg)
Difficult-to-recycle parts

The parts listed below present a low recyclability rate or can disrupt the separation and identification of the different materials, potentially leading to deterioration of the purity of the recycled materials.

Issues linked to the materials used

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Parts</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fillers such as glass fibre, talc, or flame retardants, for example, disrupt the identification and separation of the different plastic resins by wet density sorting, and reduce the potential volume of plastics to recycle.</td>
<td>Other polypropylene parts (filled) (421.0g)</td>
<td>PP (421.0g)</td>
</tr>
<tr>
<td>The use of a non-ferrous surface treatment on ferrous metals parts (e.g., copper coating on steel parts) disrupts both magnetic and induction metal sorting.</td>
<td>Steel sheets (24320.0g)</td>
<td>Steel (24320.0g)</td>
</tr>
<tr>
<td>Some materials have a lower recyclability because of their nature or because of a minor flaw in the WEEE flow. In the second case, the improvement of sorting technologies as well as an increasing demand for recycled materials could help to enhance their recyclability.</td>
<td>Cable (781.0g)</td>
<td>Other non-ferrous metal (235.3g), Other thermoplastic (547.7g)</td>
</tr>
<tr>
<td>Printed circuit board assembly (302.0g)</td>
<td>Other non-ferrous metal (97.7g), Other material (204.20g)</td>
<td></td>
</tr>
<tr>
<td>Rubber pipe (2220.0g)</td>
<td>Rubber - elastomer (2220.0g)</td>
<td></td>
</tr>
</tbody>
</table>

Issues linked to combinations of materials

<table>
<thead>
<tr>
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<th>Parts</th>
<th>Materials</th>
</tr>
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<tbody>
<tr>
<td>The use of processes to glue or mix small different plastics to each other disrupts their automatic sorting, prevents their proper separation and leads to deterioration in the purity of the recycled materials.</td>
<td>Insulation foam (525.0g)</td>
<td>Other foam - textile (525.0g)</td>
</tr>
<tr>
<td>Drum (3012.0g)</td>
<td>PP (3012.0g)</td>
<td></td>
</tr>
</tbody>
</table>
Use of recycled plastics proceeding from WEEE

Your device parts listed in the following table contain plastics that can currently be recycled in sufficient quantities and quality in order to be open-loop or closed-loop reused, by reintegrating them into the manufacturing of new products.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>TOTAL MASS (g)</th>
<th>PARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>1228.0(g)</td>
<td>Front panel ABS</td>
</tr>
<tr>
<td>PMMA</td>
<td>3.0(g)</td>
<td>PMMA</td>
</tr>
<tr>
<td>PP</td>
<td>8000.0(g)</td>
<td>Polypropylene (unfilled), Other polypropylene parts (filled), Drum</td>
</tr>
<tr>
<td>PS - HIPS</td>
<td>215.0(g)</td>
<td>Polystyrene</td>
</tr>
</tbody>
</table>

The following plastics can be recycled in sufficient quantities and quality to develop their use in the manufacturing of new products:

- PP
- ABS
- PC
- ABS-PC
- PMMA
- PS - HIPS

OK
REEECYCLAB : demo
“Best available technologies” approach

Assessment through cross-checking of input/output data:

WEEE streams material composition
- sampling and analysis (up to 50 tonnes/year)

Regular batch analysis
- Rank 1 operators: 1 batch/year
- Rank 2 operators: 1 batch/year for all fractions > 20 wt.%
- Downstream traceability
Methodology

Feedbacks from treatment operators + in-house technical expertise to identify:

- Types of assembly disrupting sorting and recycling
- Difficulties for de-pollution / extraction of specific components

Correcting factors in the calculation of the product recyclability rate

Check-lists and “educational” messages

### Issues linked to combinations of materials

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</tr>
<tr>
<td></td>
<td>Drum (8012.0g)</td>
<td>PP (3012.0g)</td>
</tr>
</tbody>
</table>
### Challenges & Key Aspects:

- **Get reliable & consistent data**

#### Batch under the control of take-back systems
- **Level 1**
  - De-pollution, treatment

#### Batch without take-back systems
- **Level 2**
  - Sorting and separation

- **Level 3**
  - Sorting and separation

- Final destination

#### Data Quality

<table>
<thead>
<tr>
<th>Estimate data</th>
<th>Empirical data</th>
<th>Declarative data</th>
<th>Batch without take-back systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**How and where is the data measured?**

*Downstream depth taken into account*
Challenges & key aspects: get reliable & consistent data

Performances of the processes (and sorting strategies) depend on the input WEEE composition and on the upstream process.
An innovative tool... to be improved and developed

First version, first objectives:
- Bring knowledge obtained from recycling activities to produce
- Help them identify the potential effects of their design choices
- Provide a first framework of reflection to support internal projects

Areas for improvement
- Better quantify the effects of some characteristics
- Integrate new materials, fillers/coatings, assembly methods
- Get a European approach
  - Availability of data in other countries, with comparable reliability?
  - Share a common methodology
Thank you !... Any questions ?

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