Eco-design and textile

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Bureau Veritas CODDE France
Bureau Veritas CODDE presentation
Ecodesign services

**LCA – Environmental Impact Assessment**
- Life Cycle Assessment (ISO 14040)
- Carbon footprint (PAS 2050)
- EIME (LCA software solution)

**TRAINING**
- Implementing an ecodesign process
- LCA of products and services using the EIME solution
- Design for recycling

**ORGANISATION – CONSULTANCY**
- Define the relevant ecodesign strategy
- Implementing ecodesign in your design process (ISO 14062)
- Product oriented environmental management system (ISO 14001)

**Communication**
- Product Environmental Profile – PEP (ISO 14025)
- Environmental labeling of consumer products (BP X30-323)
Life Cycle Assessment (LCA)

Definition

► Quantification of the environmental impacts of a given product or service caused during its life cycle
► Life Cycle and multi-criteria analysis including the carbon footprint

LCA results

Standards

► Standards: ISO 1404X
► International harmonization: ILCD Handbook
Ecodesign of products and services

Definition

► Including environmental constraints during the design phase of the product
► Life Cycle approach and multi-criteria approach
► Objectives: Implementing ecodesign as the normal way to design/purchase products

Standards/Regulation

► Standards: ISO 14062 – ISO 14001
Environmental labeling of consumer products

Definition

► Provide relevant environmental information on products to the consumers

Standards/Regulation

► Generalize LCA on each products
► Methodology standardized (BP X30-323, PAS 2050, ISO 14067)
► Provide environmental information to the customers through a label (will probably be standardized)
► Possibility to work on all consumer products

Existing labels

Global warming mainly due the use phase of the pant
The second phase contributing to the impacts is the production phase
Environmental labeling of consumer products

Global Warming (kg of CO2 eq)

- 2.7 kg
- 4.3 kg

Water Depletion (Liters)

- 150 liters
- 3300 liters
EIME LCA software

Definition
► Software to support the calculation of the life cycle environmental impacts of products and services

Standards/Regulation
► Life Cycle Analysis standards (ISO 1404X)
► Environmental labeling of products based on LCA results
► Environmental product declarations based on LCA results (ISO 14025)
Textile and environnemental issues
Contribution of the Different Categories to Some Environmental Impacts Generated at the EU Level

Sources: BIO Intelligence Service - O2 France. EXTERNAL ENVIRONMENTAL EFFECTS RELATED TO THE LIFE CYCLE OF PRODUCTS AND SERVICES
Contribution of the Different Categories to Some Environmental Impacts Generated at the EU Level

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## Contribution of the Different Categories to Some Environmental Impacts Generated at the EU Level

### Photochemical oxidation

<table>
<thead>
<tr>
<th>Category</th>
<th>Contribution</th>
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</thead>
<tbody>
<tr>
<td>Personal car</td>
<td></td>
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<tr>
<td>Food from animals</td>
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</tr>
<tr>
<td>Goods transport</td>
<td></td>
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<tr>
<td>Textiles</td>
<td></td>
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<tr>
<td>Building occupancy domestic</td>
<td></td>
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<tr>
<td>Building structure</td>
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<tr>
<td>Cleaning agents</td>
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<tr>
<td>Municipal waste management</td>
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<tr>
<td>Domestic appliances</td>
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<tr>
<td>Building occupancy commercial</td>
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<tr>
<td>Packaging</td>
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<tr>
<td>Public transport</td>
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<tr>
<td>IT Equipments</td>
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<tr>
<td>Civil work</td>
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<tr>
<td>Furniture</td>
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<tr>
<td>Water supply</td>
<td></td>
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<tr>
<td>Vegetables</td>
<td></td>
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<tr>
<td>Baby products</td>
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<tr>
<td>Footwear</td>
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<tr>
<td>Gardening</td>
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<tr>
<td>Alcoholic beverages</td>
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<tr>
<td>Paper products</td>
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### Stratospheric ozone depletion

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Textile & Environmental regulations: opportunities for Ecodesign

- IPPC Directive (emissions)
- European pollutant release and transfer register
- REACH (chemicals)
- EU waste law
- European Commission: development of the harmonised methodology for the calculation of the Environmental Footprint of products
- Environmental labeling (France 2012 BP X30-323)
ECODESIGN & TEXTILE
Context and approach
Context

70’s to 80’s

« End of Pipe » pollution treatment
Therapeutic treatments
Water and air treatment on sites

80’s to 90’s

« Middle of Pipe » pollution treatment
Preventive treatments
Polluting equipment replacement
Cleaner production

90’s up to now

Pollution anticipation
Ecodesign
New product design
New materials,
« green » technologies

PRODUCTION
Reactive strategy

PRODUCTION
Proactive strategy

LIFE CYCLE
Ecodesign

Definition

- Ecodesign is a strategic design management process that is concerned with minimising the impacts of the life cycle of products and services (e.g. energy, materials, distribution, packaging and end-of-life treatment)
Ecodesign

⇒ The approach aims at bringing environmental criteria on board at the design phase, as well as technical and economic ones:

⇒ It's a question of finding the best compromise, from the development stage, during which nearly 80% of the harmful effects of a product throughout its lifecycle are generated.

⇒ Reducing the environmental impacts over the whole lifecycle of the product, whilst preserving its suitability for the job it has to do.
Ecodesign

- The design phase of a product is the right moment to bring in the environmental issues.

Why?

- 80% of impacts can be dealt with
- 20% of impacts cannot be foreseen

- 90% of lifecycle costs are tied up at this stage
- 10% of expenditure occurs

Source: Study by TU Delft (NL)
Ecodesign

- Environmental alternatives to be chosen the soonest possible

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Source: Adapted from [Kortman et al., 1995]
Illustration: product issued from an eco-design strategy

► Ecodesign approach: Replacing PET fibres by Lyocell fibres
  - Use of renewable resource
  - Manufacturing process less polluting
  - Less mass material required

► After eco-design:
  - Reduction by 40% to 60% of the environmental footprint

Eco-Radar – Comparison of the environmental footprint of the production of two T-shirts in different material
Life Cycle Assessment (LCA): Principles
The 2 principles of LCA (standardized ISO 14040-44)

Multi-step:
To take in account all the steps of the product life cycle

Multi-criteria:
To take in account the different environmental issues linked to the product life cycle

Assess the whole life cycle

Measure/quantify numerous impacts

Avoidance of pollution transfers to ecodesign the product
Assessment of the potential impacts

EIME methodology ➔ Impacts measured on 11 environmental indicators:

- Global warming (or Greenhouse effect),
- Ozone depletion
- Air acidification
- Photochemical ozone creation
- Air toxicity
- Water toxicity
- Water eutrophication
- Water depletion
- Hazardous waste production
- Raw material depletion
- Energy consumption
LCA results: Contribution of the different life steps of a textile product

Example: bed sheet made of polyester and cotton
LCA methodology
Life Cycle Assessment: 4 steps

1 - Definition of goals and scope
2 - Inventory
3 - Impact assessment
4 - Interpretation

Action
The method– 4 steps

Step 1
Goal and Scope
- Goal definition
- Scope definition
- Functional Unit definition
- Study assumption…

Step 2
Data collection
- Data collection in order to assess the impacts

Step 3
Enter data in EIME
- Environmental impacts calculation
  ➔ EIME

Step 4
Interpretation
- Figures of environmental impacts
- Significant Environmental Aspects
- Sensitivity analysis
- Ecodesign strategy
STEP 1 : definition of goal and scope

► Goal definition

- Simple environmental assessment
- Implementing ecodesign strategy
- Communicate on the environmental impacts of the product/process
STEP 1: definition of goal and scope

Scope: system boundary definition

Life Cycle synoptic of textile product

- Raw material extraction
- Production
- Use
- Recycling/Reuse
- End-of-life
- Transport
- Energy supply
STEP 1 : definition of goal and scope

► Function and Functional unit (FU)

- A functional unit is a measure of the service delivered by the product system.
- The goal is to provide a reference to which inputs and outputs are related.

- Ex: FU = wear and wash pants for a year
- The number of products manufactured to meet the functional unit depends on the product lifetime.
- The impact of the manufacturing phase increases if the number of products required for meeting the FU increases.
STEP 2: Inventory

INPUTS

- PU, Transport
- Electricity
- Water...

- Transport
- Cardboard
- Plastic film

- Electricity
- Water...

- Transport
- Incineration
- Landfiling

OUTPUTS

Manufacturing

Distribution

Use

End of life treatments

Emissions to air, water, soil...

Emissions to air, water, soil...

Emissions to air, water, soil...

Emissions to air, water, soil...
STEP 2 : Inventory

► Data collection in order to assess the impacts

INPUTS
- Raw materials introduced
- Energy (thermal or electricity)
- Water consumption
- Chemicals auxiliaries (quantity, nature, chemicals manufacturing impacts…)

OUTPUTS
- Reference product manufactured (quantity, quality…)
- Water emissions and (COD, BOD, other chemicals concentrations, waste water treatment…)
- Air emissions (VOC, heat …)
- Solid waste (quantity, waste treatment…)
- Ground emissions
STEP 2 : Inventory

- **Raw material extraction**
- **Use**
- **Recycling/Reuse**
- **End-of-life**

**System**

- **Transport**
- **Production**
- **Energy supply**

**Elementary flows**

- Material or energy entering the system without previous human transformation

**Product flows**
Production phase
example: bed sheet in cotton fibres

- Cultivation, Harvest
- Spinning
- knitting
- Scouring
- Bleaching
- Reactive dyeing
- Finishing (softening, washing)
- Drying
- Cutting/Sewing/Assembly
Reactive dyeing

INPUT FLOWS

- Dyes
- Auxiliaries
- Thermal energy
- Electricity
- Water

OUTPUT FLOWS

- Water emissions
- Air emissions
- Ground emissions
- Wastes
STEP 3: impact assessment

Assessment: from flows to impacts

► Air emissions

- **CO₂**
- **CFC**
- **HCFC**
- **CH₄**
- **NOx**

Global warming
(g eq CO₂)

Ozone depletion
(g eq CFC11)

Photochemical ozone creation
(g eq ethylene)

Air acidification
(g eq H+)
STEP 4: interpretation
results for a bed sheet

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit</th>
<th>Manufacturing</th>
<th>Distribution</th>
<th>Use</th>
<th>End of Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Material Depletion (RMD)</td>
<td>Y⁻¹</td>
<td>33%</td>
<td>2%</td>
<td>65%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Energy Depletion (ED)</td>
<td>MJ</td>
<td>37%</td>
<td>&lt; 1%</td>
<td>62%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Water Depletion (WD)</td>
<td>dm³</td>
<td>86%</td>
<td>&lt; 1%</td>
<td>14%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Global Warming (GW)</td>
<td>kg ~CO₂</td>
<td>50%</td>
<td>&lt; 1%</td>
<td>49%</td>
<td>&lt; 1%</td>
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<tr>
<td>Ozone Depletion (OD)</td>
<td>g ~CFC-11</td>
<td>56%</td>
<td>2%</td>
<td>43%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Air Toxicity (AT)</td>
<td>m³</td>
<td>57%</td>
<td>1%</td>
<td>42%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Photochemical Ozone Creation (POC)</td>
<td>g ~C₂H₄</td>
<td>27%</td>
<td>&lt; 1%</td>
<td>72%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Air Acidification (AA)</td>
<td>g ~H⁺</td>
<td>63%</td>
<td>1%</td>
<td>35%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Water Toxicity (WT)</td>
<td>m³</td>
<td>64%</td>
<td>&lt; 1%</td>
<td>34%</td>
<td>1%</td>
</tr>
<tr>
<td>Water Eutrophication (WE)</td>
<td>g ~PO₄</td>
<td>83%</td>
<td>&lt; 1%</td>
<td>16%</td>
<td>1%</td>
</tr>
<tr>
<td>Hazardous Waste Production (HWP)</td>
<td>Kg</td>
<td>54%</td>
<td>&lt; 1%</td>
<td>44%</td>
<td>2%</td>
</tr>
</tbody>
</table>
Illustrations
Manufacture of a fabric in synthetic fibres: contribution analysis of the different steps
Contribution analysis

Manufacture of a fabric in synthetic fibres
Environmental impacts: comparison of three modes of dyeing
Comparative study: dyeing at different stages of the product manufacture

► **Functional unit:**

Production of 1kg of fabric in Polyamide dyed with dispersing dyeing.

► **Objective:** compare the environmental impacts of 3 dyeing techniques

  - Mass dyeing
  - Yarn dyeing
  - Fabric dyeing

► **System boundaries:** manufacturing phase
System boundaries

**INPUTS**

- Raw material production, Transport, Energies, Water
- Transport, Packaging production
- Energy consumption, others
- Transport, incineration, land filling…

**OUTPUTS**

- Air emissions, water emissions, ground emissions…
- Air emissions, water emissions, ground emissions…
- Air emissions, water emissions, ground emissions…
- Air emissions, water emissions, ground emissions…

**System boundaries**

- Fabric manufacturing
- Distribution
- Use
- End-of-life treatments
Comparative Cases

INPUTS
- PA Production, Transport, Energies, Water
- Energy consumption, Additives, Water
- Energy consumption, Additives

OUTPUTS
- Air emissions, water emissions, ground emissions…
- Air emissions, water emissions, ground emissions…
- Air emissions, water emissions, ground emissions…

Cases:
- Case n°1: Granule Dyeing
- Case n°2: Yarn Dyeing
- Case n°3: Fabric Dyeing

System boundaries
Comparative results

Energy Depletion

Water Depletion

Global Warming
Environmental impacts: comparison of different manufacturing locations
Synthetic fabric manufactured in France and in Thailand

► Main input variations due to different locations

- Energy mix
  - Thailand: major part of energy source = coal
  - France: major part of energy source = nuclear

- Emission water treatment
  - Thailand: no water treatment plant
  - France: water treatment plant
Comparative results

- RMD: Raw Material Depletion
- ED: Energy Depletion
- WD: Water Depletion
- GW: Global Warming
- WT: Water Toxicity
- WE: Water eutrophication
Conclusions

► The wet processing step has a consequent influence on the textile environmental impact.
  ➢ It represents a significant improvement potential.

► The wet processing steps are very complex and site specific:
  ➢ It is difficult to use generic data: data collection are required.

► Colour fastness improvement elongates life time of product. *Product life time has huge influence on the environmental impact.*
  ➢ Colour fastness testing and measurements are very relevant for assessing environmental impact of textile product.
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