List of functionalities and general structure of the ECO-TEXNANO Tool

Project acronym:	ECO-TEXNANO
Project full title:	Innovative tool to improve risk assessment and promote the safe use of nanomaterials in the textile finishing industry
Reference number:	LIFE12 ENV/ES/000667
Deliverable:	List of functionalities and general structure of the ECO-TEXNANO tool
Version:	v1. December 20th 2013
Associated Action:	A3
Action leader:	LEITAT

Table of contents

1. Introduction

The aim of this report is to define the general structure of the ECO-TEXNANO tool, which will be further developed during the action B5 of the project. The tool will support textile companies regarding the identification of the environmental, health and safety impacts of nanomaterials in the textile finishing industry. The information included in the tool will be based, beyond scientific literature and regulations, on the life cycle and risk assessment developed during the implementation of B1 and B2 actions, and the results from the pilot scale trials carried out in the action B4.

The main functionalities needed to improve knowledge on nanomaterials are presented in this report.

The main objectives of the ECO-TEXNANO tool are:

- To provide the textile finishing industry a user-friendly tool to improve its knowledge on risk assessment of nanomaterials and to promote the safe and green use along their life cycle.
- To compare the nanotextiles and the conventional textile finishing products to quantify the achieved environmental and risks improvement.
- To serve as a basis for the further development of a network platform to share data with stakeholders including scientific committees, EU policy makers and international researchers, filling the knowledge gaps about nanomaterials.

2. Structure and functionalities of the ECO-TEXNANO tool

The ECO-TEXNANO tool will contain detailed environmental, health and safety information about the four nanomaterials selected to be tested in the two pilot scale trials. The results of the pilots will be included in the tool, providing qualitative and quantitative data. Information coming from literature, such as papers and relevant European projects will be also used to complete the tool. The tool will be linked to the ECO-TEXNANO website.

2.1. General structure and content

The structure of the ECO-TEXNANO tool will be composed of four main sections:

1) **Nanomaterial selection:** this part will allow users to select the appropriate nanomaterial in function of the desired property to be provided to the textile product.
2) **Environmental Assessment:** textile companies will be able to determine the environmental impacts of its finishing textile.
3) **Risk Assessment:** users will be able to assess the health and safety potential risks associated with the application of nanomaterials in finishing processes of textiles.
4) **Sharing Knowledge Space:** the aim of this part is to improve the knowledge of textile finishing sector about the use of nanomaterials.

In addition, an online tutorial will be available in order to support textile companies to conduct the environmental and risk assessment.

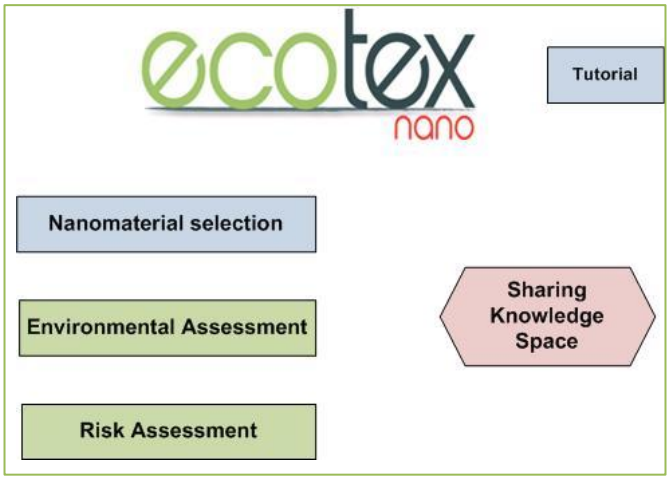

Figure 1. General structure of the ECO-TEXNANO tool.

Further details about structure and functionalities of the four sections are presented in the following chapters. Chapters 2.3 and 2.4 are focused on presenting the main functionalities to determine the environmental and risk assessment impacts caused by the application of nanomaterials in the textile finishing processes. These two plug-in will be based on the data obtained from the pilot scale trials as well as the data gathered from relevant existing projects and literature.

2.2. Nanomaterial selection

The nanomaterials introduced in the tool will be classified and accessible by type of functionality provided to the textile (e.g. antibacterial, fire resistance, stain resistance, UV resistance, hydrophobic, etc), as shown in

. Once the desired property is selected, then the available nanomaterials used for finishing textiles will be listed (Figure 3). After selecting the nanomaterial, a new screen will appear (Figure 4) containing general information of the nanomaterial, such as the chemical formula, type of nanomaterial (carbon nanotubes, metal nanoparticles, metal oxides nanoparticles and nanoclays), types of finishing textile processes applied (nano sol-gel coating, electrospinning, grafting, plasma, etc), description of the nanomaterial and examples of textile appliances. Concentration (%), average particle size (nm), shape and specific surface area (m2/g) will also be provided. Despite general information will be provided for all nanomaterials, the tool will simulate the environmental and risk assessment of just one nanomaterial per functionality. In total, the tool will be able to simulate the best 4 nanomaterials selected (1 nanomaterial per functionality). The selection procedure will be explained in detail in deliverable "A1 State of the Art and representative nanomaterials of finished textiles". As shown in Figure 3, a brief justification of the best nanomaterial per functionality will be provided.

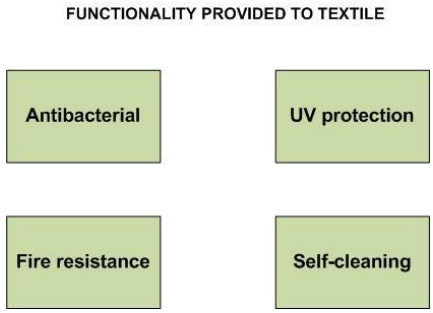

Figure 2. Nanomaterials will be searched by type of functionality.

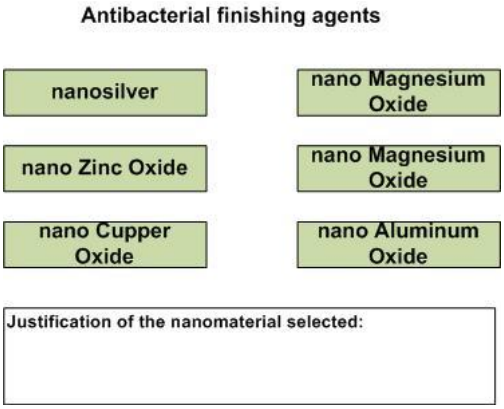

Figure 3. List of nanomaterials that provide antibacterial properties.

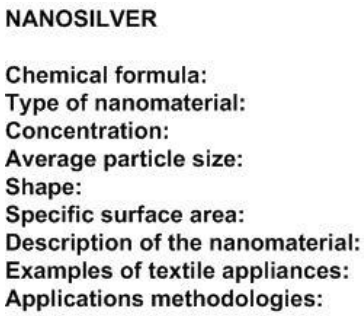

Figure 4. Information provided by the nanomaterial selected.

2.3. Environmental topic plugin

Textile companies will be able to simulate its finishing textile (conventional and nanobased treatments), obtaining quantified results about its product environmental profile. It will allow an easy and quick quantitative assessment of the environmental profile of products and processes. The methodology used will be based on ISO standards of Life Cycle Assessment 14040/14044:2006.

As a starting point, finishing textile companies will have to introduce general data into the tool, such as:

- brief description of the textile product
- weight of the textile product
- textile finishing agent applied
- concentration of the finishing agent applied
- property provided by the finishing agent

The tool will incorporate relevant inputs and outputs of each sub-system, understanding as a sub-system the different life cycle stages of the textile product. The main data requested to be introduced by the users will be the resources used (e.g energy consumption, water usage, materials) and the emissions and waste generated. The scope definition as well as the unit of analysis (functional unit) will be defined in Action B1 Life Cycle Assessment of nano-textiles and conventional finished textiles. Action B1 will generate quantitative data that will be included in the Eco-Texnano tool, especially related to nanomaterials releases and interactions. The tool will use associated databases, where the environmental LCA information (inventory & impact indicators) will be stored. The emission factors will come from recognized international LCA databases such as ELCD, Ecoinvent, etc. Users will be able to easily access/ modify/ update the content of these databases.

The tool will simulate the environmental impact assessment considering the inputs and outputs associated with the product life cycle and the most representative environmental impacts for the textile finishing sector, such as climate change, water depletion and eutrophication.

Finally, an environmental declaration will be generated showing the environmental profile of the textile for the selected indicators. Graphs could be represented in the information given to help users to understand the final results of the LCA.

The main functionalities to be included in the environmental plugin are listed in the table below:

General data	Description of the textile
	Weight of the finished textile product (g)
	lifetime of the product (years)
	Textile finishing agent (conventional or nanomaterial)
	Property provided by the textile finishing agent
	Finishing textile process
Inputs of each subsystem	Energy consumption
	Water consumption
	Materials used: textile, additives…
Outputs of each subsystem	Air, water and soil emissions
	Waste flows

	Concentration of nanomaterials released by the different processes, …
Environmental Indicators	Carbon footprint (g CO_2 eq)
	Generated Waste (g)
	Water consumption (l)
	Energy Consumption (MJ)
	Resources (g)
Results	Calculation Environmental performance

Data introduced by the Ecotexnano tool user:

- Description of the textile:
  - Weight of the finished textile product (g)
  - Lifetime of the product
- Textile finishing agent (conventional or nanomaterial)
- Property provided by the textile finishing agent
- Finishing textile process
- Natural Resources used
  - Energy consumption
    - electrical
    - thermal
  - Water consumption
- Material flows
  - Concentration of nanomaterials in the product, textile, additives…
  - Concentration of nanomaterials released
- Air, water and soil emissions
- Waste flows

Data provided by the project results (B1, B5)

- Conversion factors

Data generated by the Tool

- LCA Results

This plugin based on LCA approach will be accordingly customized for specific necessities of the textile finishing sector identified during the project duration.

2.4. Risk assessment plug-in

This plug-in will contain specific information to conduct a risk assessment under REACH requirements, considering hazardous properties of the nanomaterials and use conditions (Operational Conditions and Risk Management Measures (RMM)) as set out in the exposure scenarios. The plugin will contain a set of Excel worksheets, developed under action B2, to support textile companies to perform the risk assessment of nanomaterials. A worksheet based on the information requirements for the chemical safety assessment will be included in the plug-in, as well as an exposure scenario worksheet to assess the environmental and human exposure to nanomaterials considering the selected nanomaterial, route of exposure, operative conditions and risk management measures. Data on the exposure release will be included to define the risk posed by the use of the nano-additives for developing textile products. Granulometry and in particular particle shape of nanomaterials is an important parameter to be considered for the assessment of deposition and hazard assessment in biological media. The plug-in will deal with factors such as chemical composition, physico-chemical properties (size, shape, solubility, surface charge and surface reactivity) and possible exposure levels.

Chemical safety assessment worksheet	Chemical composition
	Physic-chemical properties (physical form, size, shape, solubility, surface charge and surface reactivity) - State of the substance at 20 °C and 101,3 kPa - Melting/freezing point - Boiling point - Relative density - Vapour pressure - Surface tension - Water solubility - Partition coefficient n-octanol/water - Flash-point - Flammability - Explosive properties - Self-ignition temperature - Oxidising properties - Granulometry - Stability in organic solvents and identity of relevant degradation products - Dissociation constant - Viscosity
	Human-toxicological effect factor

	- Acute toxicity - Irritation/Corrosion - Sensitisation - Repeated dose toxicity - Genetic toxicity - Carcenogenicity - Toxicity to reproduction
	Ecotoxicological effect factor - Aquatic toxicity - Sediment toxicity - Terrestrial toxicity
Exposure scenario worksheet	Operational conditions and risk management measures related to workers
	Operational conditions and risk management measures related to environment
	Operational conditions and risk management measures related to consumers

Data introduced by the Ecotexnano tool user:

- Operational conditions
- Risk management measures

Data provided by the project results (B2, B5):

- Physico-chemical properties
- Human toxicological effect factors
- Ecotoxicological effect factors

Data generated by the Tool

- Chemical Safety Report

Action B2 about Risk Assessment of nano-textiles and conventional finished textiles will provide relevant inputs that define in more detail the content of the Risk Assessment plug-in.

2.5. Sharing Knowledge Space

A **Sharing Knowledge Space** will be created inside the tool with the aim to improve the knowledge of textile finishing sector about the use of nanomaterials. The sharing knowledge space will compile Best Available Techniques (BAT) and manufacturing good practices in order to encourage their implementation in the textile finishing sector. A Risk Management Measures (RMM) library will be included, based on an Excel spreadsheet made up of three parts. The first part will contain the RMM and Operational Conditions (OCs) for the effectiveness of nanomaterials, while the second part will list information sources for consumers, environment and occupational measures. Finally, the RMM library will contain a guidance to provide practical advice on how to use the various worksheets. The sharing knowledge space also will contain other relevant information, such as hyperlinks on nanomaterials manufacturers' web sites with the aim to help textile companies to know where they can purchase them. A forum will be created where users can take part in on-line discussions on specific issues.

The functionalities of the Sharing Knowledge Space are listed as follows:

Risk management measures library	RMMs / OCs and details of their effectiveness. Conditions of application of nanotechnologies: concentration, process time, temperature, etc
	Lists of information sources for consumers, environment and occupational measures
	A practical guide to use the library
Best Available Techniques	List of BAT for the reduction of the environmental impact for the most relevant finishing processes
Manufacturing good practices	Compilation of good practices identified in pilot scale trials and others
List of potential risks	Identification of most potential risks of the use of nanomaterials in finishing textiles
Other relevant information	Direct links to valuable sources of data regarding nanomaterials
Information exchanger network	Platform to exchange views about nanomaterials in the textile finishing industry

3. Conclusions

ECO-TEXNANO tool will help to enhance the knowledge on environmental and risk assessment of nanomaterials to be applied in finishing processes of textiles. Therefore, this innovative tool is aimed to the finishing textile industry, assisting associated companies to apply best available techniques and good practices when they are dealing with nanomaterials.

The general structure of the ECO-TEXNANO tool will contain four applications, two of them for conducting environmental and risk assessment of nanofinished textiles. The information provided will be quantitative in both life cycle assessment and risk assessment resulting data with demonstration of pilot scale trials. Another entry of the tool will support textile companies in selecting the appropriate nanomaterial depending on the desired property to be provided into the textile product. Finally, a Sharing Knowledge Space will be integrated in the tool in order to promote the exchange of knowledge.

The functionalities and structure identified in this report will be flexible to be modified as necessary during the development of the implementation actions.