MAKING FOOTWEAR BASED ON CIRCULAR ECONOMY - REWEART

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The REWEART project will help meet the objectives of the EU's Environmental Policy. What is more, it will contribute to the implementation of EU commitments under UNFCCC Kyoto Protocol, EU GHG emission reduction commitments in 2020 under the Climate and Energy Package, Green Deal and Fashion Pact. Following the objectives of resource and energy reduction as well as waste cuts all along the product life cycle, the main ambition of REWEART project is to refer to natural ecosystems, which produces no waste, and uses only renewable resources (solar energy and water). REWEART project aims at generalising the use of proactive waste management at design stage and at anticipating and improving reactive management. The project offers us an exceptional opportunity to conceive a new business model and related services and tools, enabling, at design stage, the selection of the most suitable materials and processes to create a new footwear product 100% recycled, organic, as working hypothesis. A cost effectiveness evaluation has been made possible to make affordable new products available to the market, while a concurrent environmental impact analysis ensures that the new solutions are positive for the environment. The project results have been assessed against a set of performance yardsticks addressing environmental, social and economic impact. This paper presents the activities carried out within the LIFE REWEART project during its entire period of development.

Keywords: vegane, organic, recycled footwear

INTRODUCTION

REWEART is a LIFE project co-financed by the European Commission that aims to develop a new business model to create new 100% recycled, organic footwear.

Project duration: 01.09.2018-31.03.2022.

AIMS & OBJECTIVES

The main objective of REWEART was generalising the use of proactive waste management at footwear design stage and anticipating and improving reactive management. The project aimed to conceive a new business model and related services and tools, enabling, at design stage, the selection of the most suitable materials and processes to create a new footwear product 100% vegan, recycled and organic. The project objectives and outputs were:

- To demonstrate a new shoe production model;
- To guarantee transferability and replicability of shoe manufacturing;
- To provide public administration tools for assessing shoe manufacturing policies and strategies;
- To increase awareness and support shoe sector by providing cost-effective solutions that include more efficient techniques that may also improve profitability;
- To identify and involve all relevant stakeholders related to shoe issues.

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CONSORTIUM

The consortium was created based on the combination of different environments, experience and expertise of the partners, includes all the skills, recognized expertise and competences needed to achieve all aspects of the work program. The consortium includes 6 institutions from 3 countries.

PROJECT PARTNERS

- ✓ INCDTP – Division: Leather and Footwear Research Institute (ICPI) (Romania) – *Coordinator*;
- ✓ ATEVAL (Spain);
- ✓ FERRE AGRUPACIÓN, S.A. (Spain);
- ✓ HILATURAS FERRE, S.A. (Spain);
- ✓ MUSTANG, S.R.L. (Italy);
- ✓ VESICA PISCIS FOOTWEAR, S.L. (Spain).

ACTIVITIES AND RESULTS

The actions and means to achieve the objectives were organized as follows:

Specifications and Selection of Components

The materials from the market were selected, the materials were developed based on recycled materials, the shoe models and the shoe manufacturing procedure was defined and the production line (pilot). We selected 27 suppliers and 38 materials to produce shoes and their components that meet the requirements of an organic, vegan and recycled shoe, to different stretches. We used 14 models and developed over 100 models to test different features, materials, etc.

Demonstration Pilot Plant for Footwear

Developed pilot plant components for the production of shoes, as follows:

Pilot Unit for Shoe Production

REWEART manufacturing process proposed for the vegane shoes, is based on the STROBEL lasting system, which consist on the attachment of a non-woven textile to the upper by stitching. After this, the assembly of the upper material to the sole is done by stitching, with minimum use of adhesive, water based anyway. With this approach, we propose a prototype line consisting on a cutting machine, two/three types of stitching machines (upper and lining assembly and side stitching) and then just a lasting station by hand and an upper-sole joining with pressure and final stitching. The PILOT STATION for manufacturing footwear was developed (Fig. 1).

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Figure 1. Pilot station

Pilot for Rubber Milling; Performed by INCDTP

INCDTP has set up a small pilot facility for rubber compounds elaboration and prepared tentative outsole blends (trial-error) with rubber + wood until they achieved a final one based on optimum processability. The objective was to obtain a polymer composite based on natural rubber and wood waste which can be considered a prototype.

Yarn Production and ICT Tool

Selection of Materials for Weaving at INCDTP

Since the field of application of the present prototype is the manufacture of footwear fabrics, a thread with sufficient twist is sought to avoid breakage. At the same time, a fine thread is sought in order to have sufficient flexibility to make different weights that will be achieved through the twisting of the manufactured thread.

Processing of Threads at INCDTP

Different fabrics were made (Fig. 2) which were tested for: tensile strength and elongation, tear strength, abrasion/ friction resistance, pilling effect, seam strength, air permeability, resistance on surface hanging, fibrous composition of the woven fabrics.

Figure 2. Fabrics produced at INCDTP

Variety of yarns used to make fabrics: (a) new yarns, made within the project used mainly as weft yarns; (b) new yarns used in warp and weft; (c) the combination of new yarns, with yarns that have a min 95% cotton fibers (virgin, recovered) and with min 97% flax fibers, linen.

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ICT Tool

The ICT REWEART tool permits:
- Customization of the shoe and their parts to the available fabrics
- Recycling of garments to manufacture a bag, shoe or belt.
- Configurate 3D one of the products (shoe, belt, bag) by taking a picture of the garment to be recycled and use it as input for the customization process.

Demonstration and Validation of Unit for Vegane-Recycled-Organic Shoes

This activity permits the full demonstration of the footwear manufacturing process using the materials developed in previous actions. 2000 pairs of shoes were made. INCDTP contributed with five shoe designs (Fig. 3) as options to be manufactured.

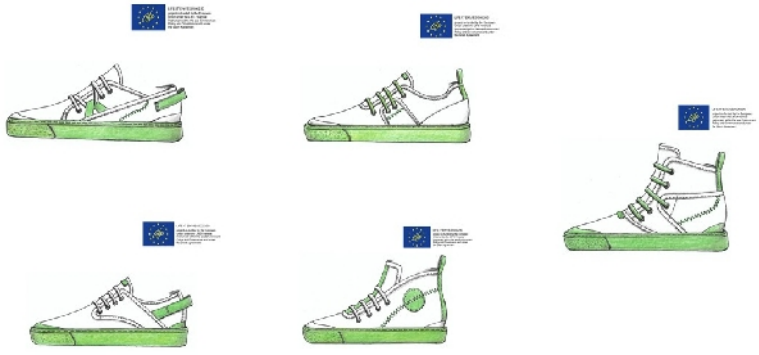

Figure 3. The models designed by INCDTP

We planned and achieved the manufacturing of 24 different designs, over 13 models using 12 different upper materials, 3 lining materials, 2 insock materials and 5 outsole materials, in all cases achieving 100% recyclability and easy shoe disassembly to facilitate recyclability. 6 of the fabrics woven at INCDTP were also used (Fig. 4).

Figure 4. Footwear made with woven materials at INCDTP

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LCA

GaBi ts Software (Professional) was used for the LCA analysis. LCAs were calculated for 12 shoe models. In addition we've calculated some variations for the SIDDHARTA model, using outsoles from different suppliers and different compositions, showing slightly different results, from 6.6 to 5.8 Kg CO_2eq/pair. The results in terms of reduction of the carbon footprint of the manufactured models, fall in the range 3.04 Kg CO_2eq /pair in the case of sandals (SRINIVASA model) to 6.25 Kg CO_2eq /pair in the case of sneakers with TPU outsole SIDDHARTA model), with an average of 5.5 Kg CO_2eq/pair.

Typical values of carbon footprint for casual or man shoes made of different materials (leather, polymeric, etc.) range from 10 to 14 Kg CO_2eq/pair.

The water footprint has also been reduced to almost zero, as all recycling procedures are based on mechanical processes leading to near zero water consumption.

As per energy consumption, typical values for casual/man shoes contribute from 3 to 6% of the total carbon footprint (5.05 kWh/pair). In the case of these VEGANE-RECYCLED-ORGANIC models the contribution is 0.5 kWh/pair.

ENVIRONMENTAL BENEFITS

i) Direct / quantitative environmental benefits:

As a direct result of the project, there will be some environmental benefits after footwear companies implement some of the recommendations for manufacturing a shoe with minimum environmental impacts. The shoes can be 100% recyclable and we have also provided recommendations to manufacture a 100% recyclable, organic and vegane shoe, so all expected project impacts have been achieved.

REWEART has permitted a reduction of 85% i.e., so consumption of 1.08 m^3/1,000 pairs is foreseen. As per CO_2 eq, typical current models amount for 13,5Kg CO_2 eq per pair and we have reached, for the different models manufactured, values in the range 3,5 to 6,23 Kg CO_2 eq/pair (Fig. 5) and in cases where we can recycle the outsole, a value of 2.21. As per water footprint, considering a typical process consum of 7.23m^3/1,000 pairs, we have achieved a reduction of 85%, which means 1.08 m^3/1,000 pairs.

At the end of the project, we use outsoles made of virgin TPU (65% weight) but we can recycle 100% of outsoles materials and 100% of upper materials, so REWEART shoes are 100% recyclable. A total of 120gr of upper materials are recycled material and 250gr virgin TPU.

One pair of shoes at the end of project contain the following recycled materials:

- Sandals 148gr per pair: outsole material (EVA 5% content recycled) 15gr + 72gr insole (100% recycled cork) + 13gr upper fabric (100% recycled cotton)= 100gr or 68% made of recycled material and 100% recyclable.

- Shoes (Leonardo model) 370gr per pair: upper material (77gr, 100% recycled), insole (39 gr, 100% recycled), insock and laces (14gr, 100% recycled)= 130gr or 35% made of recycled material and 100% recyclable.

The objective of a shoe 100% organic, vegane, reusable and recyclable has been achieved.

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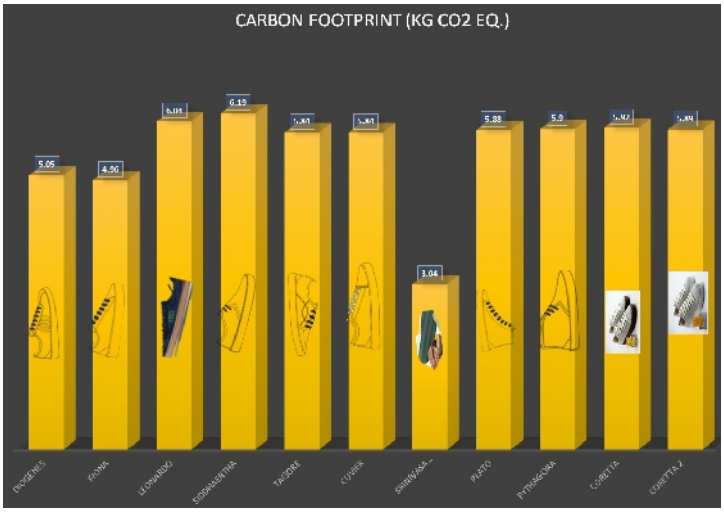

Figure 5. Carbon footprint for the different models manufactured

(ii) The case of REWEART is a real eco-design in production among footwear companies, taking environmental issues into account from the product design stage, as for example: (i) Use of minimum energy; (ii) Use of "eco" materials with minimum environmental impact; (iii) Zero waste production; (iv) Methodology for re-use of garments into shoes with the help of an advanced IT tool; (v) Reduction of GHGs emissions; (vi) Reduced packaging and water consumption.

CONCLUSIONS

REWEART project has demonstrated the concept of full recyclability of footwear properly and re-using them as components for the creation of new articles, making use of an advanced 3D configurator and incorporating B2C elements which provide our initiative the look of something that can be global with local manufacturing.

All materials used for project trials were organic, chemicals free and animal free, achieving a product 100% ORGANIC, VEGANE and RECYCLED.

LIFE REWEART has achieved the objective of zero waste, as all components can be recycled, has reduced the water footprint to zero, carbon footprint up to 85% (against regular footwear) and energy consumption to 10% compared to traditional process.

Acknowledgements

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