LIFE CYCLE INVENTORY ANALYSIS FOR CONDUCTIVE TEXTILE BASED ON HYDROPHOBIC AND HYDROPHILIC SURFACES

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In this work, we present some aspects regarding the life cycle inventory for textile surfaces with hydrophobic character required by conductive textiles with different surface resistance. There is already a few researches that deals with the aspects of conductive property influenced by hydrophobic or hydrophilic substrate, such as perfluorodecyltriethoxysilane to increase the durability of electrically conductive fabric obtained by polypyrolle treatment. In this paper, we investigated the life cycle inventory of the processes involved in obtaining the conductive textile using a hydrophobic substrate obtained by classical technology (padding/ coating) or advanced RF plasma technology (plasma hydrophobization/coating).

Keywords: hydrophobic, metallic, conductive textiles, life cycle inventory

INTRODUCTION

The scientific literature shows great concerns in the use of the advanced processes for obtain a hydrophobic effect for conductive textiles.

For the evaluation of the life cycle for conductive textiles obtained by classical finishing method and by RF plasma method, we consider the following steps:

-evaluation of the constraints in the system (CS);

-data collection of the inventory (ICV);

-calculation of the resources used in the manufacturing processes.

LIFE CYCLE INVENTORY ANALYSIS AND DISCUSSIONS

In our research we consider two technological flows, the first one is based on classical technology (padding) and the second one is based on plasma RF hydrophobisation.
The composite technological flows are the following:

- **Technological flow 1:** Boiling ➔ Bleaching ➔ Drying ➔ Padding ➔ Coating ➔ Drying ➔ Crosslinking
- **Technological flow 2:** Boiling ➔ Bleaching ➔ Drying ➔ RF plasma hydrophobization ➔ Coating ➔ Drying ➔ Crosslinking

In the fig.1 is presented the process of obtaining the conductive textile using a textile hydrophobic substrate obtained by classical method and in figure 2 is presented the composite process based on hydrophobic textile obtained by RF plasma.

Data required for the inventory of the life cycle (ICV) was collected by classical method (machine specification, laboratory tests) and using the program SimaPro.

The quantification of the environmental impact for the textile processes, using the method ECO-Indicator 99 (carcinogenic, inorganic and organic substances, climatic changes, radiation, ozone layer, eco-toxicity, acidification /Eutrophication, land-use, fossil fuels).

For comparing the two technological flows and analysis, we generate, by SIMAPRO, the characterization (figure 3), normalization (figure 4), Single Score (figure 5), weighting (figure 6) diagrams and process trees for classical method (figure 7) and for RF plasma hydrophobization (figure 8). From figure 1 and 2 it is evident that in the classical process a

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major impact has the energy consumption for drying, approximately 48% in technological flow 1 in comparison with 34% energy consumption for technological flow 2.

In figure 7 is presented the process tree for the technological flow based on classical hydrophobization treatment and in figure 8 is presented the process tree for the technological flow based on advanced technology -RF plasma based on fluorocarbons gases. The process trees (figure 7), of the technological flow 1 and technological flow 2 (figure 8), shows that the classic process (hydrophobization) involves 50.8% energy for drying and the hydrophobization based on RF plasma process involves a reduction with 17.8% of the energy consumption on comparison with classical process and also a reduction of the time allocated for hydrophobization.

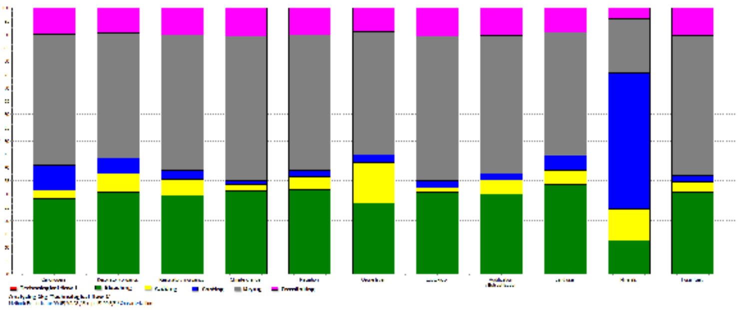

Figure 1. Composite process for conductive textile based on hydrophobic textile obtained by classical method

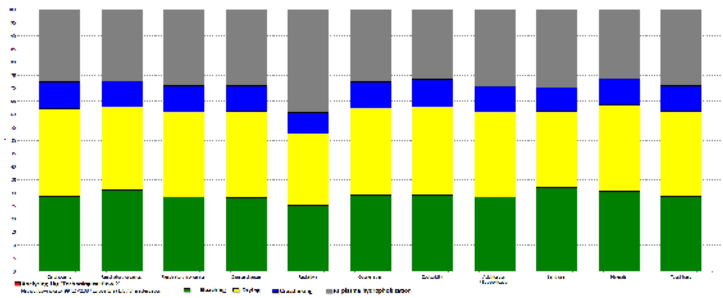

Figure 2. Composite process for conductive textile based on hydrophobic textile obtained by RF plasma

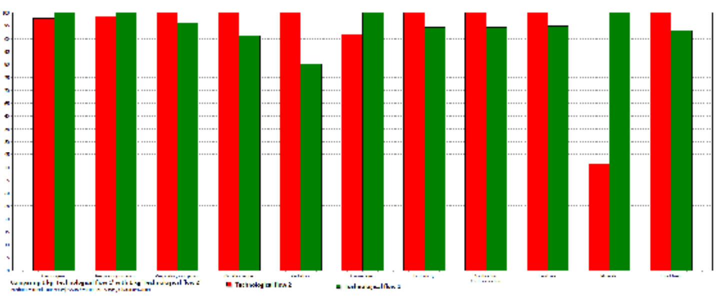

Figure 3. Characterization diagram – technological flow 1 vs. technological flow 2

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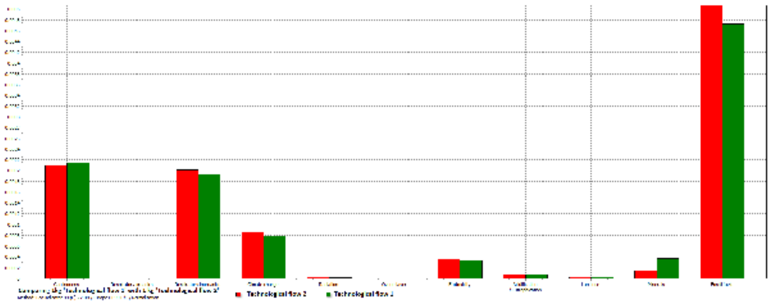

Figure 4.Normalization diagram - technological flow 1 vs. technological flow 2

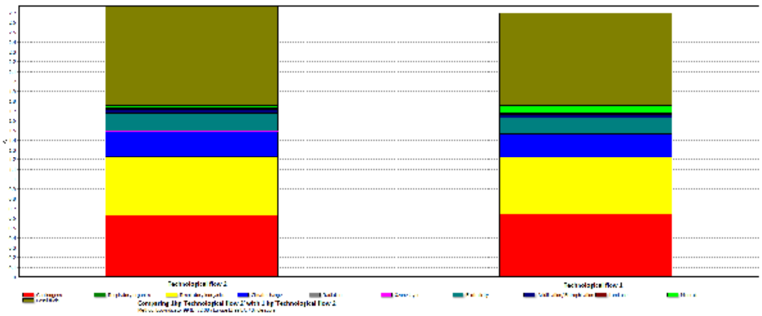

Figure 5. Single Score diagram - technological flow 1 vs. technological flow 2

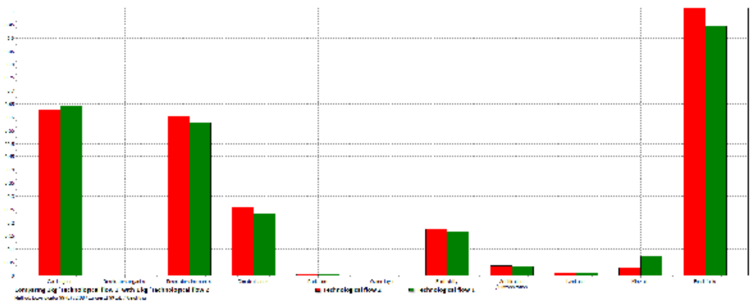

Figure 6. Weighting diagram - technological flow 1 vs. technological flow 2

The impact diagrams (figures 3-6) shows that the advanced technologies (RF plasma) has a strong impact by respiratory inorganics, climate change, radiation, eco-toxicity/acidification, land use and fossil fuel (lignite) consumption.

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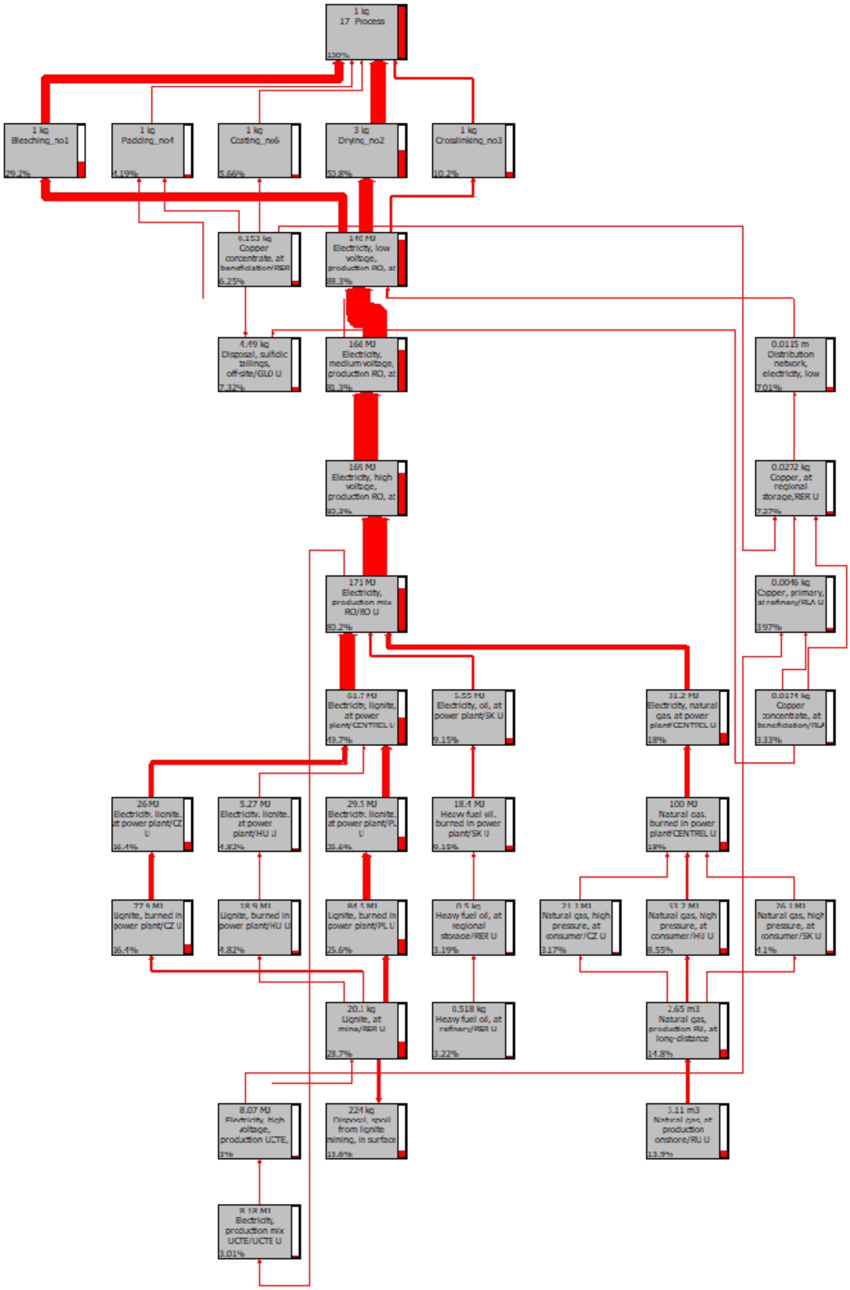

Figure 7. Process tree- technological flow 1 (Metallic coating on hydrophobic textile surface obtained by classical treatment)

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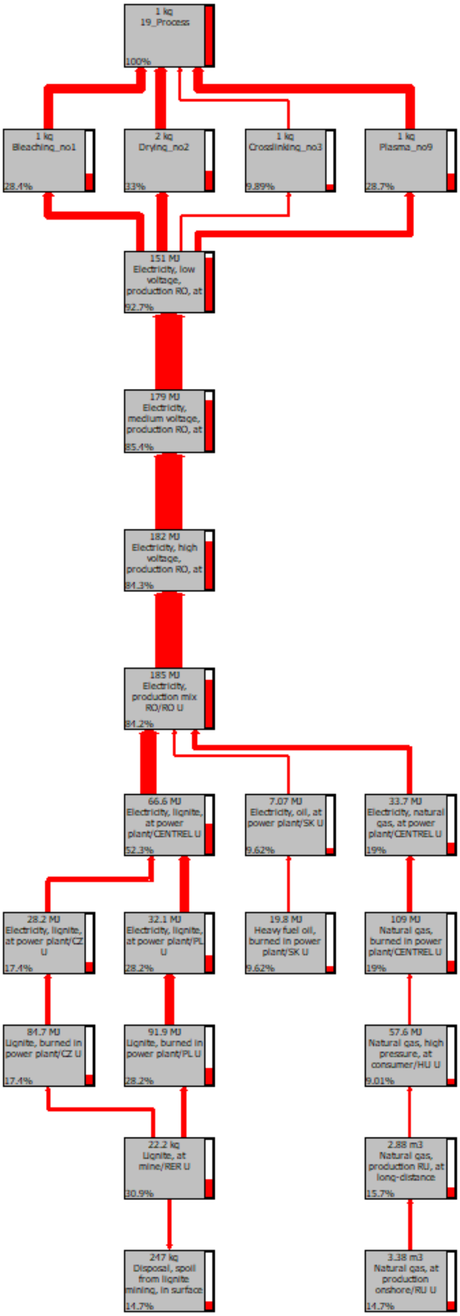

Figure 8. Process tree- technological flow 1 (Metallic coating on hydrophobic textile surface obtained by RF plasma PTFE treatment)

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CONCLUSIONS

The environmental impact analysis by SimaPro shows a reduction of inputs in terms of energy consumption and time for advanced technology (RF plasma based on fluorocarbons).

Comparing the first and second technological flow is evident that the RF plasma technology output generates a negative impact through radiation, emissions of inorganics with harmful effect by respiration.

On the other hand, the classical method (technological flow 1) has a major impact on inputs by fossil fuel consumption for production of the electrical energy.

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