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Short Communication

Life Cycle Assesment of Clothing Process

Altun Sule
Dept. of Textile Eng., College of Eng. and Architecture, University of Uludag Gorukle-Bursa TR-16059 TURKIYE

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Abstract

Clothing process is thought to be the cleanest process among the textile manufacturing methods. In the present study the environmental impacts of clothing processes were investigated using Life Cycle Assessment Methodology. According to the results, sewing process was the main responsible of the almost all impact categories.

Key words: Environmental impact, LCA, clothing, textile.

Introduction

Environmental issues have been becoming important for the last years because of increasing industrial pollutions, waste problems, effects of global warming, etc. The consumers also start to demand " green products ". As a result of these events more strategic and systematic approaches have become necessary to challenge environmental issues. Life Cycle Assessment (LCA) is one of the tools to meet this necessity.

According to ISO 14044 definition, LCA is a technique to address the environmental aspects and potential environmental impacts throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling and final disposal (i.e. cradle-to-grave)[1]. Some environmental impacts, which are accessed via LCA, are climate change, stratospheric ozone depletion, eutrophication, acidification, toxicological stress on human health and ecosystems, and the depletion of resources, water use and land use [2,].

Wastewaters with high chemical contents in wet processes, pesticide and synthetic fertilizer problems in natural fiber productions, huge energy consumption during manufacturing processes and petroleum based materials are the main environmental problems in textile industry[3-5]. LCA methodology has started to use for the assessment of environmental impacts during manufacturing and use phase in the textile sector for a while, although the studies have accumulated for the last five years [6-8].

The aim of the present study is to evaluate the environmental impact of clothing (making-up) process, which is thought to be the cleanest process in the textile industry, via LCA methodology.

Material and Methods

The study was managed according to ISO 14044. There are four phases in an LCA study: goal and scope definition phase, inventory analysis phase, impact assessment phase, and interpretation phase. The LCA software SimaPro 7.3 was used to perform the impact assessment stage. LCA was carried out according to the CML 2 baseline 2000 V2.05 method.

The goal and the scope: The goal of the study was to investigate the environmental impacts in clothing process.

System boundaries: Exclude raw material, yarn and cloth production, dyeing and finishing; include cutting, sewing and packaging.
Functional unit: Cotton t-shirt (170 gram)

Inventory analysis phase: Data was collected in factory conditions. Inventory data for the chemicals, natural gas and electricity production were taken from the Ecoinvent database. Schematic presentation of the system investigated was shown in Fig.1

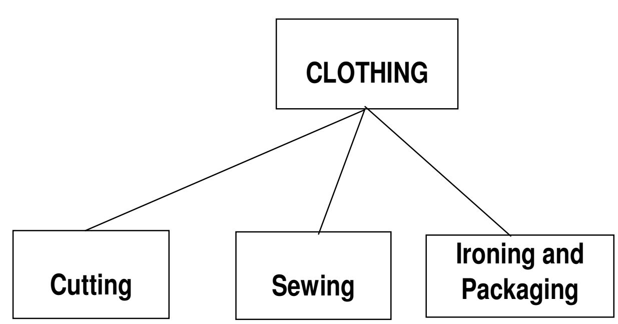

Figure -1
Schematic presentation of the system investigated

Results and Discussion

Environmental Effects: Only the classification and characterization stages were considered out of all of the steps defined by the impact assessment phase in the LCA methodology. The impact categories analyzed in this study are abiotic depletion, acidification, eutrophication, global warming (GWP100), ozone layer depletion, human toxicity, fresh water aquatic ecotoxicity, terrestrial ecotoxicity and photochemical oxidation. The characterization results are shown in table 1. Figure 2 shows the relative contributions of different processes to each impact category under the study.

Table -1
Characterization results per functional unit

Category	Unit	Value
Abiotic depletion	kg Sb eq	0,00108
Acidification	kg SO_2 eq	0,000777
Eutrophication	kg PO_4 eq	0,0003771
Global Warming (GWP100)	kg CO_2 eq	0,13941
Ozone layer depletion	kg CFC-11 eq	1,26E-08
Human toxicity	kg 1,4 DB eq	0,06365
Fresh water aquatic ecotox	kg 1,4 DB eq	0,06217
Marine aquatic ecototox	kg 1,4 DB eq	134,899
Terrestrial ecotox	kg 1,4 DB eq	0,000955
Photochemical oxidation	kg C_2H_4 eq	0,00013895

According to the results, shown in figure 2, sewing process has presented the highest contribution almost all categories excluding ozone layer depletion and photochemical oxidation. These high values in sewing process are due to electricity consumption, which is mainly obtained from non-renewable resources. Energy consumption results are shown in table 2.

According to LCA results, dichloromethane based chemical used in packaging process was responsible for high values of ozone layer depletion and photochemical oxidation values in clothing process. Dichloromethane based chemical represented almost 70 % of total contributions to photochemical oxidation and almost 50 % of total contributions to ozone layer depletion.

The electricity was the major contributor to abiotic depletion. Polyester label, which was sewed the t-shirt, and electricity are the main contributors of acidification. Eutrophication value has mainly come from electricity. When the human toxicity, fresh water aquatic ecotoxicity and terrestrial ecotoxicity were analyzed, it was concluded that the electricity was the major contributor.

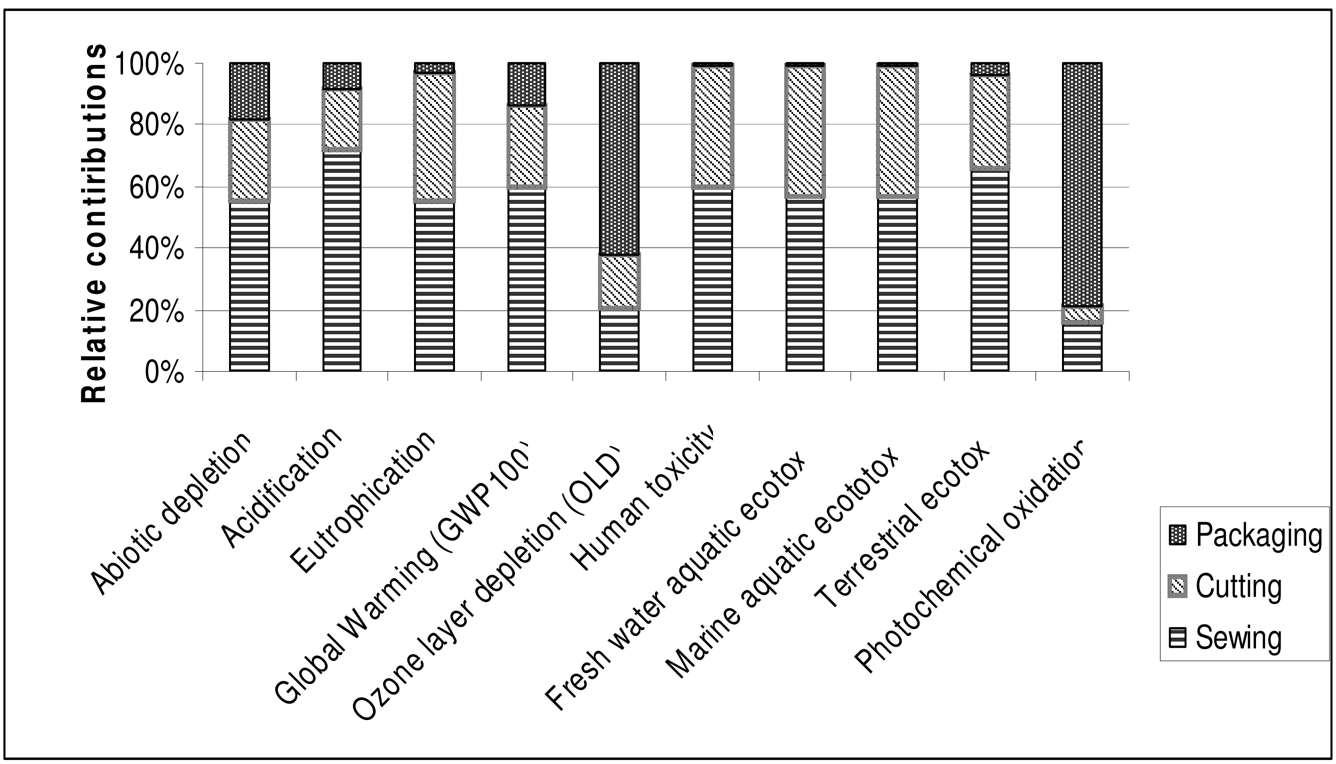

Figure-2
Relative contributions of different processes to each impact category

Energy Consumption: The energy consumption during clothing process was also investigated and the results are shown in table 2.

Table-2
Energy consumption values of the processes

	Energy Consumption (MJ)	%
Clothing (Total)	2.472	100
Cutting	0.732	29.6
Sewing	1.23	49.8
Packaging	0.51	20,6

The sewing process is the largest contribution to the total energy consumption (% 49.8), followed by cutting process (% 29.6) and packaging (% 20.6). The main contribution has come from electricity consumption of sewing machines.

Conclusion

Energy consumption and environmental effects during clothing process were investigated in this study. The main contribution almost all impact categories have come from sewing process. These results are due to higher electricity consumption in sewing machines. Dichloromethane based chemical was responsible for high ozone layer depletion and photochemical oxidation values.

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References

1. EN ISO 14044 Environmental management, Life cycle assessment – principles and framework **(2006)**

2. Rebitzer G., Ekvall T., Frischknecht R., Hunkeler D., Norris G., Rydberg T., Schmidt W.-P., Suh S., Weidema B.P and Pennington D.W., Life Cycle Assessment Part 1: Framework, Goal and Scope Definition, Inventory Analysis, and Applications, *Environment International* **30**, 701–720 **(2004)**

3. Dahllof L., LCA Methodology Issues for Textile Products, Thesis for The Degree of Licentiate of Engineering, Chalmers University of Technology, Göteborg, Sweden (**2004**).

4. Cherrett N., Barrett J., Clemett A., Chadwick M. and Chadwick M.J., Ecological Footprint and Water Analysis of Cotton, Hemp and Polyester, Bio Regional Development Group and WWF Cymru, SEI **(2005)**

5. Vandevivere P.C., Bianchi R. and Verstraete W., Treatment and Reuse of Wastewater from the Textile Wet-Processing Industry: Review of Emerging Technologies, *J. Chem. T echnol. Biotechnol.*, **72**, 289-302 **(1998).**

6. Woolridge A.C., Ward G.D., Phillips P.S., Collins M. and Gandy S., Life Cycle Assessment for Reuse/Recycling of Donated Waste Textiles Compared to Use of Virgin Material: An UK Energy Saving Perspective, *Resources, Conservation and Recycling,* **46** , 94–103 **(2006)**

7. Laursen S.E., Hansen J., Knudsen H.H., Wenzel H., Larsen H.F., Kristensen F.M., EDIPTEX – Environmental Assessment of Textiles, Working Report No. 24, Danish EPA, (**2007)**

8. Kalliala E.M. and Nousiainen P., Life Cycle Assessment Environmental Profile of Cotton and Polyester-Cotton Fabrics, *AUTEX Research Journal*, **1, 1,** 8-20, **(1999)**