A CASE STUDY FOR WATER FOOTPRINT ASSESSMENT OF A DENIM PRODUCT

DOI: 10.35530/TT.2021.55

V. Sölar^{1*}, B. Soy¹, K. Yağıci²

¹Dokuz Eylul University Textile Engineering Department, Turkey
(E-mail: vildan.sular@deu.edu.tr, berkaysoy96@gmail.com)

²Roteks Tekstil San. ve Tic.A.Ş.
(E-mail: korhanyagci@roteks.com.tr)

Abstract: The awareness of the fact that the leading cause of the bad environmental conditions in our world is the human factor, has been increasing in recent years. This awareness enables people, companies, and organizations to decrease water consumption, to decrease carbon emission, to decrease using harmful chemicals, consequently people who are aware of global warming and depletion of resources are taking actions to save our planet for a sustainable life. Textile is one of the big sectors affecting the environmental pollution in a very bad way. For that reason, the present water footprint research was conducted on textiles and a denim company was especially chosen to examine the water footprint because of denim sector's being one of the biggest polluters and wasting water in a huge amount in the textile industry.

Firstly, the limits of the research were obtained as finishing operations under the scope of water footprint. The production steps and wastewater occurring points were obtained carefully for different denim finishing processes. After that stage, personal water consumption during denim apparel production was examined in detail. To create a good inventory analysis, many meetings were performed, and a survey was prepared to collect the data about wastewater of the company. By the help of this water footprint evaluation, the processes that create the most wastewater and the distribution of water footprint according to processes and other sources that cause water consumption were determined for one pair of denim trouser accepted as a functional unit in the context of the research.

Keywords: denim, inventory analysis, textile, water footprint

1. INTRODUCTION

Textile is an industry branch where water is used intensively. In the textile industry, denim fabric production is the foremost sector in terms of consuming/polluting water. Approximately 10000 litres of water are consumed for one denim trousers. In addition, dyeing, finishing and washing processes pollute the water as much as they consume [1]. Today, consumers care not only for the quality and appearance of a product, but also for its environmental affect, and this factor drives companies towards an environmentally friendly production. Firms or organizations, with "water footprint" calculation; can create a roadmap for improvement works related to its own water consumption and water footprint. The water footprint also allows the calculation of the effect of water consumption in a particular region or geography on thirst or water scarcity in that region [2].

The total water consumption isn't sufficient to evaluate a footprint, it is necessary to transform these environmental impacts in order that it can be reported as water footprint (ISO

14046, 2011) and is defined as “the total amount of water produced by impact processes, products, or services at all stages of their life cycle” [3].

The fact that its fresh water is a central source may mean that the water will come. If the water becomes untreatable, it will be able to be made safe in terms of water resources, which are becoming sustainable to be completed in a short time. The water becoming non-recoverable can become sustainable to become complete over time. The amount of water used to produce a product or service is called “Water Footprint”. In 2002, UNESCO - I Arjen Hoekstra, which is probably not found in the total volume during the time spent, can be repeated for the first time with the "water footprint", which determines the plan of the used water volume [1]. Changes in climate conditions, water consumption and water pollution force humans to think about water resources and water quality. This situation causes water scarcity that should be calculated, assessed, estimated, and taken precautions.

Water footprint is grouped under three headings as blue, green and grey water footprints [1]. These are green, blue and grey water footprint. Green and blue water footprint consider total consumption and whereas grey measures the amount of freshwater polluted. The blue water footprint refers to the volume of surface and groundwater consumption along the supply chain of a product or service. ‘Consumption’ refers to the losses that occur when water evaporates, returns to another catchment area or the sea or is incorporated into a product. It also includes water that does not return in the same period (i.e., withdrawn in a scarce period and returned in a wet period).

2. MATERIAL AND METHOD

The research was carried out in a denim clothing company that supplies denim fabric and carries out garment, washing (finishing), packaging and shipping processes. The company was established in 1986 in Izmir. In the company where 1000 workers are employed, approximately 300 thousand pieces of denim products are produced monthly.

For the data collection stages to be healthy, meetings were held in the company within the scope of the research and the production processes were examined on site. Detailed information was obtained on dry and wet processes, spray and laser processes and end products. The water footprint of a pair of jeans considers the sum of the water footprint of each step, or process, required to manufacture it. From fibre production to fabric and apparel production, many production steps are taken place such as ginning, yarn production, indigo dying, weaving, sewing and finishing treatment operations. For that reason, the limits of water footprint calculations were determined in the present research and as a border, the finishing operations department of the company was determined. One pair of denim trouser (0.577 grams) was determined as the functional unit. The system limit of the research is shown in figure 1 and blue water footprint given in figure 2 was decided to evaluate for the company.

The two most produced products in the company were decided to calculate water footprint. These products, which are named as Product 1 and Product 2 in the research, constitute 80% of the production of the washing department of the company such as 40% and 40% (table 1).

In order to determine water consumption of the selected denim product, an inventory analysis was conducted for operational stages and personal use and cleaning. Input water was taken into consideration for every process stage, no recycled or reused water were not processed in the company. A detailed form was prepared, and the form was fulfilled by all staff working in the finishing department of the denim company. By interviewing a total of 28 people in this department and other staff supporting the production was considered during personal consumption calculation.

Figure 1. General process flow of the denim company and system limits of the research

Figure 2. Schematic representation of the components of a water footprint [4]

Table 1. Process flow for product 1 and product 2

Product 1		Product 2
Rinse		Rinse
Stone washing		Stone washing
Bleaching		Softening
Neutralization		Wringing
Softening		Drying
Spray		
Wringing		
Drying		

Water consumption according to different finishing processes was shown in figure 3 and figure 4. The highest consumption values were determined for bleaching and neutralization after bleaching. Operational and personal consumption were considered

together, it can be said that a process improvement is needed to decrease water footprint for product 1 (figure 5).

Figure 3. Water consumption of product 1 according to different finishing processes

Figure 4. Water consumption distribution for processes of product 1

Figure 5. Water footprint of operational consumption and human consumption for product 1

As seen in figure 6-7, when bleaching process was not used in production, the total

consumption of water decreases dramatically. By not using bleaching also neutralization, a darker colour is obtained obviously but if it can be explained to the customers well and customers are persuaded to use it, a high amount of water saving is possible.

Figure 6. Water consumption of product 2 according to different finishing processes

Figure 7. Water footprint of operational consumption and human consumption for product 2

3. CONCLUSION

Today, determination the impact of any production or any action on the environment and reducing these impacts by taking precautions and saving our planet has become one of our biggest tasks. Carbon and water footprint evaluations may help to determine these harmful impacts on environment before acting for any precaution. In this research, within the washing limits of denim fabric production, which processes, or stages cause harm to the environment on the basis of water footprints were examined and evaluated for one pair of trouser as a functional unit.

Certainly, assessment of water footprint does not solve all environmental problems of a company, but it simply shows the road map if the company want to start to do something for our world. As a result of the research, there are some advice for the denim company.

- Attempts may be done to reduce the amount of water used in Product 1, which includes the bleaching process.
- Ways to optimize the water level used in the current production processes in the company and ways to reuse or recycle the water that is currently used in the same process or in a different area should be planned.
- Low-flow water nozzles and faucets or faucet aerators can be used.

- It can be focused on alternative finishing methods that can be made without water or with less water.
- Particular attention can be given to colouring and patterning with laser applications which is more environment-friendly and sustainable process amongst other processes for denim apparel production.

ACKNOWLEDGEMENTS

The authors would like to express appreciation for their valuable support of Bahadır Güneşoğlu as a coordinator of the denim company and the staff of Finishing Department and R&D Department in Roteks Tekstil San.ve Tic.A.Ş. for their contribution to the study during data collection.

REFERENCES

- [1] Muthu, S.S., *Environmental Water Footprints Agricultural and Consumer Products*, 1st ed, Edition, Kindle Edition, 2019
- [2] *Sustainable Environmental Management*, 2021, Available at: <https://www.semtrio.com/en> [Accessed on September 2021]
- [3] Klemes, J.J., *Assesing and Measuring Environmental Impact and Sustainability*, Chapter 7, Oxford, UK, 2015
- [4] Hoekstra, A.Y., Ashok K.C., Maite M.A., Mesfin M.M., *The Water Footprint Assessment Manual*, Earthscan Ltd, UK, 2011
- [5] Tickner, D., Kumar Chapagain, A., *Water Footprint Assesment, A guide for Businesses*, 2017