



THE CALCULATION OF ENVIRONMENTAL IMPACT OF TEXTILE PRODUCTS

The environmental impact of a Pure Waste T-shirt

Commissioned by

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The key to unlock textile sustainability

Introduction

Pure Waste Textiles has commissioned REMO BV to calculate the environmental impact of a Pure waste T-shirt from cradle to gate. The Pure Waste T-shirt is made of 60% recycled cotton (industrial waste from garment production) and 40% of recycled polyester (based on PET-bottles). It was asked to compare the environmental impact of the Pure Waste T-shirt with a T-shirt made of 100% virgin cotton and a t-shirt made of 60% virgin cotton and 40% virgin polyester.

The calculations were performed by REMO, Anton Luiken, using the Modint Ecotool. The Modint Ecotool is a dedicated tool for the calculation of the environmental impact of textiles and textile products in all stages of production and use. The development of the tool was commissioned by the Dutch Branch organisation for the textile and clothing industry MODINT to CE Delft and Alcon Advies BV. The Modint Ecotool is a versatile tool with a database for fibers, textile processes and transports. This database is based on data from the Swiss Ecoinvent database (<https://www.ecoinvent.org/>) and verified sources from textile literature. Besides using the standard data, the Modint Ecotool offers also the option to use company specific data for processes and energy use. More background information on the Modint Ecotool can be found at: http://www.avnir.org/documentation/book/LCAconf_bijlevel1_2012_en.pdf



The T-shirt

From Pure waste the following information was given:

Pure Waste Crewneck T-shirt

- Composition: 60% recycled cotton and 40% recycled PET
- In CMT department use of renewable energy
- Production location fibers and yarn: Chandigarh (India)
- Production location fabric and T-shirt: Coimbatore (India)
- Transport between these locations by truck
- No dyeing process; the color of the recycled cotton is used as such.

Specification of the environmental impact of the t-shirt of Pure Waste

It was decided to calculate the impact based on 1000 kg of t-shirts, so the calculations are not influenced by the size of the t-shirts. However, when the weight of a t-shirt is known, it is easy to calculate the environmental impact of that specific shirt.

To calculate the environmental impact of the pure Waste t-shirt and the two reference products the following materials and processes were taken into account (table 1)

Overview materials and processes			
	Pure Waste	Reference	Reference
Composition	60% mechanical recycled cotton, 40% recycled PET bottles	60% virgin cotton 40% virgin PET	100% virgin cotton
Spinning	Open-end spinning	Open-end spinning	Open-end spinning
Yarn count	< 17 tex	< 17 tex	< 17 tex
Knitting	Circular knitting	Circular knitting	Circular knitting
Dyeing	No	Dyeing (reactive/disperse dye)	Dyeing (reactive dye)
Finishing	To reduce shrinkage	To reduce shrinkage	To reduce shrinkage
CMT	Renewable energy	Grey energy	Grey energy
Cut offs	10% (recycled)	10% waste	10% waste

Table 1: t-shirt production

It is assumed that the production of the reference shirts is in the same locations as the Pure Waste T-shirt. In this way, transport does not influence the outcome of the results, when comparing the Pure Waste T-shirt with the reference products. For the cotton fibers in the reference T-shirts a cotton from China was selected, as such cottons have an average environmental impact (not a worst case scenario).

Transport modalities and distances are given in table 2. These distances are determined using Google maps for transports over land and de website <https://sea-distances.org/> for sea transport distances.

Transport		
Modality	City	Km
Truck	Chandigarh - Coimbatore - Kochi (harbor)	2.890
Ocean ship	Kochi - Helsinki	14.100

Table 2: transport distances and modalities

Based on these distances and the modalities the environmental impact of the transport is calculated for 1000 kg of finished product. This means that in all cases 1111 kg of yarn has to be transported from Chandigarh to Coimbatore, being the 1000 kg of final product plus 10% of waste produced in the garment production ($1000 / 0,9 = 1111$). This includes also the Pure Waste material as the waste in the production of the t-shirts is produced at another location than the production of the recycled fibers and yarns.

However, for the calculation of the environmental impact of the Pure Waste t-shirt, only a 1000 kg of materials has been taken into account, as the cut-offs are recycled and used again. For the references it was assumed that the waste is not recycled and will have no other use. Therefore, the amount of starting material is not a 1000 kg but 1111 kg. Calculating 10% waste leaves after all the processing 1000 kg of t-shirts for both Pure waste and the references.

Results of the environmental impact calculations

The results of the impact calculations are given for the yarns (table 3), the finished products (table 4), the environmental impact of the transport (table 5) and the finished product including transportations (table 6). The results are expressed in 1000 kg of material as functional unit.

Calculation per 1000 kg of yarn				
		Pure Waste	Reference 1	Reference 2
CO ₂ -eq	kg	3.387,9	6.951,2	7.089,6
Energy	MJ	55.440	123.397	106.665
Water	L	2	7.060.000	11.774.000

Table 3: environmental impact of the Pure Waste yarn and the references

Calculations per 1000 kg finished product				
		Pure Waste	Reference 1	Reference 2
CO ₂ -eq	kg	4.834,4	9.689,4	10.367,8
Energy	MJ	80.852	172.743	166.756
Water	L	6.205	7.131.000	11.873.000

Table 4: environmental impact of Pure Waste finished products and the references

Transports per 1000 kg				
		Pure Waste	Reference 1	Reference 2
CO ₂ -eq	kg	684,7	684,7	684,7
Energy	MJ	11.311	11.311	11.311
Water	L	0	0	0

Table 5: environmental impact of the transports of the Pure Waste materials and the references

Totals including transports per 1000 kg of product				
		Pure Waste	Reference 1	Reference 2
CO ₂ -eq	kg	5.519,1	10.374,1	11.052,8
Energy	MJ	92.163	184.054	178.067
Water	L	6.205	7.131.000	11.873.000

Table 6: environmental impact of the Pure Waste finished product and the references including transports

Impact per T-shirt of 200 grams				
		Pure Waste	Reference 1	Reference 2
CO ₂ -eq	kg	1,10	2,07	2,21
Energy	MJ	18,4	36,8	35,6
Water	L	1	1.426	2.375

Table 7: environmental impact of a Pure Waste T-shirt and the references.

The reference products score on all 3 parameters less compared to the Pure Waste T-shirt.

Savings of the Pure Waste T-shirt are about 50% on CO₂-eq. and energy and > 99% on water consumption.