Fly Me CHAIR

Environmental impact assessment

1 Description and assessment of the Materials used in the Product

2 Description and assessment of the Production process

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1 Description and assessment of the Materials used in the Product

Materials are assessed according to energy consumption and burdening of the environment when the Product reaches the end of its life cycle, their physical characteristics and feasibility for recycling.

- **Steel**

Energy contents: 23.4 MJ/kg *recycled: 10 MJ/kg*

Steel is a commonly used and economical construction material. Due to good mechanical properties, it can be used in wide variety applications. Further it is suitable for many different processing and fabrication methods.

The waste generated by steel (→rust) has hardly any impact on the environment. Moreover, the material is very suitable for recycling and the infrastructure for recycling steel is well established.

- **Stainless steel**

Energy contents: 73 MJ/kg *recycled: 23 MJ/kg*

Basically the applications for stainless steel are similar to steel. However compared to steel, stainless offers remarkable advantages; excellent corrosion resistance, durability, no need for surface treatment and further stainless steel is used where cleanliness and hygiene are required. Due to the inherent value of stainless steel scrap, the recycling infrastructure for recycling stainless steel is well organised. The global average for recycled content for stainless steel is 60%.

- **Plastic**

Energy contents: 70 MJ/kg *recycled: 10 MJ/kg*

Plastic takes little energy to produce. Most synthetics are suitable for recycling, although their mechanical characteristics deteriorate each time. Because of its relatively low price, the demand for recycled plastics is minnow, and further the infrastructure for recycling plastics is not well organized. Due to these factors, plastics are burned most of the time → energy production.

- **Plywood**

Energy contents: 19.44 MJ/kg *recycled: - MJ/kg*

Bent plywood is used in seat/back design. Raw material is birch veneer, and it is origin from renewable natural resources. The supplier is working according to ISO 14001 requirements and uses FSC certified materials. Since recycling possibilities for plywood are limited, the material is burned most of the time → energy production.

- **Foam**

Cold foam is used for the padding component of the chair. The cold foam process is a reaction between polyoles (polyol and isocyanate MDI) inside the mould impression, blowing agent is water. Provided that no other substances are coated in foam, such as metal parts, it is very suitable for re-use in the shape of polypress plates, i.e. plates of compressed and glued, ground cold foam.

The seat/back construction (plywood) is foam coated during moulding process, yet it is possible to separate the items mechanically. The foam is CFC-free and is produced in countries with strict environmental regulations i.e. Finland and Estonia. Further the foam supplier is working according to ISO 14001 requirements.

- **Upholstery**

Fabric: for the upholstery of the Product the company standard collection is used. Fabrics in the collection are mainly made out of wool. Wool is a natural product, but requires a lot of water during production and the dyes used often contain heavy metals that may end up in the waste water. However, the fabrics in our collection do not contain any heavy metals, and water used during production is purified and neutralised. We have two main sources for woollen fabrics, both manufacturers operating under strict environmental legislation:

- fabrics origin from a Danish manufacturer with a Oeko-Tex, Ecolabel Flower and DS certificates and
- British manufacturer with ISO 14001 and BS standard

2 Description and assessment of the Production process

The production processes are assessed according to energy consumption, emissions during the process and residual waste.

- **Plastic injection-moulding**

During injection-moulding, the processed material is heated to melting-point and pressed into a die cavity or mould impression. As the mould is cold, the material solidifies. When the mould is opened, the product is ready. Depending of the component, some additional fabrication or surface treatment may be needed.

Heating and pressing of materials takes place electrically. Depending on the plastic type used in injection-moulding waste and rejects are reused or alternatively used in energy production. During the process, no substances that burden the environment are released.

- **Steel punching, forming and cutting**

Steel is punched, formed and cut by electrically driven hydraulic machines which form and cut the steel with knife-like tools. No substances that burden the environment are released in this process. Cutting waste is removed as scrap metal and delivered to recycling.

- **Plywood bending**

In plywood bending process several thin veneer layers are placed in a moulding press, glue added between the layers. The mould is closed and the part compounds when either heat or high frequency is introduced. The final shape is produced by cutting the pressed form to desired shape. Trimmings are used in energy production. During the process, no substances that burden the environment are released.

- **Welding**

In the welding process, steel parts are joined by being melted, while welding wire is added. The welding pool is heated electrically. During welding, vapours of combusted pollution are released. These are extracted and filtered.

- **Machining techniques**

Metal axles and pipes are produced by means of machining techniques such as turning, milling and sawing. Cutting oil is used in the machining process. This is a mixture of water and a very small quantity of soluble oil. The chips are collected, while the oil residues are removed by means of centrifugation. The oil is processed as chemical waste. The chips are removed as scrap metal and recycled.

3 Description and assessment of the Surface Treatment Methods

Surface treatment techniques are assessed for emissions and residual waste.

- **Powder coating**

Coating
The coated parts are covered in powder in an electrostatic process (i.e. coating) and powder polymerizes when the part is placed in a heated furnace (approx. 200 ºC). Any powder that is lost is collected and reused or cured in the furnace. Cured powder results in a 'block' of plastic which has no impact on the environment and disposal is permitted.

Degreasing
Before the powder is applied, the parts must be degreased. This takes place in hot alkaline water. Apart from the water vapours, no vapours that burden the environment are released. When the water is saturated, the dissolved greases are separated by a water treatment plant. The water is discharged, whilst the greases are removed as chemical waste.

This makes powder coating one of the most environmentally friendly surface treatment techniques.

- **Black annealing**

During black annealing, the steel parts are provided with a black oxide coating in a salt solution. The oiling of the products causes slight anticorrosion and a lubricating effect. This technique is used for axles and pins.

- **Electro-zincing**

In the electro-zincing process, a very thin layer of zinc is added to, for example, steel. This thin coating provides excellent protection against rust.

The process takes place in a container with water and a dissolved zinc compound. Subsequently, the products are rinsed in the water, during which a small part of the zinc comes into the water.

The rinse water is purified in a treatment plant and discharged. What is left is chemical waste and must be processed.

- **Chromium-plating**

The chromium-plating process is similar to the electro-zincing process. In many cases, several layers are applied underneath the chromium, such as copper and nickel. Since chromium, copper and nickel form part of the group of "heavy metals", they are hazardous to the environment. The heavy metals are recovered from the residues of the water treatment plant. They can then be re-used. Before applying chromium plating, the parts must be degreased in similar way as in powder coating.

4 Description and assessment of the Packing practices

Packing operations are assessed for burdening of the environment and recycleability.
There are two packing operations involved in production:

- packing of parts
- packing of finished product

Parts
For the packing of large parts, pallets and wire-mesh trolleys are used, which are recycled.
For smaller parts, cardboard boxes and plastic bags (LDPE) are used, which are recycled several times.

Finished product
For the packing of finished product, cardboard boxes and plastic bags (LDPE) are used. Since Martela takes care of its own transport, we are able to take back our packing material and have it recycled or disposed of in a responsible manner.

Cardboard
In cardboard production main raw materials are recycled paper and virgin fibre. As a waste product, it can be used again as a raw material for cardboard. This makes cardboard the most environmentally friendly packing material. Only white (bleached) cardboard is an extra burden on the environment and is therefore not used as a packing material. On average the raw material mixture in our cardboard packages is: 40% recycled and 60% virgin fibre.

Plastic bags (PE)
A plastic bag is often needed for proper scratch-resistant and dust-proof packing. Natural PE is the most environmentally friendly plastic for this. Since the bags are very thin (=0.05mm), they require only very little material. Moreover, the plastic bags can be used several times. Hardly any hazardous substances are released when processed in a waste incinerator.

5 The product structure

- **Environment-related issues**

Dismantling
The chair can be dismantled entirely, since all materials can be separated. No composite materials have been used in the product.

- **Materials and weights**

Steel, plywood, PUR and plastics are materials that are suitable for recycling. 94.5% of the chair is made from these materials.

	Kg	%
Steel	15.1	68.2
Plywood	3.7	16.7
Plastic	0.14	0.6
PUR foam	2.0	9.0
Fabric (wool)	0.8	3.6
Miscellaneous	0.4	1.8
Total	**22.14**	**100**

The total energy content is 575.1 MJ if base is other than stainless steel.

- **The structure of the product**

  - **Seat / back design**

Weight: foam 2.0 kg, plywood 3.7kg *energy contents: 211.9 MJ*
– the seat/back insert is made out of bent plywood provided with tee nuts with pronges
– Actual stuffing has been made out of cold foam (polyurethane) on the seat/back insert, foam is produced CFC-and HFC-free
– the inserts (plywood) can be used in energy production
– the upholstery is not glued onto the foam → zipper fastening, which makes it relatively easy to separate
– the backing fabric (3mm laminated fabric) is glued onto the foam, the glue used is solvent free water based 2-component glue.
– standard upholstery according to Martela collection.

  - **Seat fastening flange and column**

Weight: 3.64 kg *energy contents: 90.741 MJ* *(if stainless steel 125 MJ)*
– Upper flange is punched and welded steel plate with returning mechanism (Patron 351000-MC3) assembled
– Column is made out of steel tube ∅ 63,5x2, L=242mm

  - **Base flange**

Weight: 11.12 kg *energy contents: 261.0 MJ* *(if stainless steel 811.56 MJ)*
– The base flange has been made out of steel; ∅ 550/40,5*6mm and is provided with PA glides (L-24-8/3,5-5), weight á 3 g