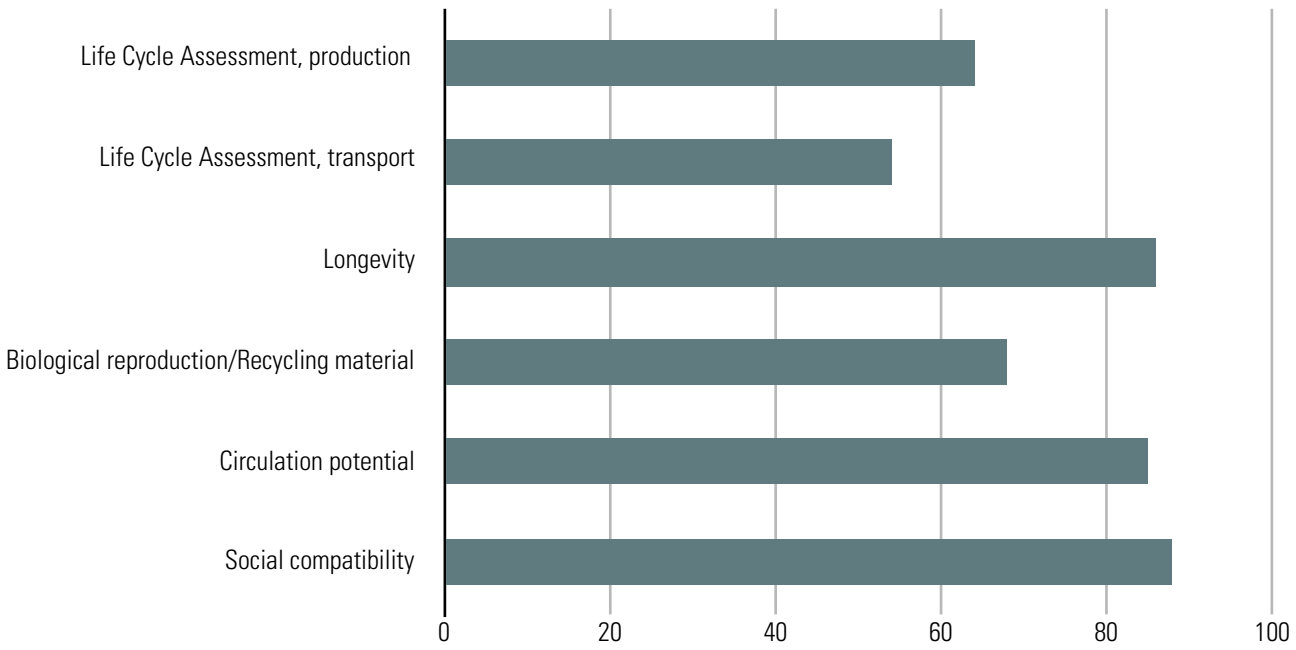
ZEITRAUM

MORPH DUO LOUNGE

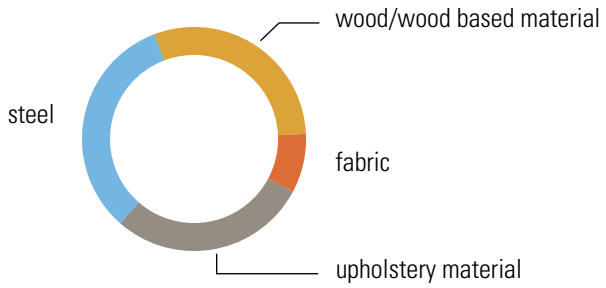
Design by Formstelle, 2015

zeitraum-moebel.de

MORPH DUO LOUNGE, fabric; walnut



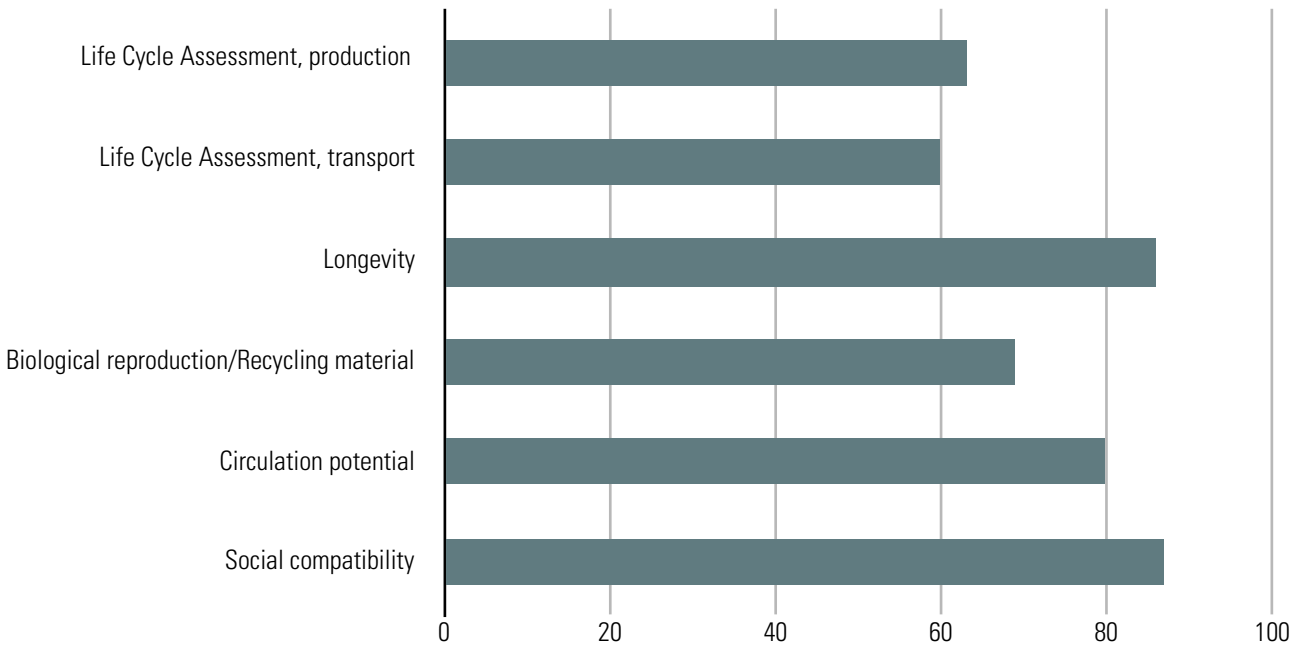
- wood/wood based material
- fabric
- upholstery material
- steel
- other



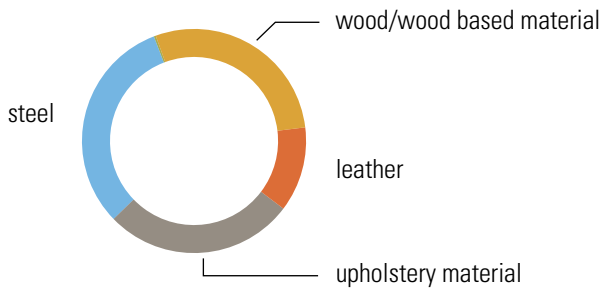
MORPH DUO LOUNGE, fabric; walnut	Material/Product rating									
	Walnut	Fabric, Rohi, Opera	PUR, Upholstery	Poly-ester fiber	Steel	PA	Natural oil, Osmo	PVAC	PUR adhesive	Weighted rating, %
Life Cycle Assessment, production	10	5,33	3	9	5,33	3	5	10	0	63,61859 %
Life Cycle Assessment, transport	5	5	6,5	6,5	5	6,5	9	6,5	6,5	54,34 %
Longevity	10	9	5	8	10	8	10	9	9	86,322 %
Biological reproduction/ Recycling material	10	10	0	0	9	0	6	0	0	67,852 %
Circulation potential	8	8	7	10	10	10	10	4	4	85,184 %
Social compatibility	9	10	9	9	8	9	10	9	9	87,539 %
Average rating, ø	8,666	7,888	5,083	7,083	7,888	6,083	8,333	6,416	4,75	Total weight
Share in kg	4,2	1,2	3,3	0,73	4,61	0,008	0,02	0,009	0,008	14,085
Share in %	29,81 %	8,51 %	23,42 %	5,18 %	32,72 %	0,05 %	0,14 %	0,06 %	0,05 %	
Weighted rating	2,583	0,671	1,19	0,366	2,58	0,003	0,011	0,003	0,002	
Product rating in %	**74,09**									

Packaging	Material/Product rating	
	Cardboard	Weighted rating, %
Life Cycle Assessment, production	10	100 %
Life Cycle Assessment, transport	9	90 %
Longevity	4	40 %
Biological reproduction/Recycling material	9	90 %
Circulation potential	10	100 %
Social compatibility	10	100 %
Average rating, ø	8,666	Total weight
Share in kg	6,3	6,3
Share in %	100 %	
Weighted rating	8,666	
Product rating in %	**86,66**	

MORPH DUO LOUNGE, leather; walnut



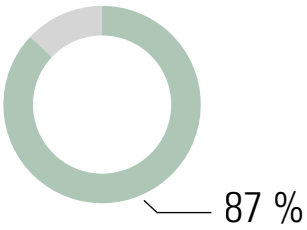
- wood/wood based material
- leather
- upholstery material
- steel
- other



MORPH DUO LOUNGE, leather; walnut	Material/Product rating									
	Walnut	Leather, Jepard	PUR, Upholstery	Poly-ester fiber	Steel	PA	Natural oil, Osmo	PVAC	PUR adhesive	Weighted rating, %
Life Cycle Assessment, production	10	5	3	9	5,33	3	5	10	0	62,80987 %
Life Cycle Assessment, transport	5	10	6,5	6,5	5	6,5	9	6,5	6,5	60,302 %
Longevity	10	9	5	8	10	8	10	9	9	86,495 %
Biological reproduction/ Recycling material	10	10	0	0	9	0	6	0	0	69,179 %
Circulation potential	8	4	7	10	10	10	10	4	4	80,093 %
Social compatibility	9	9	9	9	8	9	10	9	9	86,847 %
Average rating, ø	8,666	7,833	5,083	7,083	7,888	6,083	8,333	6,416	4,75	Total weight
Share in kg	4,2	1,8	3,3	0,73	4,61	0,008	0,02	0,009	0,008	14,685
Share in %	28,6 %	12,25 %	22,47 %	4,97 %	31,39 %	0,05 %	0,13 %	0,06 %	0,05 %	
Weighted rating	2,478	0,959	1,142	0,352	2,476	0,003	0,01	0,003	0,002	
Product rating in %	**74,25**									

Packaging	Material/Product rating	
	Cardboard	Weighted rating, %
Life Cycle Assessment, production	10	100 %
Life Cycle Assessment, transport	9	90 %
Longevity	4	40 %
Biological reproduction/Recycling material	9	90 %
Circulation potential	10	100 %
Social compatibility	10	100 %
Average rating, ø	8,666	Total weight
Share in kg	6,3	6,3
Share in %	100 %	
Weighted rating	8,666	
Product rating in %	**86,66**	

1 American walnut



Tab. 1 A: Material data sheet, American walnut, general[1 2]

Material group	Natural material; wood; hardwood
Botanical name	*Juglans nigra L. (Juglandaceae)*
Name	American Walnut (GB); Black Walnut (US); Amerikanischer Nussbaum, Schwarznuss, Schwarze Walnuss (D); Noyer Noir (F)
Material Norm. Ref.	DIN EN 13556: JGNG
Origin	Missouri
Occurrence	Midwestern and northeastern U.S.; Ontario to Florida, Minnesota to Texas; southeastern Canada. Prefers deep, loose fresh loam soils and mild climate; fairly winter hardy
Use	Solid and veneer, furniture and interior finishing; turning; marine interiors; small and seating furniture; piano making; musical instruments; buttons; inlays; etc.

[1] WAGENFUEHR, R. (2007) - Wood Atlas. (6) Leipzig: Hanser Wirtschaft, Fachbuchverlag Leipzig, pp. 551-554

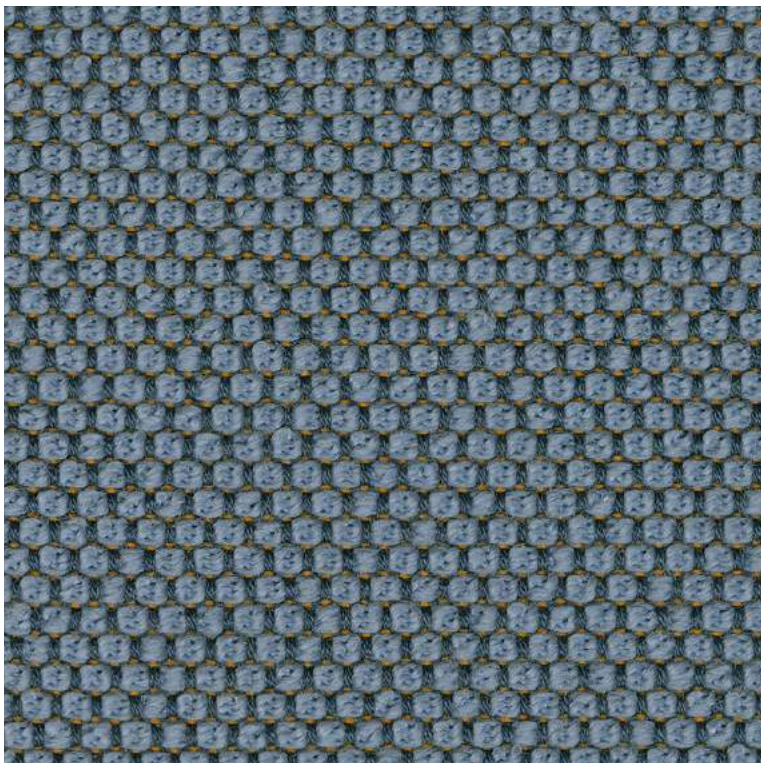
[2] LOHMANN, U. (2010) - Wood encyclopedia. The standard work for wood and forestry. (4) Hamburg: Nikol-Verlag, page 859

Tab. 1 B: Material data sheet, American walnut, specific[3]

General description		
Certifications/Information	The Evergreen Initiative; NHLA; FSC on request	
Life cycle assessment data hardwood, average (GER)		10
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	2,18 MJ	10
Use of freshwater resources (FW)	0,00048 m³	10
Environmental impact per m³	**A1-A3**	
Global Warming Potential (GWP)	-1,74 Kg CO_2-eqv.	10
Environmental impact Transport, per 1000 kgkm (580 kg/m³)		5
Production site: Germany/ZEITRAUM		
Truck - ca. 300 km	A4	10
Total non-renewable primary energy (PENRT)	362,4 MJ	
Use of freshwater resources (FW)	0,019164 m³	
Global Warming Potential (GWP)	26,907 Kg CO_2-eqv.	
Main raw material origin: Missouri/Production site		0
Truck - ca. 2000 km	A4	
Total non-renewable primary energy (PENRT)	2416 MJ	
Use of freshwater resources (FW)	0,12776 m³	
Global Warming Potential (GWP)	179,38 Kg CO_2-eqv.	
Container ship - ca. 10000 km	A4	
Total non-renewable primary energy (PENRT)	1094 MJ	
Use of freshwater resources (FW)	0,005636 m³	
Global Warming Potential (GWP)	90,11 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable/repairable (> 20 years)	10
Biological reproduction/ Recycled material	100 %	10
Circulation potential	70 % - 99 % (technological/recycling)	8
Socially compatible	Yes	9

[3] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

Total average rating		**8,66**
Processing		
Mechanical	Very good; can be cut and peeled, suitable for turning and carving; low tendency to crack and warp	
Drying	good; but slow; low tendency to tear and shed; good stability	
Adhesion	good; alkalis can cause stains	
Surface finishing	Very good; can be stained and excellently varnished; tinting of the wood color by smoking	
Natural durability DIN EN 350-2 (with weathering)	Moderately durable; sapwood low; heartwood fairly good; resistant to fungi and insects; durability class 3	
Physical properties		
Kiln density (0 % wood moisture content)	560… 610 kg/m³	
Bulk density (12 - 15 % wood moisture)	580… 640… 810 kg/m³	
Pore ratio	ca. 63 %	
Shrinkage rate at 1 % moisture reduction	radial - 0.19 %; tangetial - 0.26 %; volume - 0.40 %	
Mechanical properties		
Compressive strength (σ_{dB})	44… 53 N/mm²	
Flexural strength (σ_{bB})	90… 103 N/mm²	
Tensile strength ($\sigma_{zB} \perp$)	ca. 4,7 N/mm²	
Shear strength (τ_{aB})	8,8… 9,6 N/mm²	
Hardness (HB ‖)	ca. 50 N/mm²	
Hardness (HB ⊥)	ca. 26 N/mm²	
E-modulus (E_b ‖)	11000… 13500 N/mm²	



2 Rohi, Opera

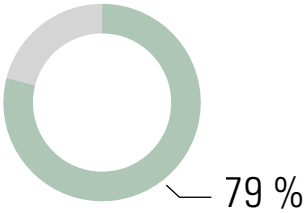


Fig. 2: www.rohi.com

Tab. 2 A: Material data sheet, Opera, general[4]

Material group	Natural synthetic material; textiles; upholstery fabric; virgin wool, polyamide
Name	Opera
Material abbreviation	WV (virgin wool); PA (polyamide)
Manufacturer	Rohi, Germany (GER)
Manufactured in	Germany (GER)
Designer	Rohi
Version	29 different colors
Use	Object areas and private living spaces with very high stresses

[4] ROHI (2021) - Rohi; Products <https://www.rohi.com/en/products/living/> Accessed, on 11/12/2021

Tab. 2 B: Material data sheet, Opera, specific[5][6]

General description (manufacturer spec.)		
Certifications/Information	RAL-UZ 117 2+3, IWTO Guidelines for Sheep Welfare, FR-free, AB2998 (US Export Norm), ISO 9001, REACH, CP65 (on request)	
Fire resistance	**Fire tests (without additional flame retardant finish)**: CAL TB 117 - 2013 • DIN EN 1021-1/-2 • BS 5852 Part 1: 1979 • UNI 9175 1 IM • ÖNORM B1/Q1 • IMO 2014/90/EU **Fire tests (with optional flame retardant finish)**: BS 5852: 2006 Crib5 • DIN 4102-1 B2 • DIN EN 13501-1 E • FAR 25.853 12 sec. vertical • NF P92-507 M2	
Environmental benefits		
AZO dyes	Not contained	
Heavy metals	Not contained	
Formaldehyde	Not contained	
Brominated flame retardants	Not contained	
Spinning oil used	n.a.	
Appearance		
Pattern	Solid	
Length	n.a.	
Width	140 cm	
Thickness	n.a.	
Color	www.rohi.com; Differences may occur	
Textile surface	n.a.	
Basic materials		
Virgin wool	96 %	
Polyamide (Nylon)	4 %	
LCA data comparator for Opera, Rohi (no data available) - Hero (96 % WV, 4 % PA), Kvadrat		5,33
Resource use per m²	**A1-A3**	
Total non-renewable primary energy (PENRT)	89 MJ	7
Use of freshwater resources (FW)	0,34 m³	4
Environmental impact per m²	**A1-A3**	
Global Warming Potential (GWP)	7,3 Kg CO_2-eqv.	5
Environmental impact Transport, per 1000 kgkm (0.870 kg/m)		5

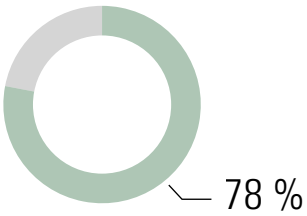
[5] ROHI (2021) - Rohi; Products <https://www.rohi.com/en/products/living/> Accessed, on 11/12/2021

[6] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

Production site: Germany/ZEITRAUM		
Truck - < 100 km	A4	10
Total non-renewable primary energy (PENRT)	120,8 MJ	
Use of freshwater resources (FW)	0,006388 m³	
Global Warming Potential (GWP)	8,969 Kg CO_2-eqv.	
Main raw material origin: Australia/production site		0
Truck - ca. 2000 km	A4	
Total non-renewable primary energy (PENRT)	2416 MJ	
Use of freshwater resources (FW)	0,12776 m³	
Global Warming Potential (GWP)	179,38 Kg CO_2-eqv.	
Container ship - ca. 10000 km	A4	
Total non-renewable primary energy (PENRT)	1094 MJ	
Use of freshwater resources (FW)	0,005636 m³	
Global Warming Potential (GWP)	90,11 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable/moderately repairable (> 20 years)	9
Biological reproduction/ recycled material	96 %	10
Circulation potential	70 - 99 % technological/recycling	8
Socially compatible	Yes	10
Total average rating		**7,88**
Resistance to dirt	Not sensitive to dirt	
Physical properties		
Weight	ca. 1010 g/m	
Mechanical properties		
Resilience	90.000 Martindale	
Pilling (ISO1-5)	min. 4 - 5	
Light fastness (ISO 1-5)	min. 5 - 8	
Seam slippage	n.a.	
Care		
Washing	Professional cleaning recommended	
Chlorine	Do not bleach	
Drying drum	Do not dry	

Ironing	Moderate hot ironing	
Dry cleaning	Professional cleaning recommended	

3 Reinhardt Leather, Jepard



Tab. 3 A: Material data sheet, Jepard, general[7]

Material group	Natural materials; animal products; mammalian leather, cowhide (mineral tanning)
Name	Jepard
Manufacturer	Leder Reinhardt GmbH
Manufactured in	Germany (GER)
Cattle origin	Europe
Version	13 different colors
Use	Clothing: jackets, pants, bags, backpacks, belts, etc.; jewelry; hats; caps; shoe soles, straps Furniture making: upholstery materials, seat shells, etc.; saddlery; automotive industry; book covers; art objects; etc.

[7] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Tab. 3 B: Material data sheet, Jepard, specific[8][9]

General description (manufacturer spec.)		
Certifications/Information	n.a.	
Fire resistance	**Fire tests**: CA TB 117-2013	
Appearance		
Size	4,2… 5,2 m²	
Thickness	1,1… 1,3 mm	
Color	13 color versions	
Texture	Pappillary layer - smooth, scarred Reticular layer: fibrous (also called flesh side)	
Life cycle assessment data leather		5
Resource use per m²	**A1-A3**	
Total non-renewable primary energy (PENRT)	n.a.	
Use of freshwater resources (FW)	n.a.	
Environmental impact per m²	**A1-A3**	
Global Warming Potential (GWP)	n.a.	
Environmental impact Transport, per 1000 kgkm (approx. 0,9 kg/m²)		10
Production site: Germany/ZEITRAUM		
Truck - ca. 200 km	A4	10
Total non-renewable primary energy (PENRT)	241,6 MJ	
Use of freshwater resources (FW)	0,012776 m³	
Global Warming Potential (GWP)	17,938 Kg CO_2-eqv.	
Main raw material origin: Germany/production site		
Truck - ca. 1000 km	A4	10
Total non-renewable primary energy (PENRT)	1208 MJ	
Use of freshwater resources (FW)	0,06388 m³	
Global Warming Potential (GWP)	89,69 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable/moderately repairable (> 20 years)	9
Biological reproduction/ recycled material	> 95 % (chrome tanning)	9

[8] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

[9] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

Circulation potential	40 - 70 % technological/downcycling	4
Socially compatible	Yes	9
Total average rating		**7,66**
Resistance to dirt	Not sensitive to dirt	
Processing		
Mechanically	Mechanical processing of the material with tools designed for this purpose; cutting possible; offcut (upholstered furniture) approx. 30-45 %	
Storage	Relative humidity: 50-70 %; Temperature: 5-15 %	
Adhesion	good; possible with suitable adhesives	
Surface processing	good; can be dyed; smooth leather can and should be greased, oiled or waxed to protect the der from drying out; too much grease can also cause the leather to dry out; leather can be cleaned with lukewarm water; avoid using solvents	
Other	Untreated leather is porous and permeable to water and air; direct sunlight can cause drying and color change	
Natural durability	With regular care, the service life of leather can be increased many times over	
Properties	Very tear-resistant; elastic; water-permeable; breathable	
Physical properties		
Density	400… 900 kg/m³	
Mechanical properties		
Continuous folding behavior (EN ISO 5402)	30.000	
Light fastness (ISO 105-B02)	3	
Wet abrasion (ISO 11640)	20	
Dry abrasion (ISO 11640)	50	
Elongation at break (unwashed underleather)	n.a.	
Notes	The most important leather is cowhide; leather is largely a by-product of the meat industry; some animals are bred only for their leather, e.g. snakes, crocodiles or lizards	

4 PUR flexible foam, (MDI)

51 %

Tab. 4 A: Material data sheet, PUR flexible foam, general[10]

Material group	Synthetic Material; Synthetic Upholstery Material
Name	Polyurethane Foam (GB); Polyurethan Weichschaum (D);
Material abbreviation	PUR foam
Manufactured in	Germany (GER)
Use	Automotive industry (upholstery, fittings); furniture upholstery; shoe soles; etc.

[10] KALWEIT A. (2012) - Handbook of technical product design - materials and manufacturing. Berlin: Springer Verlag

Tab. 4 B: Material data sheet, PUR flexible foam, specific[11][12]

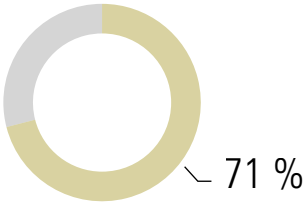
General description (manufacturer spec.)		
Certifications/Information	ISO 9001, DE-UZ 117 (Blue Angel)	
Fire resistance	CAL117, DIN EN 10211 EUFAC, DIN EN 10212 EUFAC	
Delivery form	Bales, flakes, mats, etc.	
Texture	soft, porous	
Color	Available in all colors	
Life cycle assessment data Comparative material for PUR flexible foam (no data available) - PU slabstock foam insulation panels (GER)		3
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	98,5 MJ	0
Use of freshwater resources (FW)	0,028696 m^3	9
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	4,48 Kg CO_2-eqv.	0
Environmental impact Transport, per 1000 kgkm (approx. 75 kg/m^3)		6,5
Production site: Germany/ZEITRAUM		
Truck - ca. 500 km	A4	10
Total non-renewable primary energy (PENRT)	430,3 MJ	
Use of freshwater resources (FW)	0,030265 m^3	
Global Warming Potential (GWP)	32,055 Kg CO_2-eqv.	
Main raw material origin: n.a./production site		3
n.a. - ø > 7000 km	A4	
Total non-renewable primary energy (PENRT)	8456 MJ	
Use of freshwater resources (FW)	0,44716 m^3	
Global Warming Potential (GWP)	627,83 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Durable (10 - 20 years)	5
Biological reproduction/ recycled material	0 %	0
Circulation potential	70 - 99 % technological/downcycling	7

[11] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021.

[12] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Socially compatible	Yes	9
Total average rating		**5,08**
Resistance to dirt	Not sensitive to dirt	
Notes	MDI: methylene diphenyl isocyanate; chemical compounds from the group of aromatic isocyanates	

5 Polyester fibers



Tab. 5 A: Material data sheet, polyester fibers, general[13]

Material group	Synthetic Material; Synthetic Upholstery Material
Name	Polyester Fibers (GB); Polyesterfaser (D)
Material abbreviation	PES
Manufactured in	Germany (GER)
Use	Furniture upholstery

[13] KALWEIT A. (2012) - Handbook of technical product design - materials and manufacturing. Berlin: Springer Verlag

Tab. 5 B: Material data sheet, polyester fibers, specific[14][15]

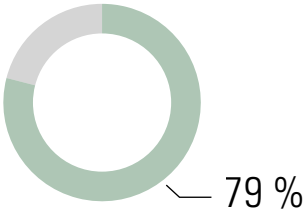
General description		
Certifications/Information	REACH, OEKO-TEX® STANDARD 100, DIN EN ISO 9001, DIN EN ISO 14001, DIN EN ISO 50001, CP65	
Fire resistance	BS 5852 Part 2, CAL117	
Delivery form	Mats, wadding, etc.	
Texture	soft, fibrous	
Color	Available in all colors	
Life cycle assessment data Comparative material for PE wadding (no data available) - PE nonwoven (GER)		9
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	22 MJ	8
Use of freshwater resources (FW)	0,00252 m^3	10
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	0,73 Kg CO_2-eqv.	8
Environmental impact Transport, per 1000 kgkm (approx. 0.5 kg/m^2)		6,5
Production site: Germany/ZEITRAUM		
Truck - ca. 500 km	A4	10
Total non-renewable primary energy (PENRT)	430,3 MJ	
Use of freshwater resources (FW)	0,030265 m^3	
Global Warming Potential (GWP)	32,055 Kg CO_2-eqv.	
Main raw material origin: n.a./production site		3
n.a. - ø > 7000 km	A4	
Total non-renewable primary energy (PENRT)	8456 MJ	
Use of freshwater resources (FW)	0,44716 m^3	
Global Warming Potential (GWP)	627,83 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable (> 20 years)	8
Biological reproduction/ recycled material	0 %	0
Circulation potential	100 % (technological)	10

[14] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

[15] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Socially compatible	Yes	9
Total average rating		**7,08**
Resistance to dirt	Not sensitive to dirt	
Properties		
Density	1380 kg/m³	
Acid resistance	Conditionally resistant to organic and mineral acids	
Moisture absorption	0,2 to 0,5 %	
Thermal properties		
Softening temperature Vicat	ca. 230 °C to 240 °C	
Melting point/range	250 °C	

6 Steel, MORPH LOUNGE/ DINING



Tab. 6 A: Material data sheet, steel, MORPH LOUNGE/DINING, general

Material group	Natural material; metals; transition metals
Parts origin	Bavaria, Germany
Occurrence	Worldwide; South America, Western Australia, China and Eastern Europe, Canada
Use	Metal chair frame

Tab. 6 B: Material data sheet, steel, MORPH LOUNGE/DINING specific[16][17]

General description		
Certifications/Information	n.a.	
Emission class (formaldehyde)	Formaldehyde free	
Surface	smooth, hard	
Color	Grey	
Life cycle assessment data Steel profile, (GER)		5,33
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	10,99 MJ	4
Use of freshwater resources (FW)	0,002314 m^3	4
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	0,9944 Kg CO_2-eqv.	8
Environmental impact Transport, per 1000 kgkm (7850 kg/m^3)		5
Production site: Germany/ZEITRAUM		
Truck ø - ca. 200 km	A4	10
Total non-renewable primary energy (PENRT)	1812 MJ	
Use of freshwater resources (FW)	0,09582 m^3	
Global Warming Potential (GWP)	134 Kg CO_2-eqv.	
Main raw material origin: China/production location		0
Truck - ca. 2000 km	A4	
Total non-renewable primary energy (PENRT)	2416 MJ	
Use of freshwater resources (FW)	0,12776 m^3	
Global Warming Potential (GWP)	179,38 Kg CO_2-eqv.	
Container ship - ca. 10000 km	A4	
Total non-renewable primary energy (PENRT)	1094 MJ	
Use of freshwater resources (FW)	0,005636 m^3	
Global Warming Potential (GWP)	90,11 Kg CO_2-eqv.	
Sustainability Assessment		

[16] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

[17] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Longevity	Very durable/repairable (> 20 years)	10
Biological reproduction/ recycled material	80 - 90 %	9
Circulation potential	100 % (technological)	10
Socially compatible	Yes	8
Total average rating		**7,88**
Processing		
Mechanical	More difficult to machine due to hardness, drilling, turning, milling, cutting; forming (bending, compression, tension forming)	
Joints	Riveting; screwing and welding	
Surface finishing	Engraving, polishing, embossing, grinding, lasering	
Other	High plastic deformability under impact loading; materials with low carbon content are easier to deform	
Durability	Heat resistant, corrosion and heat resistant	
Notes	The life cycle assessment of iron improves the more often the material has been recycled or the proportion of recycled material increases	

7 Polyamide

61 %

Tab. 7 A: Material data sheet, polyamide, general[18]

Material group	Synthetic material; plastic
Name	Polyamide (GB, US); Polyamid (D)
Short name	PA
Manufactured in	Germany (GER)
Use	Machine and equipment construction; vehicle construction; electrical engineering; furniture construction

[18] KALWEIT A. (2012) - Handbook of technical product design - materials and manufacturing. Berlin: Springer Verlag

Tab. 7 B: Material data sheet, polyamide, specific[19][20]

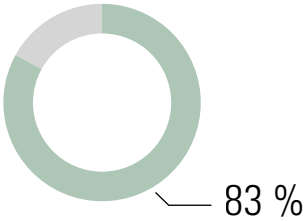
General description		
Certifications/Information	n.a.	
Delivery forms	Granules, fibers, pipes, films, molded parts	
Color	Available in all colors	
Life cycle assessment data Nylon casting (PA 6.6) (GER)		3
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	251,7 MJ	0
Use of freshwater resources (FW)	0,04378 m^3	10
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	16,91 Kg CO_2-eqv.	0
Environmental impact Transport, per 1000 kgkm (1140 kg/m^3)		6,5
Production site: Germany/ZEITRAUM		
Truck - ca. 500 km	A4	10
Total non-renewable primary energy (PENRT)	604 MJ	
Use of freshwater resources (FW)	0,03194 m^3	
Global Warming Potential (GWP)	44,845 Kg CO_2-eqv.	
Main raw material origin: n.a./production site		
n.a. - ø > 7000 km	A4	3
Total non-renewable primary energy (PENRT)	8456 MJ	
Use of freshwater resources (FW)	0,44716 m^3	
Global Warming Potential (GWP)	627,83 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable (> 20 years)	8
Biological reproduction/ recycled material	0 %	0
Circulation potential	100 % (technological)	10
Socially compatible	Yes	9
Total average rating		**6,08**
Processing		

[19] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

[20] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Mechanically	Very good; with conventional plastic processing machines; drilling, sawing; milling; etc.	
Adhesion	Good; with adhesives for low-energy plastics	
Surface processing	Brushing; Sanding; Painting; Oiling; Embossing	
Resistance	Easy care; water resistant; resistant to fungi and insects	
Properties		
Elongation at break	50,0 %	
Density	1140 kg/m³	
Moisture absorption	2,5 - 3,5 %	
Dielectric strength	25 kV/mm	
Notched impact strength (Charpy)	3,0 kJ/m²	
Thermal properties		
Vicat softening temperature according to DIN EN ISO 306 Vicat B/50	250 °C	
Continuous operating temperature	-30 bis 95 °C	

8 Osmo, hard wax oil



Tab. 8 A: Material data sheet, Osmo, hard wax oil, general[21][22]

Material group	Coating materials; Oils
Name	Hard wax oil (GB, US); Hartwachsöl (D)
Manufacturer	Osmo Holz und Color GmbH & Co. KG
Manufactured in	Germany (GER)
Version	Osmo Hard Wax Oil 3032 satin, 3062 matt
Use	Furniture construction; for interior use; also suitable for parquet, cork and terracotta

[21] KALWEIT A. (2012) - Handbook of technical product design - materials and manufacturing. Berlin: Springer Verlag

[22] Osmo (2019) - Osmo Hard Wax Oil 3032 satin, 3062 matte <https://www.osmo.de> Accessed, on 03/02/2019

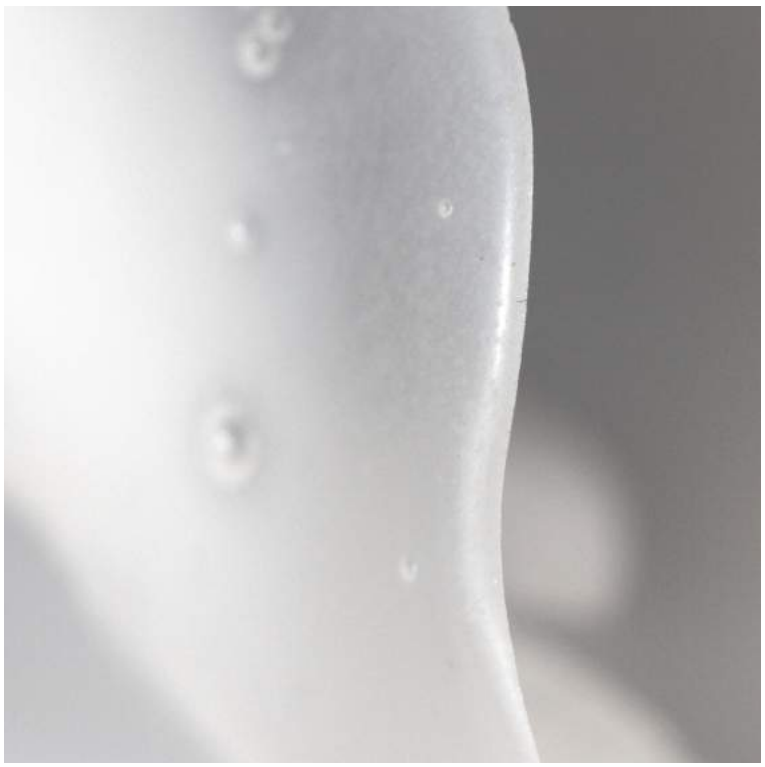
Tab. 8 B: Material data sheet, Osmo, hard wax oil, specific[23][24]

General description		
Certifications/Information	ISO 9001, ISO 14001, ISO 18001	
Emission class (formaldehyde)	Formaldehyde-free	
VOC's	< 500 g/l (volatile components emit during curing)	
Delivery forms	Liquid	
Color	yellowish (transparent/yellowish in cured form)	
Texture	Glossy to matt (cured)	
Contents		
50 - 60 % solids	Natural oils and waxes (sunflower oil, soybean oil, safflower oil, carnauba and candellila wax) Paraffins	
Additives	Siccatives (desiccants) and water-repellent additives	
Solvent	Desaromatized white spirit (gasoline-free - according to the purity requirements of the European Pharmacopoeia)	
Life cycle assessment data hard wax oil (GER)		5
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	n.a.	
Use of freshwater resources (FW)	n.a.	
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	n.a.	
Environmental impact Transport, per 1000 kgkm		9
Production site: Germany/ZEITRAUM		
Truck - ca. 200 km	A4	10
Total non-renewable primary energy (PENRT)	172,12 MJ	
Use of freshwater resources (FW)	0,012106 m^3	
Global Warming Potential (GWP)	12,822 Kg CO_2-eqv.	
Main raw material origin: n.a./production site		
n.a. - ø 3000 km	A4	8
Total non-renewable primary energy (PENRT)	3624 MJ	
Use of freshwater resources (FW)	0,19164 m^3	

[23] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

[24] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Global Warming Potential (GWP)	296,07 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable/repairable (> 20 years, with good care)	10
Biological reproduction/ recycled material	51 - 60 %	6
Circulation potential	100 % (biodegradable)	10
Socially compatible	Yes	10
Total average rating		**8,33**
Processing		
Application	With brush, spatula or spray gun	
Storage	Can be stored up to 5 years with tight closure	
Properties		
Density	0,89 g/cm³	
Viscosity	Thixotropic, creamy	
Consistency	Medium viscosity	
Moisture resistance	Good	
Notes	Osmo Polyx®-Oil is based on natural vegetable oils and waxes; Osmo Polyx®-Oil contains neither biocides nor preservatives. It is harmless to humans, animals and plants when dry and complies with DIN 53160 (sweat- and saliva-proof) and EURO-NORM EN 71 (suitable for children's toys)	



9 PVAc dispersion adhesive, D3

64 %

Tab. 9 A: Material data sheet, PVAc dispersion adhesive, D3, general[25][26]

Material group	Synthetic material; adhesives; dispersion adhesives
Name	Dispersion Adhesive (GB, US); Dispersionsklebstoff, PVAc-(Polyvinylacetat) Klebstoffe, Weißleim (D)
Manufacturer	Kleiberit Klebstoffe GmbH
Manufactured in	Germany (GER)
Version	Kleiberit 303, D3-adhesive
Use	Furniture construction; especially for interiors; staircase construction, ship interior finishing; surface bonding of HWS; door and window production

[25] KALWEIT A. (2012) - Handbook of technical product design - materials and manufacturing. Berlin: Springer Verlag

[26] KEIBERIT (2019) - KLEIBERIT 303, D3, PVAC Adhesive <https://interior-construction.kleiberit.com/fileadmin/Content/Documents/DE/Infoblaetter/303_D3_Leim_D.pdf> Accessed, on 02/03/2019

Tab. 9 B: Material data sheet, PVAc dispersion adhesive, D3, specific[27][28]

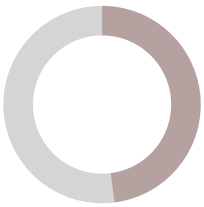
General description		
Certifications/Information	ISO 9001, ISO 14001, ISO 50001	
Emission class (formaldehyde)	Formaldehyde-free	
Delivery forms	Liquid	
Color	Whitish (transparent in cured form)	
Texture	Glossy	
Life cycle assessment data Dispersion-based solvent-free adhesives, coatings and sealants (GER)		10
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	26,7 MJ	10
Use of freshwater resources (FW)	0,00758 m³	10
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	0,955 Kg CO_2-eqv.	10
Environmental impact Transport, per 1000 kgkm		6,5
Production site: Germany/ZEITRAUM		
Truck - ca. 200 km	A4	10
Total non-renewable primary energy (PENRT)	172,12 MJ	
Use of freshwater resources (FW)	0,012106 m³	
Global Warming Potential (GWP)	12,822 Kg CO_2-eqv.	
Main raw material origin: n.a./production site		
n.a. - ø > 7000 km	A4	3
Total non-renewable primary energy (PENRT)	8456 MJ	
Use of freshwater resources (FW)	0,44716 m³	
Global Warming Potential (GWP)	627,83 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable/moderately repairable (> 20 years)	9
Biological reproduction/ recycled material	0 %	0
Circulation potential	Only thermally recyclable	4
Socially compatible	Yes	9

[27] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

[28] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Total average rating		**6,41**
Processing		
Adhesion	With brush, spatula or glue roller	
Properties		
Density	1,1 g/cm³	
PH level	3	
Consistency	Medium viscosity	
Moisture resistance	D3	
Heat resistance	Up to 120 °C	
Notes	PVAc adhesive is available solvent-free and solvent-based	

10 PUR adhesive



48 %

Tab. 10 A: Material data sheet, PUR adhesive, general[29][30]

Material group	Synthetic material; adhesives; polyurethane adhesives
Name	Polyurethane-Adhesive (GB, US); Polyurethan Klebstoff (D);
Manufacturer	beko GmbH
Manufactured in	Germany (GER)
Version	Fibcon 15
Use	Furniture construction, or similar; joining wood, ODB, MDF, chipboard, fiberboard, coated board, natural stone, artificial stone, concrete, acrylic, ceramics, gypsum board, foam (EPS), rigid foam, insulation, etc.; Indoor and outdoor

[29] KALWEIT A. (2012) - Handbook of technical product design - materials and manufacturing. Berlin: Springer Verlag

[30] Beko (2019) - Fibcon 15, Beko <https://www.beko-group.de/Produkte/(location)/1415-260-100-501-Fibcon-PU-Fiber-Glue> Accessed, on 03/02/2019

Tab. 10 B: Material data sheet, PUR adhesive, specific[31][32]

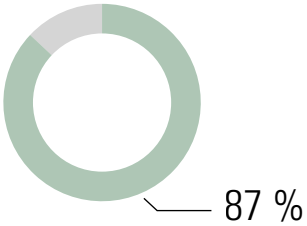
General description		
Certifications/Information	n.a.	
Emission class (formaldehyde)	Formaldehyde-free, no volatile components	
Delivery forms	Liquid, viscous	
Color	Yellowish	
Texture	Glossy	
Smell	Low smell	
Life cycle assessment data Polyurethane-based adhesives and sealants, unfilled/solvent-free, polyol-containing (GER)		0
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	119 MJ	0
Use of freshwater resources (FW)	2,68 m^3	0
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	5,87 Kg CO_2-eqv.	0
Environmental impact Transport, per 1000 kgkm		6,5
Production site: Germany/ZEITRAUM		
Truck - ca. 200 km	A4	10
Total non-renewable primary energy (PENRT)	172,12 MJ	
Use of freshwater resources (FW)	0,012106 m^3	
Global Warming Potential (GWP)	12,822 Kg CO_2-eqv.	
Main raw material origin: n.a./production site		
n.a. - ø > 7000 km	A4	3
Total non-renewable primary energy (PENRT)	8456 MJ	
Use of freshwater resources (FW)	0,44716 m^3	
Global Warming Potential (GWP)	627,83 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Very durable/moderately repairable (> 20 years)	9
Biological reproduction/ recycled material	0 %	0
Circulation potential	Only thermally recyclable	4

[31] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

[32] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Socially compatible	Yes	9
Total average rating		**4,75**
Processing		
Adhesion	With brush, spatula	
Properties		
Durability	6 months	
Wood moisture	8 - 18	
Consistency	Medium viscosity	
Moisture resistance	Indoor and outdoor	
Heat resistance	- 40 to 120 °C	
Notes	Fiber-reinforced, with "reinforcement", waterproof bonding, resistant to weathering and aging, solvent-free, resistant to many chemicals; can probably cause cancer	

11 Cardboard, chairs



Tab. 11 A: Cardboard, chairs, general

Material group	Packaging
Name	Cardboard (GB, US); Karton (D)
Manufacturer	Schuhmacher Packaging GmbH
Manufactured in	Germany (GER)
Use	Packaging material for the production of cardboard boxes

Tab. 11 B: Cardboard chairs, specific[33][34]

General description		
Certifications/Information	ISO 9001, ISO 50001, DIN ISO 22000, DIN EN ISO 14001, EMAS, ISO 28000;2007, FSC	
Color	Brown	
Texture	matt	
Contents		
85 %	Recycled paper	
15 %	Primary raw material	
Life cycle assessment data „Kraftpapier" (GER)		10
Resource input per kg	**A1-A3**	
Total non-renewable primary energy (PENRT)	5,888 MJ	
Use of freshwater resources (FW)	0,004899 m^3	
Environmental impact per kg	**A1-A3**	
Global Warming Potential (GWP)	-0,8973 Kg CO_2-eqv.	
Environmental impact Transport, per 1000 kgkm		9
Production site: Germany/ZEITRAUM		
Truck - ca. 200 km	A4	10
Total non-renewable primary energy (PENRT)	172,12 MJ	
Use of freshwater resources (FW)	0,012106 m^3	
Global Warming Potential (GWP)	12,822 Kg CO_2-eqv.	
Main raw material origin: Germany, Central Europe/Production site		
Truck - ca. 1500 km	A4	8
Total non-renewable primary energy (PENRT)	1812 MJ	
Use of freshwater resources (FW)	0,09582 m^3	
Global Warming Potential (GWP)	134,535 Kg CO_2-eqv.	
Sustainability Assessment		
Longevity	Moderately durable/repairable (< 10 years)	4
Biological reproduction/ recycled material	85 %	9

[33] BMI 2021: Oekobaudat. Database <https://www.oekobaudat.de/no_cache/en/database/search.html> Accessed, on 10/27/2021

[34] MATERIALARCHIV (2019) - Materialarchiv <http://www.materialarchiv.ch/app-tablet/#search> Accessed, on 03/01/2019

Circulation potential	100 % (technological)	10
Socially compatible	Yes	10
Total average rating		**8,66**
Disposal note	Waste paper	

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