

Environmental Declaration of Cold Rolled 1.4301 Stainless Steel

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Description of the company and the product

Outokumpu is one of the world's largest stainless steel producers, with annual net sales of almost EUR 3.5 billion. The business employs some 9000 people. The plants in Finland, Sweden, U.K. and the US produce a wide range of stainless steel products including hot and cold rolled, precision strip, tubular and long products together with a comprehensive range of fittings, flanges and welding consumables. They are available in various grades, dimensions and surface finishes. Main products are cold and hot rolled stainless steel coils.

Stainless steel melting shops are located in Finland, Sweden and United Kingdom.

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Product Description

The austenitic 1.4301 stainless steel (AISI 304) has good resistance to atmospheric corrosion and to many organic and



Fig. 1. Outokumpu stainless steel strip

Chemical composition

	C	Si	Mn	P	S	N	Cr	Ni	Fe
Min (%)							17.0	8.0	Bal.
Max (%)	0.07	1.0	2.0	0.045	0.015	0.11	19.5	10.5	

inorganic chemicals. It has good formability characteristics. The most common surface finish is designated 2B, meaning that the product is cold rolled, heat treated, pickled and skin passed. The 2B surface finish has good corrosion resistance, smoothness and flatness. The properties and dimensions of Outokumpu 1.4301 stainless steel are shown in Table 1. The product is marked with designations in accordance with European standards (e.g. EN 10088).

Properties and dimensions of Outokumpu 1.4301 stainless steel

Typical mechanical properties for plate

Table 1a

Yield strength 0.2% MPa	Tensile strength MPa	Elongation in 50 mm %
290	600	55

Dimension of cold rolled 2B sheet and plate

Table 1b

Thickness mm	Width mm	Length mm
0.42...8.0	100...2000	240...13500

Content Declaration

The main raw materials used are stainless steel scrap and carbon steel scrap, ferrochrome and nickel. The chemical composition of 1.4301 stainless steel is shown in Table 2. In accordance with directive 2002/95/EC (hazardous substances in electrical and electronic equipment) and directive 2000/(53)/EC (end-of-life vehicles) no lead, mercury, cadmium, hexavalent chromium, PBB or PBDE has been added in the manufacturing process of the stainless steel.

Life Cycle Inventory

A stainless steel life cycle inventory was performed in 1997 (European LCI database, 2001), using data from manufacturing sites. Ferrochrome and nickel LCI studies were carried out at the same time and their data was included in the stainless steel LCI. Other upstream data was sourced from databases and literature. The methodology of the LCI study was in compliance with the ISO 14040 and ISO 14041 standards.

Table 2

System Boundaries

The boundaries of the industrial system considered covered the production steps from the raw materials to the finished products (Figure 2). The manufacture of downstream products, their use and end of life were not taken into account. Data concerning (1) packaging (except for the interleaving paper) (2) landfill sites which receive stainless steel workshops waste (3) scrap recovery and processing outside the steelworks and (4) soil emissions were not included in the LCI study. Scrap transport to the site was included in the study.

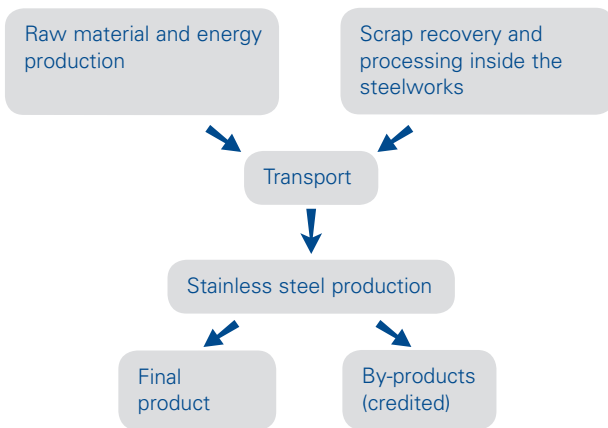


Fig. 2. System Boundaries

Functional Unit

The functional unit is 1000 kg 1.4301 2B stainless steel. The total production of slabs in Outokumpu Stainless plants in 1997 was 1 350 000 tonnes.

Environment Performance

Manufacturing Phases

The manufacturing phases of stainless steel are shown in Figure 3. The steel is melted in the furnace and refined

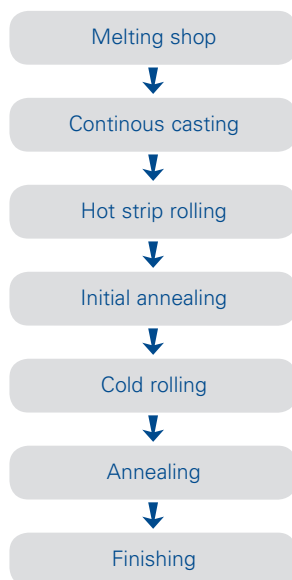


Fig. 3. Stainless steel manufacturing phases

in the converter. The stainless steel that has been cast into slabs is hot rolled into thinner and longer steel strips. In the cold rolling process the dimensions are further reduced. The material is softened by annealing and the surface is cleaned by pickling.

Description Of Use Phase

Outokumpu's main markets for stainless steel are within Europe (70% of net sales), Asia (19%) and North and South America (9%). Stainless steel is mainly used in process industries, such as pulp, paper and the chemicals industry, vehicle manufacture and the building and construction industry (Figure 4).

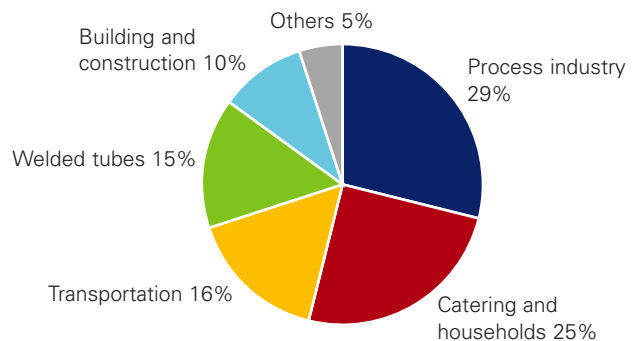


Fig. 4. End-uses of stainless steel

The finished product is transported from the mills mainly by truck (Figure 5). The aim is to increase the proportion of rail transports used, but the great range of destinations makes this difficult, in some cases.

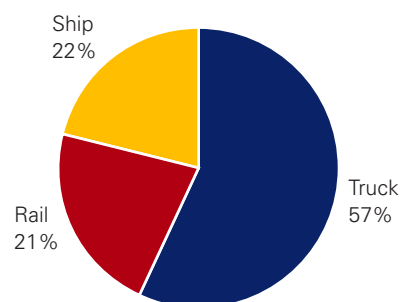


Fig. 5. Means of transport of final product

The durability and corrosion resistance of stainless steel helps to save resources since the material does not have to be replaced for a long time. Its corrosion resistance also prevents metals from leaching into the environment. Studies on 1.4301 stainless steel, exposed to an urban environment showed that the concentrations of Cr, Ni and Fe in runoff waters from the stainless surfaces were far below the concentration limits for drinking water and reported ecotoxicity values for plants and organisms. Yearly metal release rates of Cr, Ni and Fe were 0.2-0.6, 0.1-0.5 and 10-140 mg/m², respectively (Wallinder et al., 2004).

Recycling And End-Of-Life Information

The life expectancy of Stainless steel products depends on the final product or application. Since the product is used in several different end-use sectors, end-of-life scenarios are not included in this declaration. The average service time of a stainless steel product has been estimated at between 15 and 20 years, but will vary depending on application. For example, the product lifetime for electrical and electronic equipment it is generally estimated to be about 10 years whilst for construction and tableware it is generally estimated to be about 30 years. (Nickel Institute, 2005) An essential parameter in the life cycle is the recycling rate. Stainless steel is virtually 100% recyclable, and steel is the most recycled material in the world. All Outokumpu's stainless steel plants use recycled material as their main raw material. However, there is not enough scrap containing nickel and chromium on the

market to satisfy the demand for production of new stainless steel. Consequently, virgin ore is invested in the future steel cycle. Disposal of stainless steel to landfill is not harmful to the environment, but it is a waste of resources.

Environmental Performance Data

Table 3 summarizes the main resource uses, emissions and waste generation of Outokumpu 1.4301 stainless steel production within the system boundaries. The amount of scrap or secondary raw material used significantly affects the environmental impact. The higher the stainless scrap input, the less virgin resources are used. Steelmaking is highly energy intensive and consumed energy is one of the most important environmental impacts. The sites are constantly working on their energy efficiency and significant improvements have been achieved in the last decades.

Environmental Performance Data for 1000 kg 1.4301.

All data is cradle-to-gate unless otherwise specified, i.e. raw material production is included

Table 3

Resource use	Non renewable resources without energy content (total)	976	kg
	Chromium (Cr, ore)	180	kg
	Nickel (Ni, ore)	61	kg
	Iron (Fe, ore)	171	kg
	Non renewable resources with energy content	1849	kg
	Coal (in ground)	1176	kg
	Natural gas (in ground)	230	kg
	Oil (in ground)	444	kg
	Water (excl. surface water)	35390	kg
	Recycled material (scrap)	702	kg
	Renewable energy	2920	MJ
	Non renewable energy	60552	MJ
	Electricity	5753	MJ
	Pollutant emissions	Greenhouse gases	
CO ₂ equivalents		6400	kg
Ozone depleting gases			
CFC-11 equivalents		0.00022	kg
Acidifying gases			
H ⁺ equivalents		1924	mol
Gases creating ground-level ozone			
Ethene equivalents		1.7	kg
Substances contributing to oxygen depletion			
O ₂ equivalents		240	kg
Specific substances to air (gate-gate data)			
NO _x as NO ₂		1455	g
SO _x as SO ₂		66	g
Cd		0.10	g
Cr		13	g
Hg		0.17	g
Ni		5.7	g
Pb		5.6	g
Zn		16	g
Particulates		292	g
Specific substances to water (gate-gate data)			
Cr	2.2	g	
Ni	1.8	g	
Zn	0.8	g	
Oil	0	g	
Suspended material	133	g	
Waste generation	Hazardous waste	0.7	kg
	Total waste	6420	kg

Environmental Management

Managing environmental issues is an integral part of Outokumpu's daily business. The Avesta and Tornio sites are already certified to the environmental standard ISO 14001, whilst work is ongoing to certify the Sheffield site by the end of 2005.

References

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Wallinder IO, Bertling S, Herting G and Leygraf C. 2004. Release rates of chromium, nickel and iron from pure samples of the metals and 304 and 316 stainless steel induced by atmospheric corrosion – A combined field and laboratory study. Acom 2/2004.

Outokumpu is a dynamic metals and technology group with a clear target to become the number one in stainless steel. Customers in a wide range of industries use our metal products, technologies and services worldwide. We are dedicated to helping our customers gain competitive advantage. We call this promise the Outokumpu factor.

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