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LCA METHOD – USEFUL TOOL IN STEEL PRODUCTION INDUSTRY

LCA METOD – KORISTAN ALAT U INDUSTRIJI ČELIKA

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ABSTRACT

Today global steel producers give increased emphasis on protecting the environment and deploy into production and supporting the activities of the so-called concept of sustainable development, which is reflected particularly in the implementation of environmental management systems.
In the work a short review of the World and Slovenian steel production, and the state in the biggest steel producer (steelwork) in Slovenia is presented.
In the frame of our study is discussed in detail life cycle assessment (LCA) method, and especially its advantages and disadvantages.
We analyzed potential application of LCA for the Slovenian steel producers, especially the case of ACRONI d.o.o..

Keywords: steel production, environment, LCA, environmental management

SAŽETAK

Danas globalni proizvođači čelika daju veći naglasak na zaštiti okoliša i implementaciji koncepta održivog razvoja u proizvodnji odnosno implementaciji sistema upravljanja okolišem.

U radu je dat kratki pregled proizvodnje čelika u svijetu i Sloveniji odnosno stanje u najvećem proizvođaču čelika (Željezari) u Sloveniji.
U okviru istraživanja detaljno je opisana metoda ocjene životnog ciklusa (LCA), sa osvrton na prednosti i nedostatke. Analizirana je potencijalna primjena LCA za slovenske proizvođače čelika, posebno u slučaju Acroni doo.

Ključne riječi: proizvodnja čelika, okoliš, LCA, upravljanje okolišom

1. INTRODUCTION

Steel touches every aspect of our lives. No other material has the same unique combination of strength, formability and versatility) [1,2].
Steel is a perfect and everlasting material, unlimited in its practicality and possibility for upgrading. It is the only material which can be recycled to one hundred per cent (Figure 1) [3].

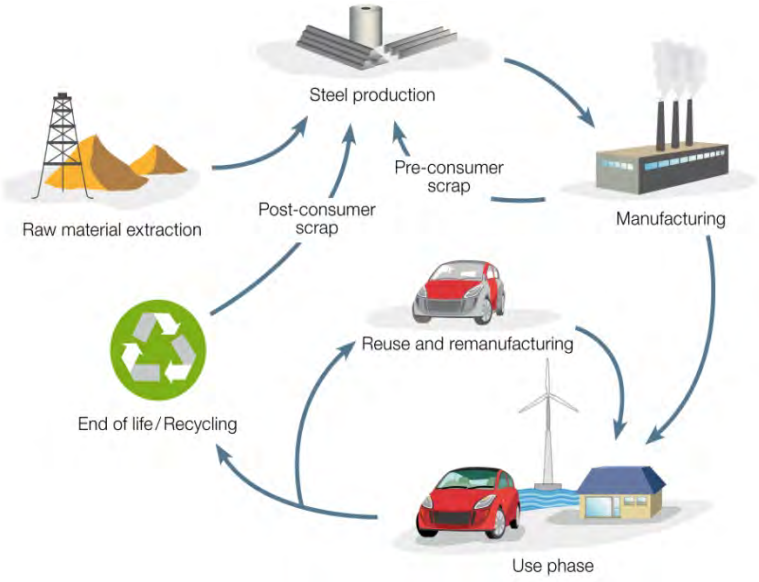

Figure 1. The life cycle of steel) [3].

Due to its versatile applicability it is a reliable partner in various fields, such as construction, mechanical engineering, automotive industry, ship-building, production of pipes, home appliances and so on [4]. The variety of advantages of steel products range from technical, such as material strength and high production technology, economical as steel ensures quick and easy construction, fast assembly and fast installation, to advantages as regards safety as it enables low weight and anti-seismic construction [5]. Due to its aesthetic advantages it is also often used for thin and light construction, and is cherished for its simplicity. The possibility of recycling steel to 100 % also presents a significant environmental advantage [6].

2. WORLD STEEL PRODUCTION

The amount of energy required to produce a 1 tonne of steel has been reduced by 50% in the last 30 years. All steel created as long as 150 years ago can be recycled today and used in new products and applications. By sector, global steel recovery rates for recycling are estimated at 85% for construction, 85% for automotive, 90% for machinery and 50% for electrical and

domestic appliances. Leading to a global weighted average of over 70%. Nowadays, 97% of steel by products can be reused [3].
In the 1970s and 1980s, modern steel plants needed an average of 144 kg of raw materials to produce 100 kg of steel. With investments in research, technology improvements and good planning, the steel industry today uses only 115 kg of inputs to make 100 kg of steel – a 21% reduction. Steel is a key driver of the world's economy (see Table 1). World crude steel production: From 28.3 megatonnes (Mt) in 1900 to 851 Mt in 2001 to 1527 Mt in 2011. The World production of steel in year 2012 was 1510 Mt, in EU27 was production of steel in year 2012 169.4 Mt (production stagnated), and in China 708.8 Mt. For example: average Slovenian steel production in last 10 years is approximately 640.000 tonns per year [3].
World steel industry directly employs 2 million people worldwide, with a further 2 million contractors and 4 million in supporting industries. As key product supplier to industries such as automotive, construction, transport, power and machine goods, steel industry has employment multiplier of 25:1. Steel industry is at the source of employment for more than 50 million people. World average steel use per capita has steadily increased from 150 kg in 2001 to 220 kg in 2010.
Today global steel producers give increased emphasis on protecting the environment and deploy into production and supporting the activities of the so-called concept of sustainable development, which is reflected particularly in the implementation of environmental management systems.

Table 1. World steel production for the period 1970-2013[3].

Year	*World steel production (Mt)*
1970	*595*
1975	*644*
1980	*717*
1985	*719*
1990	*770*
1995	*752*
2000	*849*
2005	*1144*
2010	*1414*
2011	*1527*
2012	*1510*
2013	*1607*

Under green economy steel industry has to be sustainable on 3 levels:

- financially sustainable,
- socially sustainable, and
- environmentally sustainable.

The most used and established method for detecting the effects of the product on the environment is a method of life cycle assessment (LCA), which analyzes the effects of the product on the environment in all its life stages (design, materials selection, manufacture, use, and ultimately its removal), and is an important tool when we deciding on choosing and optimizing the technology and raw materials [7,8,9].

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3. SLOVENIAN STEEL PRODUCTION

The biggest owner of the Slovenian Steel Group (SIJ) and at the same time of the Slovenian steel industry is Russian company KOKS (which is majority owned by the Zubitskiy family). On January 1st.2014, the parent company SIJ had the ownership presented in Table 2 [10].

Table 2. Shareholders[10].

Shareholders	*Number of shares*	*% of ownership*
OAO KOKS	*718.351*	*71.2239*
Republic of Slovenia	*248.655*	*25.0001*
D.P.R. d.d.	*21.468*	*2.1530*
Others	*16.142*	*1.6230*

The SIJ (Slovenian Steel Group) is one of the largest business groups in Slovenia according to both income and the number of employees, and such is one of the key elements of Slovenian economic development. The biggest steel producer (steelwork) in this group is ACRONI [10].

Vision and Strategy: SIJ will continue orientation towards constant improvement of the technology, production processes and logistics, and they will also intensively build our their sales network to maintain and increase our market share in the EU and worldwide.

The production range of Slovenian Steel Group (and ACRONI), comprises products of a flat and long steel program and forgings made of high quality steel in an electric arc furnace and vacuum metallurgy processes with a high processing rate. The steel grades produced can be divided into 5 basic groups [10]:

- structural steel,
- tool and high-speed steel,
- stainless steel,
- electrical sheets, and
- other special steel.

4. STEELWORK ACRONI AND ENVIRONMENT

ACRONI is a niche producer of flat-rolled stainless and special steels which are produced as quarto heavy plates and hot and cold rolled coils (Figure 3). Annual production of ACRONI in year 2013 was approximatelly 450.000 tonnes (approx. 70% of whole Slovenian steel production). ACRONI exports more than 80% of its products, and it is the biggest supplier of stainless steel quarto plates in Europe [10].

ACRONI's goals:

- to exercise customer demands,
- constant development of new products and technologies,
- putting research achievements into practice, and
- innovations as a part of business strategy.

ACRONI services [10]:

1. Chemistry: Sector of Chemistry operates within the ACRONI and is responsible for the quality of the field of chemical analysis. It includes a workshop laboratory preparation of samples, the chemical laboratory and a laboratory for the monitoring of steel production in the steel plant. In the field of environmental protection to monitor the operation of industrial waste water treatment plants, waste-water monitoring is performed and produced estimates of the waste to the needs of businesses, as well as for external customers.

2. Technical control: The laboratory is competent to carry out the mechanical and technological tests in accordance with the applicable standards SIST, EN, DIN and ISO. Mechanical tests, in most cases supplemented by chemical and metallographical investigation, which knowledge of the properties of metallic materials rounded off.
3. Research and development: The tradition of steel producing in ACRONI presents support for our activities but its also a great obligation for the future development. The inherited knowledge and experiences we have enriched with new knowledge and efforts are promise that they will continue their successful work [10].

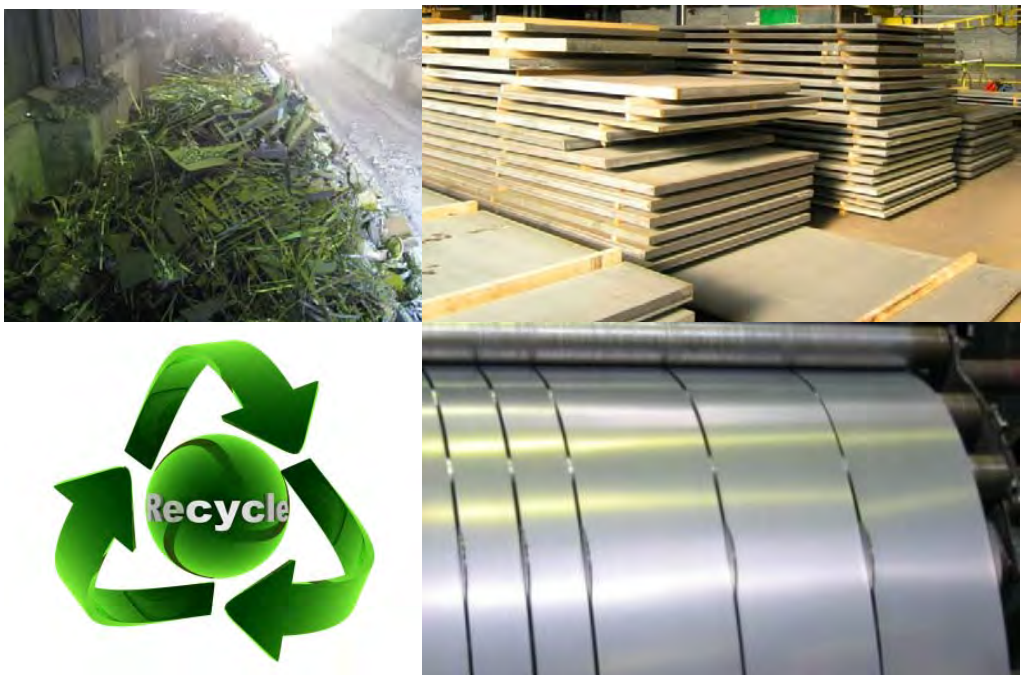

Figure 2. ACRONI production: from steel scrap to final products.

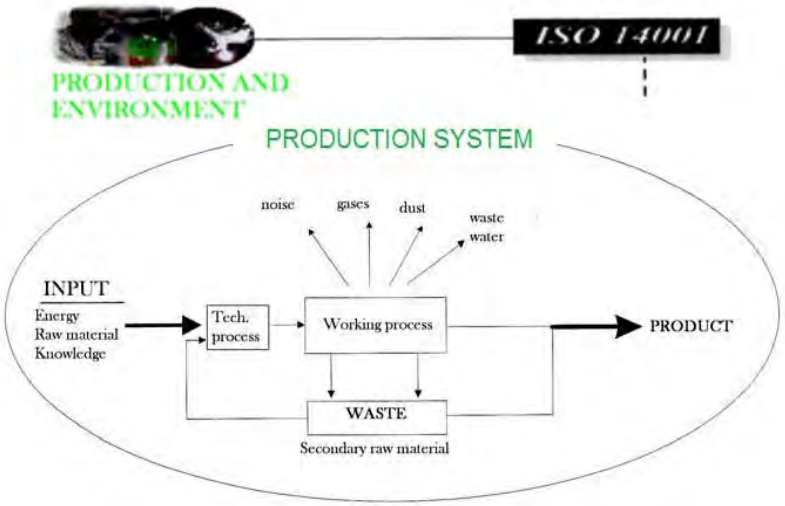

Figure 3. Production system according to the international standard ISO 14001[11].

For centuries, ACRONI has been manufacturing high-quality steels that have been successfully selling on the most demanding markets. Gradually reduced environmental impacts and protection of environment has become one of the priorities of company's strategy. ACRONI's environmental awareness constantly grows, what can be proven with international standards ISO 14001 (Figure 3), which gives the requirements for environmental management systems, confirms its global relevance for organizations wishing to operate in an environmentally sustainable manner, and OHSAS 18001, an international occupational health and safety management system specification. They introduce environmentally friendly technological processes that have the least impact on the environment. Equal attention is devoted to the management of energy sources. In ACRONI they constantly monitor emissions of wastes, gasses and waste waters.

5. LIFE CYCLE ANALYSIS

What is a product's life cycle? Simply stated, the life cycle of a product embraces all of the activities that go into making, transporting, using and disposing of that product. The typical life cycle consists of a series of stages running from extraction of raw materials, through design and formulation, processing, manufacturing, packaging, distribution, use, reuse, recycling and, ultimately, waste disposal.

What is LCA? Life cycle assessment (LCA) involves the evaluation of some aspects - often the environmental aspects - of a product system through all stages of its life cycle. Sometimes also called "life cycle analysis", "life cycle approach", "cradle to grave analysis" or "Ecobalance", it represents a rapidly emerging family of tools and techniques designed to help in environmental management and,l onger term, in sustainable development.

Environmental-energetic analyisis of the process which is the base for Life cycle assessment (LCA) is the same for the bank and steelwork (Figure 4).

Figure. 4. Environmental-energetic analysis of the process [2] .

In the year 2011 the steel producer ACRONI was invited to cooperate in the project of life cycle assessment (LCA) for the two groups of steel grades 304 and 316.

For the project has been used the standard software for LCA analysis GaBi. The aim of the project was to show that steel producing industry knows how important is the synergy between steel producer and society.

Rational handling and manipulation with materials and resources considering two main principles: reduction of consumption of natural and unrenewable resources, and reduction of

pressure on environment, when materials and products become unapplied and transformed into a waste.
Advantage of a steel producers (steelworks) is in the fact that its products are 100 % recyclable at the end of their life cycle.

6. CONCLUSIONS

A short review of the World and Slovenian steel production, and the state in the biggest steel producer (steelwork) in Slovenia is presented.
In the frame of our study is discussed life cycle assessment (LCA) method in the praxis the most used and established method for detecting the effects of the product on the environment. We analyzed potential application of LCA for the Slovenian steel producers, especially the case of ACRONI, the biggest steel producer in Slovenia. Heavy plates of two typical steel grades from ACRONI production program were analysed during the pilot project.

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