

HISTORICAL SURVEY OF IRON AND STEEL PRODUCTION IN BOSNIA AND HERZEGOVINA

ZGODOVINSKI PREGLED PROIZVODNJE ŽELEZA IN JEKLA V BOSNI IN HERCEGOVINI

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Cast-iron and steel production facilities were, and still are, frequently located on sites with deposits of iron ore and coal. The center of steel metallurgy in Bosnia and Herzegovina, and of the former Yugoslavia, is located in the Iron and Steel Plant Zenica, today known as Arcelor Mittal Zenica. In this paper the beginning, the development and the planned growth of the iron and steel plant in Zenica is presented with periods of success and periods of crisis.

Key words: Iron and Steel Plant Zenica, development, pig iron, steel.

Proizvodne naprave za grodelj in jeklo so pogosto zgrajene na ležiščih železove rude in premoga. Središče proizvodnje jekla v Bosni in Hercegovini ter v nekdanji Jugoslaviji je bilo v Železarni Zenica, danes Arcelor Mittal Zenica. V tem sestavku so predstavljeni začetek, razvoj in načrtovana rast Železarne Zenica z obdobji krize in uspeha.

Ključne besede: Železarna Zenica, razvoj, grodelj, jeklo

1 INTRODUCTION

Metal materials based on iron have been used for millennia; first as natural iron metal and then extracted from iron ores¹. Pig iron is produced in blast furnaces and is the basis for steel production, with a share of more than 60 %. Pig iron is produced from ores with 40 % to 65 % Fe. Besides the content of iron, the possibility of using it in a blast furnace without previous ore processing is of essential importance².

Steel is an alloy that can be plastically worked; it is of strategic importance for every country and has many applications³. Its wide range of technological and mechanical properties make steel the most important metallic material with a steady growth in annual production. Today's technical society would not be possible without steel, which is produced in an annual quantity that is five times greater than the total production of all the other metallic materials⁴.

2 HISTORICAL SURVEY

The Iron and Steel Works Zenica is the basis of the Bosnian and Herzegovinian (BH) economic mosaic, with a development based on the advantages determined by its location and which are the basis for the future technological development: the millennium tradition of iron production, the location and the natural advantages of its central location in BH, the deposit of quality coal, the proximity of the Vareš iron-ore deposit and the

advantage of road and railway communications along the Bosna valley.

The concession for the erection of the Ironworks Zenica was given in 1892 to the Austrian industrialists Leon Bondy (Prag), Moritz and Adolf von Schmit (Wilhemsburg) and Hans von Peng (Thorl). The first production facilities were erected in a single year, and in 1893 the production of small profiles and wire rod was started. The official name of the company was Eisen und Stahlgewerkschaft Zenica.

In the rest of the paper a review of the iron works is given for the period 1892–2008, with the emphasis on different stages. In 1898 the owners formed the share company Eisenindustrie – Aktiengesellschaft Zenica, with the aim to strengthen the company, and the increased capital and profit enabled the further construction and modernization of the production facilities in the period 1898 to 1913. In 1908 the iron works became a member of the Central European cartel of the metallurgical industry. A maximum production of 38 583 t of steel was achieved in 1912, and this was not exceeded until 1936, when a substantial enlargement of the production facilities was introduced. In 1936 the Kingdom of Yugoslavia backed the restructuring and the enlargement of the production facilities for steel. In this year, the characteristic growth of production facilities by stages was started with the erection of the rolling mill for heavy profiles. The production increased to 80 000 t of steel, and more than 72 000 t of final rolled products.

In the period of capital erection from 1947 to 1958, in the time of Socialist Yugoslavia, the Ironworks Zenica

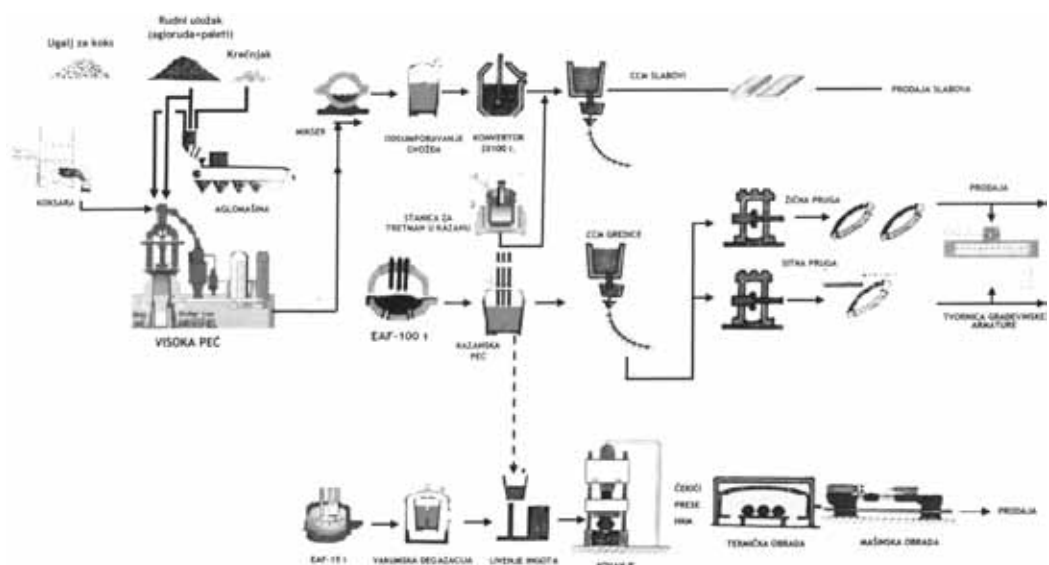


Figure 1: Technological scheme of the integrated production of steel in the Ironworks Zenica (2007)
Slika 1: Tehnološka shema integrirane proizvodnje jekla v Železarni Zenica (leto 2007)

was enlarged with the erection of the integrated process, and by the 60th year the project to build facilities with an annual production of 265 000 t of steel was prepared. This program was planned to be realized in three stages.

The production facilities enlarged in the period from 1892 to 2008 occurred in several stages. As an integrated steel producer, it includes all the processing stages: the production of coke, agglomerate, pig iron, steel, power stations and steel transformation to final products with hot rolling and forging.

3 STAGES OF DEVELOPMENT OF THE IRONWORKS ZENICA

The stages of development are shown by year together with the annual production for all works and for 110 years of activity. In this period of time the name and the owners changed, and presently the name is Arcelor Mittal Zenica.

1892–1893

*Erection and revamping of production facilities
 35 000 t per year*

Erection of 2 puddling furnaces, 2 rolling mills, drives and the boiler

1895–1898

55 000 t per year

Completion and reconstruction of production facilities. Erection of 3 Siemens-Martin (SM) furnaces with a capacity of 15 t, electrical power station and a new light profiles rolling mill (**Figures 4, 5, 6 and 7**).

1936–1940

Erection of the heavy rolling mill, 2 SM furnaces of capacity 40 t and 50 t, electric arc furnace of capacity 3 t, drive generators and the mechanical workshop 100 000 t per year



Figure 2: The Ironworks Zenica in 1895
Slika 2: Železarna Zenica leta 1895

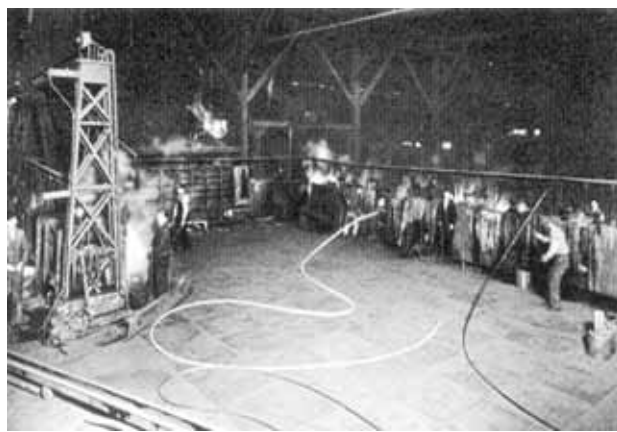


Figure 3: Light rolling mill at the beginning of the 20th century
Slika 3: Lahka valjarna v začetku XX. stoletja

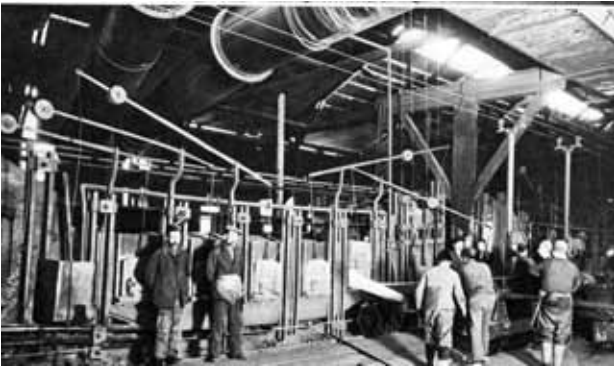


Figure 4: Heating furnaces for the light rolling mill before the First World War

Slika 4: Ogrrevne peći za lahko valjarno pred prvo svetovno vojno



Figure 6: Ore bedding with a view of the blast furnaces

Slika 6: Rudni dvor s pogledom na plavž



Figure 5: Taking specimens from the SM furnace before the First World War

Slika 5: Odvzem vzorcev iz SM-peći pred prvo svetovno vojno

1947–1958

Pig iron: 600 000 t per year

Steel 75 000 t per year

Finished rolled and forged products 540 000 t

Erection of:

- 4 coke batteries with 39 furnaces per battery, with an annual capacity of 650 000 t and with auxiliary facilities,
- the complex of blast furnaces consisting of the ore treatment with a capacity of 400 000 t of burden materials, agglomeration with 8 Greenwald pans with surfaces of 22 m² and a capacity of 800 000 t per year of agglomerate,
- 3 blast furnaces with volumes of (850, 750 and 800) m³ and a capacity of 600 000 t of pig iron,
- the new steelworks with 4 fixed SM-furnaces with a capacity of 70 t, 4 tilting 180 t SM furnaces and the 10 t electric arc furnace,
- complex of rolling mills with a Blooming mill, a continuous mill for half products and 3 finishing rolling mills: medium, light and wire rod rolling mills,
- forging shop with presses of 6 MN, 18.5 MN and 51 MN, hammers and the rolling mill for rings and wheels,

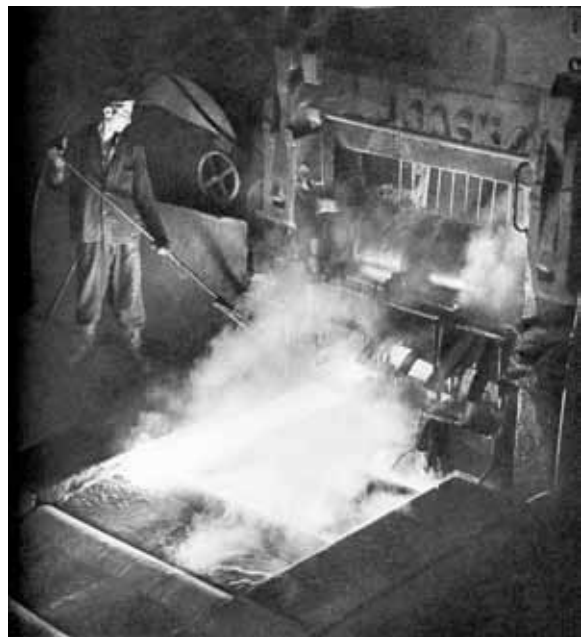


Figure 7: Medium rolling mill

Slika 7: Srednja valjarna



Figure 8: Manual charging of additions in the SM furnace

Slika 8: Ročno zakladanje dodatkov v SM-peč



Figure 9: Charging of ingots in the pit furnace
Slika 9: Zakladanje ingotov v talno peč



Figure 12: Heavy forging piece on the 18.5 MN press
Slika 12: Težak odkovek na preši 18,5 MN

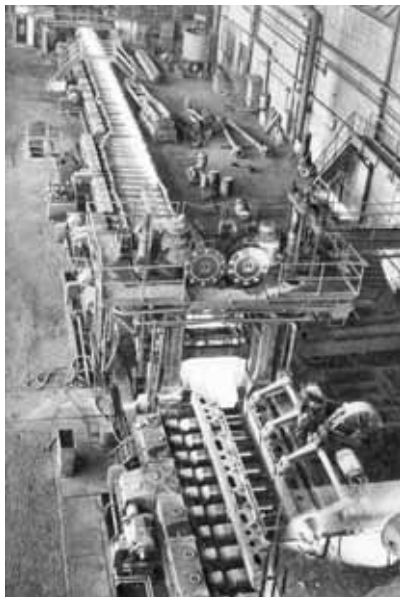


Figure 10: Rolling on the Blooming rolling mill
Slika 10: Valjanje na valjarni Bluming

- facilities for thermal treatment and machining, and the power station

1960–1961

A draft project was prepared for new investments for a realization in three stages 2 650 000 t per year

1965–1968 (stage I)

1 000 000 t per year

Modernization and a production-capacity increase. With the completion and reconstruction of the ore treatment and the blast furnaces for the production of 700 000 t per year of pig iron, the erection of a new system for steel-scrap conveying and the introduction of oil heating for the SM-furnaces, the erection of slag bedding, the projected steel plant annual production was

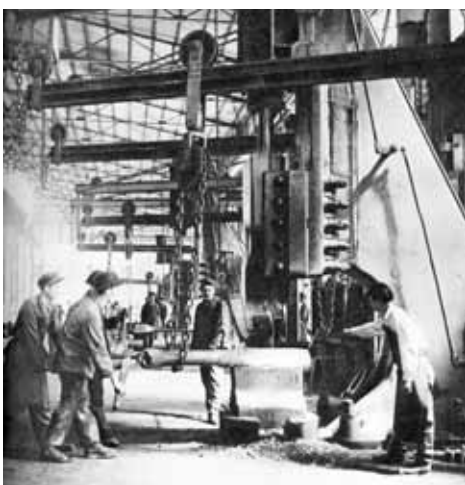


Figure 11: Hammer forging
Slika 11: Kovanje s kladivom



Figure 13: Casting in moulds
Slika 13: Ulivanje kokil

achieved. For the plants own needs, a steel casting shop was built.

1965

*The seconds stage of the project was finished
1 250 000 t per year*

1970–1989 (Stage II)

A new integrated ironwork was erected with the following facilities:

- coke battery no. 5 with 65 ovens with a capacity of 720 000 t per year,
- unloading stations and the transport system for raw materials,
- agglomeration shop with 6 units, each with a surface of 75 m²,
- blast furnace 4 with a volume of 1 756 m³ and a capacity of 1 250 000 t per year of pig iron,
- facilities for the treatment of ore materials
- a steel plant with 100 and 130 LD convertors and mixers 21 300 t,
- continuous casting for blooms of section (265 × 340) mm,
- billet-rolling mills with an annual capacity of 1 500 000 t, a light rolling mill with a capacity of 650 000 t per year and a wire rod rolling mill with a capacity of 430 000 t per year,
- power complex with 2 220 t/h steam boilers, a heat shop and a pumping station for water, turbogenerators of 7 MW and 25 MW, turbotuyeres TD-4 and TD-5 with 18 MW for technological air for the blast furnace 4, transformers and the net for the distribution of energy.



Figure 14: Discharging of red-hot coke
Slika 14: Praznjenje žarečega koksa iz peći

1988

*The productions was 1 118 780 t of convertor,
762 886 t of SM and 24 334 t of electro steel
1 906 000 t per year*

Total (stages I and II) 2 250 000 t per year

1990–1991

The British company British Steel Consultants, London, and the World Bank suggested several development options for the reconstruction of the Ironworks Zenica. They established that the ironworks may become profitable after the realization of the proposed program and become competitive in the market. A study was prepared on the basis of the total steel production in Yugoslavia.

1992

The production in Ironworks Zenica, with a tradition of over 100 years of production and working with steel, was halted in the second half of 1992 because of the war and all the facilities were preserved. In September and October 1992 the ironworks was heavily damaged by air bombing.

The realization of the reconstruction program proposed by the company British Steel Consultants, London was stopped.

1993–1995

The protection of the facilities was ensured and the air-bombing damage was repaired.

The proposal for the revitalization and the start up of production was prepared in August 1994 with the cooperation of local specialists and those from development organizations in Zenica and with the optimistic anticipation of the employees and the managers for the future. They were convinced that the production of steel was justified by economic, market and development factors.

In the study, all the base, technical, market, economic and financial elements were considered for an optimized production program. In particular, the following were analyzed:

- the permanent halting of old and loss-making facilities,
- the economic and technical justification for the reactivation of facilities erected after 1976,
- the necessity of production for supplies to the manufacturing industry and because of market trends,
- the number of employees,
- the required financial funds for the restructuring of production facilities and for the working capital,
- the economic evaluation of the technical, technological, production and market parameters, the role of the Ironworks Zenica in the economy of the Republic of Bosnia and Herzegovina,

- the development potential and the change of ownership.

The following were proposed: to permanently stop the old and loss-bringing facilities from the 1950s: the coke battery 1 to 4, the ore-treatment facilities, the old agglomeration with 8 Greenawald pans, the blast furnaces 1 to 3, the SM steel plant, the electric arc furnace 3 t and the cast-steel factory, the heavy and light mills and the wire rod mills II.

- Revitalization and the start of facilities erected after 1976 aimed at an integrated cycle production with the production of coke, agglomerate, pig iron, steel and rolled and forged products.
- The increase of the capacity of the old electric arc furnace from (10 to 15) t per year and the reconstruction of the vacuum facility for molten steel.

1998–2000

The moral codex and the traditional perseverance of the Zenica metallurgists maintained the cadres, the facilities and the start of the production of steel with the remelting of steel scrap from dismantled and permanently halted facilities in the SM and electric arc furnaces. This forced solution was accompanied by significant reconstructions to cover the marketing requirements. The production was started in the rolling mill and the forging shop and with the manufacturing of reinforcing nets, building armature and lattice beams. In parallel, in 1998 the certification audit confirmed the management quality conformed to the requirements of ISO 9001 for the rolling and forging products

2000

*SM furnace 53 118 tons,
electric arc furnace 23 533 t
76 651 t*

2003–2004

Planned production 1 000 000 t



Figure 15: The new electric arc furnace 100 t
Slika 15: Nova elektrobločna peč



Figure 16: The new continuous-billets casting facility
Slika 16: Nova naprava za kontinuirno ulivanje gredic

In 2003 and 2004 the EAF 100 t, the continuous casting, a new formill and a new heating furnace for the light rolling mill were built.

The production of approximately 1 000 000 tons of steel was achieved in the electric arc 15 t and in the SM-furnaces. The operation of the forging shop of approximately 15 000 t was based on the plants own steel, while, for the rolling mill beside the SM furnaces production, a limited quantity of billets was also imported.

In August 2004 a contract was signed with the company LNM Holdings N.V, which became the owner of 51% of the Zenica company. By the end of 2004 the operation of the SM-furnaces was closed permanently.

2004–2006

The production with the electric arc furnace 15 t was used for the forging shop and, with the electric arc furnace 100 t, for the rolling mills. In parallel, a revision of projects was carried out in the frame of the starting up of the integrated steel production.

2006

Annual production of electric steel 480 035 t

2008

Production was started with the reconstructed blast furnace, agglomeration and the coking plant.

2007–2008

The "Feniks" project aimed at starting up the integrated production was approved and its realization was started. In parallel, activities were started up for the preparation of measures and time limits for the decrease of emissions and pollution, applying the best available methods, with the aim to obtain an environmental license.

The work with reconstruction and overhauling of the facilities for primary processing continued: agglomeration, blast furnace, steel plant, energy supply and quality control, for infrastructure and auxiliaries. By the second quarter of 2008 the test

production of the coking plant and by July also the test production with agglomeration, blast furnace, convertor steel plant and the auxiliaries were started.

2007

Annual electric steel production 533 289 t

2008

Annual electric steel production planned 780 000 t

2009

Annual steel production planned 1 140 000 t

2012

New investments and the construction of continuous casting for slabs planned for the annual production of 2 000 000 t

4 CONCLUSION

Steel has for a long time been connected to Central Bosnia and Herzegovina, and especially to the area of

Zenica, a distance of 70 km from Sarajevo. With the start of the integrated production process in the Ironworks Zenica, this area again acquired a strong base industry for the production and transformation of iron ore, steel and market products.

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