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ANALYSIS OF THE ECONOMICAL, ECOLOGICAL AND QUALITY ADVANTAGES CONSEQUENT RESULTING FROM INITIATION OF TECHNOLOGY INTEGRATED IN METALLURGY

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Abstract

Metallurgical sector plays important role in the economy of each country because steel products present essential raw material for basic industries. Changes in the sectors of iron , steel and non-ferrous metals and the current development of technology of technology forces. Changes in the sectors of iron , steel and non-ferrous metals and the current development of technology forces the steel mills increased productivity, reduce production costs while ensuring to obtain a product with the required properties and to improve the competitiveness of enterprises in the global market. Currently, the most popular in meeting these requirements, enjoys a method of integration which combine individual operations into one integrated whole. The use of modern , perfectly designed , fully automated design of mechanical, hydraulic and measurement allowed us to achieve an innovative line of production. This article presents the general characteristics of the steel industry and a description of the latest integrated technology currently used in foundries and rolling mills. It also presents examples of the use of integrated technologies in metallurgy and the effects of economic, environmental and quality resulting from their use on an industrial scale.

Keywords: metallurgical sector, integrated technology

1. INTRODUCTION

Ever-increasing quality requirements, bullish commodity and energy prices and high spending on environmental protection are typical economic conditions faced by metallurgy. One way to improve the efficiency of the steel industry is the integration of processes, namely combining a number of devices in a single installation. Although the failure of one component interrupts the entire installation, but the economic benefits derived from the use of these installations determine their increasingly widespread use. Integrated processes are based on the optimization and flexibility, while reducing the energy intensity, number of stops and increasing productivity. In addition, investment and operating costs are lower. Only through perfect alignment of design, technology, and improved automation of measurement and control devices, the most important goal, which is to increase the profitability and competitiveness of production, would be achieved.

2. CHARACTERISTICS OF INTEGRATED PROCESSES IN METALLURGY

The technological process of the manufacture of steel products is implemented in stages: ore preparation, proper preparation of metals, metal refining, obtaining alloys, casting, metal forming, heat treatment and surface treatment, for example cyaniding or zinc coating, etc. Depending on its destination, the final steel product, characterized by varying degrees of processing, from articles in the condition after hot or cold rolling, to products with a high degree of formation of microstructure and surface finishing by applying

multiple layers [1,2]. The main stages of the manufacturing process of steel products have been shown in Figure 1.

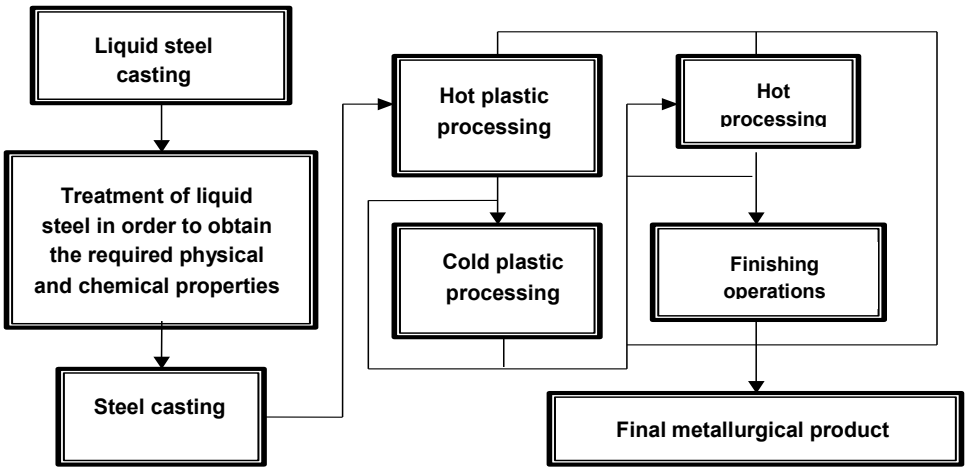
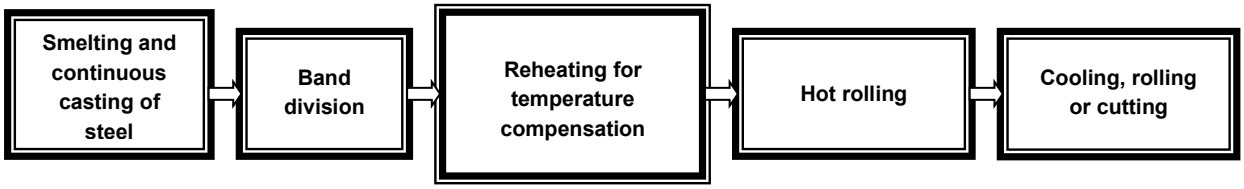


Fig.1. The main stages of the manufacturing process of steel products [1]

The integration of processes is used to improve the efficiency of the steel industry in a number of steelworks. The ultimate aim of the integration of processes in the steel industry is total merger of the formerly separate stages of the production process in a closed cycle to shorten the production line and the time of process implementation. Not all steel products can be produced in integrated processes. For the production of steel strip, several integrated lines have been developed. The best known of them are the CSP (Compact Strip Production) and ISP (Inline Strip Production). Fig. 2 presents a diagram of an integrated process for preparing the strips.



Rys. 2 Main technological operations of an integrated process of hot strip production [3]

The most common CSP lines are made of steelmaking furnaces, casting machines, tunnel furnaces for ingots heating and temperature compensation, continuous 7 quarto mills assembly, scissors before and after the tunnel furnace, laminar refrigerator and reels. ISP (Fig. 3) is characterized by a very short production time of high-quality strips from most types of steel of compact design [3].

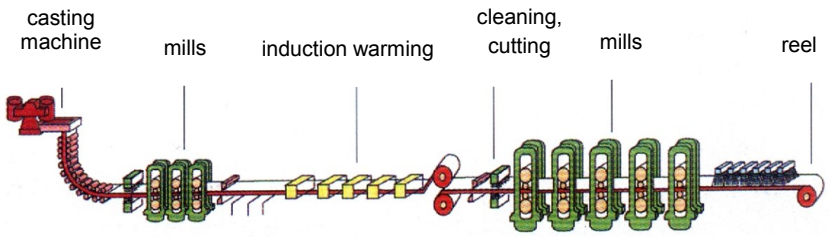


Fig. 3. Diagram of ISP process technological line [4]

For hot manufacturing of long products, in turn, Danieli has developed an integrated line called "Black Box". It was possible to combine the continuous casting operations, ingots heating to rolling temperature and rolling rods and profiles. In case of integrated processes for cold-rolled strip the initial stage is to combine the cold rolling of the strip with a continuous etching line, used in rolling mills worldwide. There are also

installations with the following located successively: annealing line, temper mill and strip finishing machines. An example of an integrated line for cold rolling aluminum strips is Fujian Suimin steelworks with an extremely modern system for the rolling of a variety of products with a production capacity of 80 thousand tons per year. It uses an extensive system of monitoring and control which allows you to select the optimum rolling speed, rapid exchange of the rolls and strip flatness control. Integrated lines for metallic and non-metallic coating have been also developed. In them, metal, conversion and organic coating operations has been grouped together. Depending on demand, some of the production may be just galvanized, then the metallized coating section is not working. The storage of vertebrae has been completely omitted between zinc plating and painting.

Another example of an integrated process is CaR technology for the production of copper tubes with the casting sleeve and the immediate planetary rolling in the rolling mill. The heat generated during the process allows you to roll pipes into circles. The final diameter of the rolled tube can be changed freely over a wide range for the data type of the rolling mill [1,5].

3. ECONOMIC, ENVIRONMENTAL AND QUALITY EFFECTS OBTAINED THROUGH THE USE OF INTEGRATED PROCESSES IN METALLURGY

The main factors which force the integration of the manufacturing process of steel products are: reduction of manufacturing costs by reducing energy, material and labor consumption, the number of operations and liquidation of storage costs, reduced capital expenditures by reducing the number of devices and the size of the buildings, and the extent of the transport system, reduction of the size of profitable performance production line, increasing productivity by eliminating the defects occurring during storage and transport, reduction of environmental pollution, introduction of modern equipment and the elimination of preservatives for a period of transportation, improvement of the quality and properties of the products, by creating new possibilities to influence the structure of the products and by increasing the degree of controllability process.

Introduction of CSP, compared with a conventional process allows for economic benefits shown in Fig. 4.

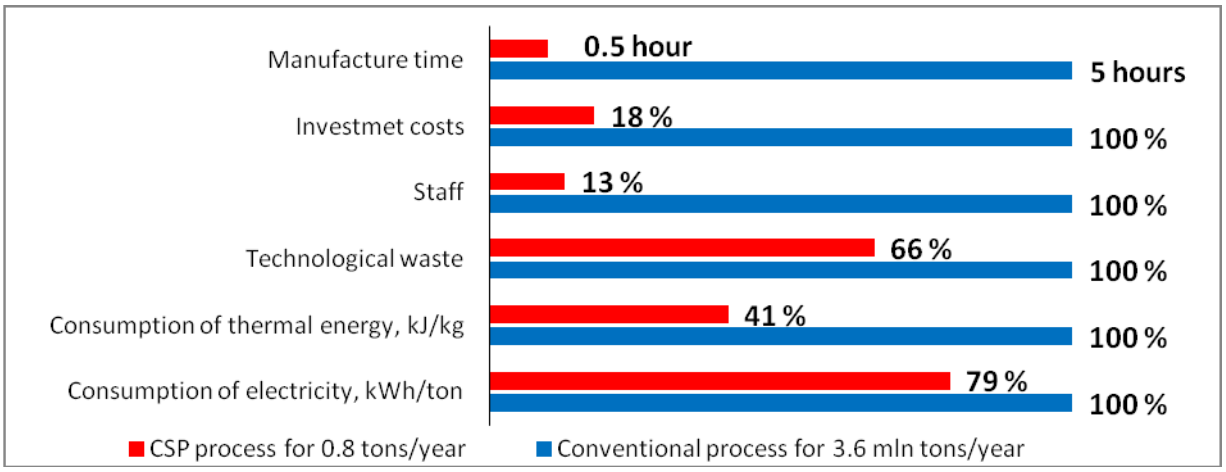


Fig. 4. Comparison of conventional strip production with CSP technology [6]

The main advantage of using integrated processes of hot strip production in metallurgy is a significant use of heat from ingots from the steelmaking process for rolling. This results in lower consumption of thermal energy. Flat and thin slabs used in CSP and IPS processes exhibit significantly improved properties when compared to conventional ingot processes.

Black Box technology also allows for a maximum reduction of the cost of storage and transport of ingots, as well as reduction of energy consumption by 60-70% in practice as compared to the conventional method of production, reduction of employment, increased yield and device performance and shortening the

implementation of the order. The time required to replace the rollers has also been minimized, and thus the speed implementation of the order has been reduced [5].

As a consequence of etching and cold rolling line integration, the strip quality improvement was achieved by the reduction of the number of folding and unfolding vertebrae to accurate thickness by minimizing the acceleration and deceleration of rollers, and by eliminating unnecessary storage between the etching plant and rollers, and reduced investment costs as well as reduced number of employees, with an increase in productivity by reducing the time of preparation of the vertebrae for each individual process and the selection of the optimum operating parameters [7]. During normal operation of the rolling tandem 5 m from each rolled coil at the beginning and end of a coil, corresponding to the length of the strip during acceleration and deceleration of rolling mills, exhibits exceeded thickness tolerance, uniform mechanical and technological properties along the length and width of the annealed coil. This creates optimum conditions for the heat treatment, reduction of the corrugation of material to create optimal conditions for smoothing, the possibility of using high-temperature annealing - 850 °C, thus obtaining the highest possible formability of sheet metal, increased life of products [8].

The advantages of the integrated coating line in comparison to the individual lines are as follows: lower investment costs, reduced manufacturing cycle time and improved ability to adapt it to variable market conditions, and more economical operation, because mechanical devices are reduced to a minimum, lubrication or chromate assemblies in plating lines or rinsing, degreasing and brushing assemblies in strip coating lines are eliminated, the operating personnel is reduced, the operation of changing paint does not require starting strip, so that the downtime is eliminated, and there is no need to reload the content from one operation to the next, allowing for a substantial reduction in inventory and production time and storage space.

By using an integrated production line for aluminum strips, a substantial reduction in thickness at a higher speed has been achieved and thus the efficiency has been optimized to reduce the time of the whole production cycle, improved flexibility of production, reducing the number of workers required to operate machinery and transport equipment.

The integrated CaR line for copper pipe production has saved 40-50% of energy, a significant reduction in capital costs, as it requires less production space, reduced cycle time, increased production flexibility with the ability to carry out even large orders, shorter replacement rollers, which allow for quick change of the production program, reducing the number of employees handling equipment, and to limit noise to 80 dB.

All steelworks with integrated production lines use the closed water circuit technique for cooling expansion of technological devices. Wastewater from dirty circuits is discharged into rain and industrial drains, and goes down with rain and infiltration water to industrial wastewater treatment plant. Rain and industrial wastewater after cleaning and reprocessing is returned as industrial water for filling up cooling circuits in the mill. The remaining wastewater is treated mechanically in reservoirs and discharged to an external receiver. Recycled wastewater (after cleaning in the factory treatment plant) is used for circuit fill up [1,6,8,10].

4. CONCLUSIONS

Metallurgy is of strategic importance for the economy. The use of integrated production line reduces the investment outlay and later operating costs as compared to a conventional installation. Integrated lines require smaller production halls and warehouses, thus shortening the manufacture time of products. Negative effects on the environment have been also reduced. Due to the shortened turnaround time combined with good quality and competitive prices, products manufactured in integrated processes increase customer satisfaction. Note, however, that the integrated processes have some disadvantages. Quite rigidly fixed relationship between the various processes will slow the pace of work for operations that can be

performed faster. Moreover, not all products can be produced with this technology. This reduces the reliability of the whole installation, if many units operate at the same time.

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