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## Difficulties in work safety management in a company producing steel flat bars

Marta Niciejewska<sup>1</sup>

<sup>1</sup> Department of Production Engineering and Safety, Faculty of Management, Czestochowa University of Technology, Armii Krajowej 19B, 42-200 Czestochowa, Poland, e-mail: [marta.niciejewska@wz.pcz.pl](mailto:marta.niciejewska@wz.pcz.pl)

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### Abstract

According to research, metal processing industry has the highest risk of accidents at work, due to the necessity for personal protective equipment use and strict execution of safety rules and procedures. The paper presents the individual characteristics of health and safety management in the company producing steel flat bars. Special attention has been paid to the safety aspect of the use of automated logistical equipment (gantries, automatics) that increase the risk of work-related accidents. The results of research on the difficulties resulting from the specifics of production (metallurgical industry) has been presented.

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## 1. Introduction

Metallurgical industry, is one of the most important industries in manufacturing area. It deals with the preparation of extracted ore from the ground for pure metal, metal refining, heat treatment and chemical and thermal treatment as well as casting to give them specific shapes and the production of alloys (ULEWICZ R. 2003, BROZOVA S. 2013, NOWAKOWSKA-GRUNT J. 2016, SALEK R. 2016, BROZOVA S. 2016) – the metallurgical industry is divided into the iron and steel industry and non-ferrous metallurgy (DEPARTMENT OF ECONOMIC INFORMATION OF THE POLISH INFORMATION AND FOREIGN INVESTMENT AGENCY S.A. 2011). Metallurgical industry, besides the metal processing, also includes a number of side effects that are related to product quality management (quality engineering – Total Quality Management), material flow (logistical systems), machine maintenance (Total Production Maintenance) as well as activities related to physical and organizational safety, environment management, waste utilization, corrosion protection etc. (LABER L. 2013, PUSTEJOVSKA P. 2010, LESTYÁNSZKA ŠKŮRKOVÁ K. 2014, KLIMECKA-TATAR D. 2013). The structure of the Polish metallurgical industry from a processing point of view is presented in Figure 1 (DEPARTMENT OF ECONOMIC INFORMATION OF THE POLISH INFORMATION AND FOREIGN INVESTMENT AGENCY S.A. 2011).

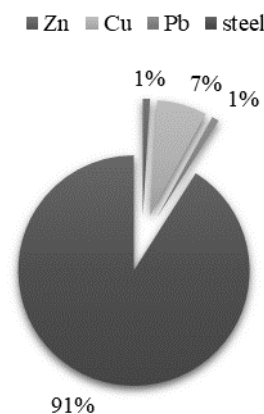


Fig 1. Structure of the Polish metallurgical industry

The largest number of companies in Poland in the metallurgical industry are concentrated in Silesia (about 23%). Other regions with large number of such kind of companies are: Mazowieckie (about 14%) and Malopolskie (about 11%) and Wielkopolskie (about 10%). Podlaskie Voivodship (about 1%), Lubuskie and Warminsko-Mazurskie (both over 2%) are the smallest. More than 3/4 of the companies in this industry are "small" companies, especially micro-enterprises. However, this percentage is clearly lower than in the national average for all companies (about 95%). This tendency is also preserved in other categories – the metallurgical sector is the

biggest one in Poland. In the range of 10-49 of employees is 16% of companies (for the whole economy about 4%), in the range of 50-249 of employees – 7% (respectively 0.8%) and the largest companies with over 250 employees is 3% in respect to 0.13% for the whole economy (SIEROŃ A. 2016). The structure for the number of metallurgical enterprises according to the number of employees is shown in Figure 2. On a global scale, according to World Steel Association data, in 2015, the 1.623 billion tonnes of steel were produced. This is a decrease of 2.8% over the production from 2014. The majority of world production is still located in Asia, where 1.114 billion tonnes were produced in 2015 – less than 2.3%. The same decline has been noted in this sector of the Chinese economy giant. In the Middle East, over the past twelve months, 803.8 million tonnes of raw material have been produced. Also in Japan, the steel industry recorded a decrease – in this case by 5%. Annual production was at 105.2 million tonnes.

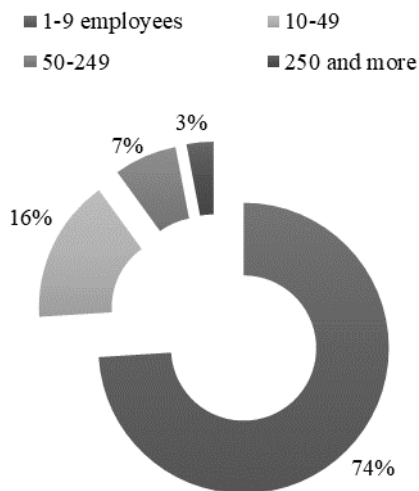


Fig. 2. Polish companies in the metallurgical industry according to the number of employees employed

The only large country that recorded growth in Asia (and the only country among the top ten steelmakers in the world) is India, where production increased by 2.6%. In total it amounted to 98.6 million tonnes (POLAND METALS REPORT 2011). The situation in the European Union is similar. Nevertheless, there are countries in Europe where there is a marked upturn. In the EU countries, the situation is generally not very well. Within the European Union, steel production decreased by 1.8% in 2015 and now stands at 166 million tonnes. In Germany a very small decrease was observed, however. In this case, it was 0.6% but now production is 42.7 million t behind our western border. The biggest decreases in EU countries were recorded: in France - by 7.2% (to 14.984 million t), in Italy - by 7.1% (to 22.022 million t) and in the UK - by a record 10.4% (to 10.86 million t). At the same time, there are places in the EU where steel production has increased during the last twelve months.

These green islands are Spain, which increased production by 4.4% and gained 14.875 million tonnes of raw material, as well as Poland with an increase of 6.4% and 9.106 million tonnes (RAPORT ZRÓWNOWAŻONEGO ROZWOJU ARCELORMITTAL POLAND 2014) – the data are shown in Figure 3.

In Eastern Europe, a slight decrease was recorded in Russia, by 0.5%. Currently there are 71,114 million tonnes of steel produced there. To a very clear decline, which cannot be particularly surprising, occurred in Ukraine. In this case, the production of raw material decreased by 15.6% and is now 27.17 million t per year. At the same time, metallurgical growth recorded in Belarus – by 4%, to the level of 2,615 million t. A spectacular rise was recorded by Moldova – the increase was 26.9% there. Total production in this country is currently 445 thousand tonnes.

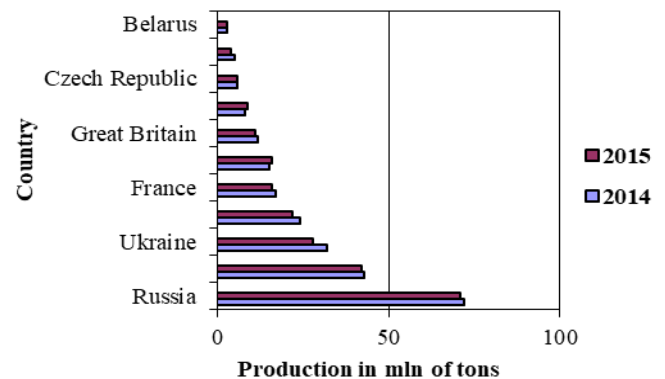


Fig. 3. Structure of steel production in Europe in 2014-2015

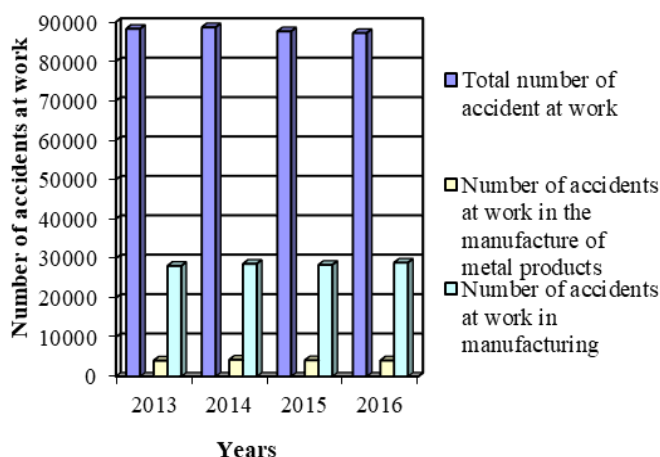
As reported by Eurofer (European Steel Association) – over the past 18 months, the volume of imported steel from China to the European Union has been doubled. At the same time China's surplus production of this resource is 400 million tonnes per year. Meanwhile, the demand of the whole of Europe is 155 million t. Currently, most steel in Poland (about 60-70%) comes from imports. From Belarus, it was 300 thousand t, i.e. twice as much as in 2014. However, in Poland almost 9 million tonnes are produced per year, with annual consumption exceeding 12 million tonnes. The HIPH in Katowice clarifies these data: in 2015, the Polish economy consumed about 12.5 million tonnes of steel. For comparison, in 2013, it was 12.3 million t. Market analysts from HIPH said that this year also a further increase in demand for this raw material is expected. It is worth pointing out that steel consumption in Poland has steadily increased and has reached the pre-crisis level (SIEROŃ A. 2016).

## 2. Dangerous events in metal products manufacturing enterprises - profilectical activities

The metallurgical industry according to the National Register of Industrial Activities (KRD) is included in the industrial processing group (C) including specification No. 24 – metal production and specification no. 25 –

manufacture of finished metal products excluding machinery and equipment. From the statistical data point of view presented by the Central Statistical Office the number of accidents at work in the metal industry is a significant part of the total number of accidents at work. The number of metallurgical accidents in relation to the total number of accidents at work is shown in Figure 4.

In 2016, the total number of people injured in accidents at work was slightly higher than in 2015 which is the result of the Central Statistical Office (GUS). Positive information from the data is that the number of people who have suffered accidents with severe injuries at work is smaller than in 2015. The number of fatal accidents has also decreased. On the other hand, the number of accidents at work in the manufacturing of metal products in 2016 (as compared to the previous year) also decreased. The number of accidents at work in the manufacture of metal products is almost 1/7 of all accidents recorded in manufacturing. There is therefore a clear need for prevention in the metallurgical processing industry (Gus 2013-2016).



**Fig. 4.** Number of accidents at work in manufacturing (metal production and manufacture of finished metal products) in relation to the total number of accidents at work

Despite all the methods and tools available to prevent accidents, for example presented by the Central Institute for Labor Protection (the National Research Institute in Warsaw) – taking into account the number of industrial accidents in general, still the number of accidents is relatively high. There are many factors that threaten the lives and health of workers in the metallurgical industry. Specificity of the metallurgical industry, which is characterized, among others. Strict procedures in the production processes as well as strict procedures and safety standards make it difficult to effectively manage the safety of work. Companies use prophylactic activities to minimize health and life risks. An observation was undertaken in the metallurgical industry, with an office registered in the Silesia province. The observation deals with longitudinal cutting coils - producing steel flat bars. This process takes place at the production and technological line for longitudinal slitting of coil sheets (ULEWICZ R., KLIMECKA-TATAR D.,

MAZUR M., NICIEJEWSKA M. 2015). At the same time, there are three employees, two of whom operate a sheet metal straightener. Figure 5 presents a simplified production and technological process of longitudinal sheet cutting and steel flat bars formation. One of the advantages of technological lines is the high level of mechanization and automation of manufacturing processes that ensures the high level of products quality (GÓRECKI W. 2001). On the one hand, it is necessary to adapt it to the actual needs and capabilities of the enterprise and, on the other hand, to develop transparent procedures that of dangerous events that be a source (JASICA G. 2010). Ensuring a high level of organizational safety is the basis for the efficient operation of the production line in the company (JASICA G. 2010, SYGUT P. 2016).

One worker (usually a brigadier), who is located in the cabin at about one and a half meters above the production and technology line, is in charge of the whole process. This employee has a preview of the whole process, regulates the rate of line shift, while watching the work of employees. Accidents that occurred in this company concerned scratches and small cuts in the area around the upper limbs, and formed at the stage of cutting the beginning and end of the sheet. In addition, incident occurred while straightening the sheet in the straightener (KAWECKA-ENDLER A. 2016). One of the most serious injuries at work was pulling through the straightener rolls and crushing the fingers of the employee handling the machine. The cause of this particular accident was the inattentive and careless behavior of the employee. In standardized processes where the topic of technological and technical protection has rarely been exhausted and all protective and preventive measures have already been taken, the weakest link to workplace safety is the worker.

1. Metal sheet cutting
2. Metal sweet straightening
3. Longitudinal sweet cutting
4. Coiling metal sweet for coils

**Fig. 5.** Simplified production and technological process of longitudinal sheet cutting and steel flat bars formation (based on: KAWECKA-ENDLER A. 2016)

The risk of exposure to hazardous factors that cause accidents at work is increased by the automation of work processes and the resulting handling of equipment such as gantries and straighteners. Job instruction is not always enough to make a worker aware of the risks posed by work on automated equipment. After the inspection by the National Labor Inspection, appropriate security devices were used in the rectifier. In addition, the employer implemented throughout the entire production process narrow tapes called "band-iron", a system that monitors the worker's production and technology line, which informs and warns employees of potential danger with appropriate pictogram and sound signals. They are located on a screen mounted above the production line. The whole is controlled from the cockpit of brigadier. The results of the research conducted in the company, using direct interviews, show that the implementation of the system of observation of undesirable behavior of

workers on the production and technology line has brought measurable results in the last four years in the absence of serious accidents at work. The only accidents occur are minor scratches, resulting from cutting off the so-called "tongues" of the beginning and the end of the metal sheet. The use of a worker's labor control system using pictogram-sounders has proved to be an effective preventive measure, reducing the risk to workers' health and life.

### 3. Conclusion

The monotony and the static workload cause musculoskeletal ailments, and consequently muscle and spinal pain, reduced perceptiveness and stress, all of this can be a consequence of working in an automated environment under strict procedures. The employee's attitude to the work, from attention and focus on the elements of the work process, but most importantly knowledge of the effects of the risks to which it is exposed depends on the safety of the whole work process. It is important to note that any change in practice always depends on the specific individual situation of the enterprise and requires a precise definition of the factor (or factors) that will allow the use of a specific innovation potential. The technical and organizational solutions presented in this paper, in one of the Silesian metallurgical companies, are examples of good practices implemented in Polish manufacturing companies in the aspect of work safety.

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## 生产扁钢的公司在安全生产管理方面存在困难

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### 關鍵詞

冶金工业  
生产  
安全

### 摘要

据调查，金属加工行业工作中发生事故的风险最高，因为需要使用个人防护用品，严格执行安全规程和程序。本文介绍了生产扁钢的公司的健康和安全管理的特点。已经对使用自动化的后勤设备（门架，自动装置）的安全方面给予了特别关注，这些设备增加了与工作有关的风险。介绍了生产特性（冶金工业）所产生困难的研究成果。

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