

ANALYSIS OF THE TREND OF CHANGES IN THE ACCIDENT RATE IN THE POLISH MINING INDUSTRY IN COMPARISON TO OTHER INDUSTRIES AND EU COUNTRIES

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Purpose: The main objective of the study was to analyse the trend of changes in accident rates in the Polish mining sector against the accident rates registered in other industries and EU countries.

Design/methodology/approach: The study used a three-stage comparative analysis of accident rates for fatal and non-fatal accidents at work occurring in the mining industry and the 20 most important industries defined by NACE (Statistical classification of economic activities in the European Community) in EU countries. The method of analysis was based on the principle: from the general to the specific, at the first stage analysing and averaging the accident rates occurring in EU countries among the 20 industries and comparing them with the same rates occurring in Poland. The second stage of the analysis compared accident rates in mining and construction in EU countries, and the third stage analysed average accident rates in mining and construction in Poland. Such studies were carried out in order to diagnose the accident rate and, on this basis, to diagnose the trend in this area.

Findings: The analysis carried out allowed us to establish that the negative trend of increasing accident rates in the Polish mining sector does not coincide with changes in accident rates occurring in the 20 most important sectors of the economy of the European Union countries under consideration. The increase in the accident rate and fatal accident rate recorded in Poland in recent years is not present in the same analysed period in other industries, including the mining sector in EU countries or the highly accident-prone construction sector. The analysis made it possible to conclude that the increase in accident rates is not a general trend, but only a feature of the Polish mining industry. Such results point in the direction of the necessary research to be carried out in further stages aimed at identifying the causes of the increase in accident rates in the Polish mining industry and seeking effective remedial measures.

Research limitations/implications: The research and analyses carried out have clearly indicated that the increase in the number of accidents in the mining industry is an isolated phenomenon in comparison with the number of accidents in other sectors and countries of the European Union, therefore further, in-depth research to be carried out in the Polish mining industry must focus on diagnosing the causes of this state of affairs, which should be sought within mining companies by analysing safety culture, carrying out in-depth analyses of accidents at work or examining the effectiveness of preventive health and safety measures.

Practical implications: The results of the conducted research and analysis can be used by entities such as universities, scientific and research institutes, as well as occupational health and safety supervisory institutions in the mining industry. The presented results diagnose the state of safety in the mining industry and indicate the direction of further research.

Social implications: Safety is one of the basic human needs, so any research and analysis in the field of occupational health and safety has a potentially positive impact on the increase of the quality of life of societies, public and industry policies. They therefore have high social implications.

Originality/value: The publication uses an original research method based on a three-stage analysis of the accident rates of industries and countries in the European Union.

Keywords: mining, accidents at work, incidence rate.

Category of the paper: research paper.

1. Introduction

Restructuring processes in the Polish mining industry have brought about many qualitative changes in the closer and further environment of the industry's enterprises (Bijańska, Wodarski, 2020; Smoliło, Chmiela, 2021). These changes are noticeable, among others, in the area of occupational safety, which has become a fundamental pillar forming modern mining (Chen, Zorigt, 2013; Cliff, Harris, Bofinger, Lynas, 2017). Occupational safety is an important social category (Johanson, Aboagye, Yao, 2022), but it is also an economic category (Simsek, 2024), because prevention and safety in general is a cost to be borne in the course of business (Cao, Zhou, Miao, 2025; Estudillo, Carretero-Gomez, Forteza, 2024). It needs to be managed in a rational and sustainable manner especially with regard to the production-safety relationship. How important this issue is can be seen from the fact that the most important Polish scientific and research institutions have been dealing with this problem for many years. Unfortunately, many issues remain unresolved. In this study, the authors decided to analyse trends in accident rates in the Polish mining industry against the background of other industries and countries in the European Union. They were prompted to do so by the negative trend of changes in accident rates in the Polish mining industry (WUG, 2025), which shows an upward trend from 2020 onwards. In their search for the reasons for this, the authors carried out a complex analysis of the accident rate, starting with an analysis of the accident rates determined for 20 branches of the economy of the European Union countries (Eurostat, 2025; ESAW, 2020). The authors then made a comparative analysis of the accident rate occurring in the Polish mining industry with the accident rate occurring in the mining industry of EU countries, and, in addition, they also made an in-depth comparative analysis of the accident rate occurring in the mining industry with the accident rate determined for the equally high accident rate construction industry (Woźniak, Hoła, 2024), both in Poland and in the European Union as a whole. The results of this analysis are intended to help diagnose the reasons for the increase in the accident rate in the Polish mining industry. To provide an answer to the question of whether this trend coincides

with a similar direction of changes in the accident rate in other sectors and in all countries of the European Union or whether it is a trend occurring only in the Polish mining sector. The results of the analysis are not only cognitive but also practical, as they indicate the direction of further diagnosis and analysis of the causes of the occupational safety situation in the Polish mining industry. In the specific period of restructuring of the Polish mining industry, requiring a reduction in production costs and the closure of mines, problems relating to work safety that are not well known and recognised are emerging. These are not just problems in the technical sphere, but also in the social sphere. Comprehensive solutions must therefore be sought in this area in order to reverse the negative trend of increasing accident rates in the Polish mining industry.

2. Description of the research method

The authors formulated the following research hypothesis: the increase in mining accidents observed in recent years is a characteristic of only the Polish mining industry in the EU. To verify the research hypothesis thus adopted, a three-stage comparative analysis method was used, based on source data obtained from Eurostat and the Higher Mining Authority. Looking for reasons for the increase in accident rates in recent years in the Polish mining industry (WUG2, 2025; Wyganowska, Tobór, 2022; Gajdzik, Małysa, Sujova, Bialy, 2022; Ogrodnik, Kęsek, 2022), the authors used accident rates in the 20 most relevant industries of the European Union economy for the period 2014-2022 in making a comparative analysis. This time range is due to the delay in updating the data - EUROSTAT does not have complete data for 2023-2024. For statistical analyses of data from different European countries, the authors used the overall rate of accidents at work as a ratio of the number of accidents (non-fatal or fatal in a given year) per 100,000 persons employed in a given industry.

Accident rates were analysed for the following industries:

- Agriculture; industry and construction (except mining); services of the business economy.
- Agriculture, forestry and fishing.
- Mining and quarrying.
- Manufacturing.
- Electricity, gas, steam and air conditioning supply.
- Water supply; sewerage, waste management and remediation activities.
- Construction.
- Wholesale and retail trade; repair of motor vehicles and motorcycles.
- Transportation and storage.

- Accommodation and food service activities.
- Information and communication.
- Financial and insurance activities.
- Real estate activities.
- Professional, scientific and technical activities.
- Administrative and support service activities.
- Public administration and defence; compulsory social security.
- Education.
- Human health and social work activities.
- Arts, entertainment and recreation.
- Other service activities.

Standardised data on accidents at work are collected as part of the administrative data “European Statistics on Accidents at Work (ESAW)”, based on a methodology first developed in 1990. European Statistics on Accidents at Work (ESAW) data are collected and disseminated on Eurostat's website on an annual basis. In addition to absolute accident numbers and percentages, Eurostat calculates accident rate values.

Accident rates are calculated as the ratio of the number of accidents (fatal and non-fatal) for a given year, country, sector, gender, age group or other breakdown, to the relevant number of persons employed (reference population) and multiplied by 100 000. The result of such calculations is the number of accidents per 100 000 employees (per age, sector or country - and this depends on the objectives of the analysis).

The paper uses a three-stage comparative analysis of the values of fatal and non-fatal accident rates occurring in the mining industry, construction and the 20 most important industries found in EU countries. The method of analysis was based on the principle: from the general to the specific. The following stages of research and analysis were planned and carried out:

- STEP 1: Analysis of the values of average accident rates occurring in EU countries among 20 industries and comparison with the same rates occurring in Poland. The analysis of accident rates in the selected 20 industries results from the statistical classification of economic activities in the European Community - NACE (Statistical Classification of Economic Activities in the European Community managed by Eurostat) - applied in the ESAW. For ESAW data, NACE Rev. 2 is used from the reference year 2008 onwards.
- STEP 2: Analysis of accident rates in mining and construction in EU countries. The comparison of the accident rates occurring in the mining industry with those occurring in the construction industry follows from the ESAW accident statistics, which, giving examples of high-risk sectors, points to agriculture, construction and transport. Accident rates in mining will therefore be compared with an industry that by definition has a high accident rate.

- STEP 3: Analysis of the values of average accident rates occurring in mining and construction in Poland.

3. Analysis of accident rates in 20 sectors of the EU economy

3.1. Step 1 of the research – analysis of the average accident rates found in EU countries and Poland

In the first stage of the analysis, changes in the accident rate in the 20 most important industries in the European Union were observed. The timeframe adopted for the analysis was 2014-2022. The authors used the average accident rate for the 20 selected industries. An analysis of the average accident rate per 100 000 employees in the industry shows a clear downward trend between 2014 and 2022 (Fig. 1). The accident rate fell by 9% during this period. This is a very significant positive development in the area of occupational safety.

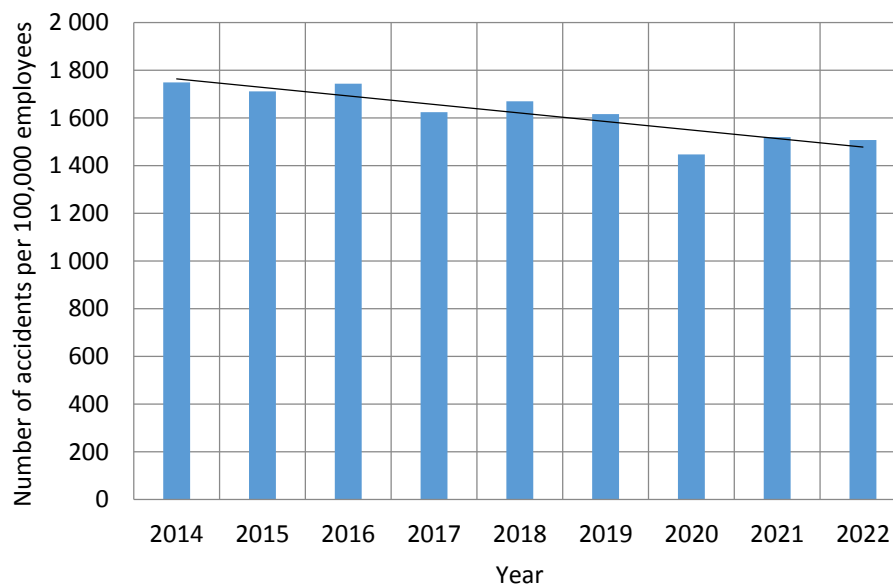


Figure 1. Accident rate averaged over 20 industries of EU countries.

Source: own elaboration based on Eurostat.

An analysis of the fatal accident rate carried out on the basis of an average of the fatal accident rates for the 20 EU countries' industries also showed a very clear downward trend (Fig. 2). It is worth emphasising that, with the overall accident rate analysed above, the fatal accident rate decreased by as much as 18%. This is a very significant, even spectacular, positive development in the area of occupational safety in the countries of the European Union.

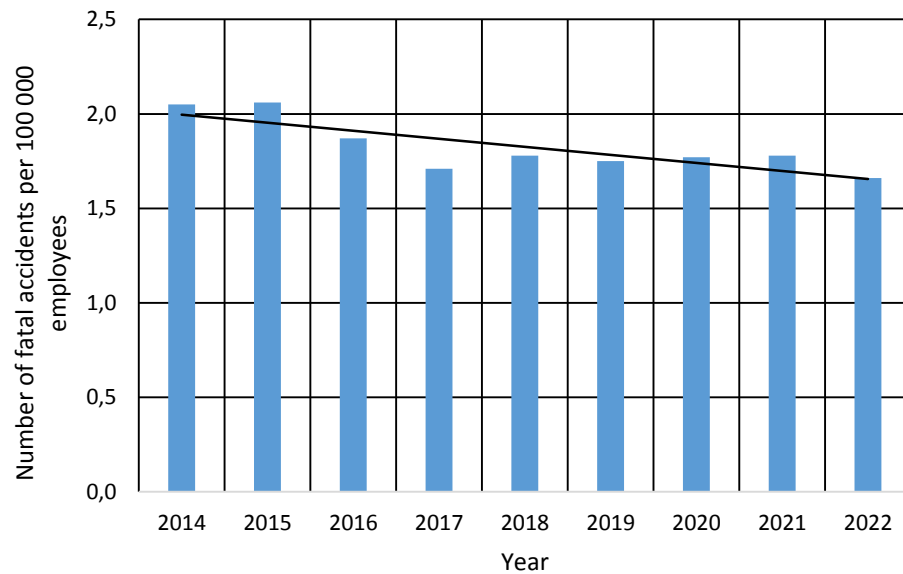


Figure 2. Fatal accident rate averaged over 20 EU country industries.

Source: own elaboration based on Eurostat.

Accident rates analysed for 20 industries in EU countries were also analysed in Poland for comparison. The aim of this research is to determine the trend of change – decreases or increases in the analysed identical indicators for the identical industries.

The accident rate averaged for 20 industries in Poland, with a selection of 20 industries analysed in all EU countries, also shows a clear downward trend in accident rates (Fig. 3). This trend is consistent with the accident rates analysed above for European Union countries.

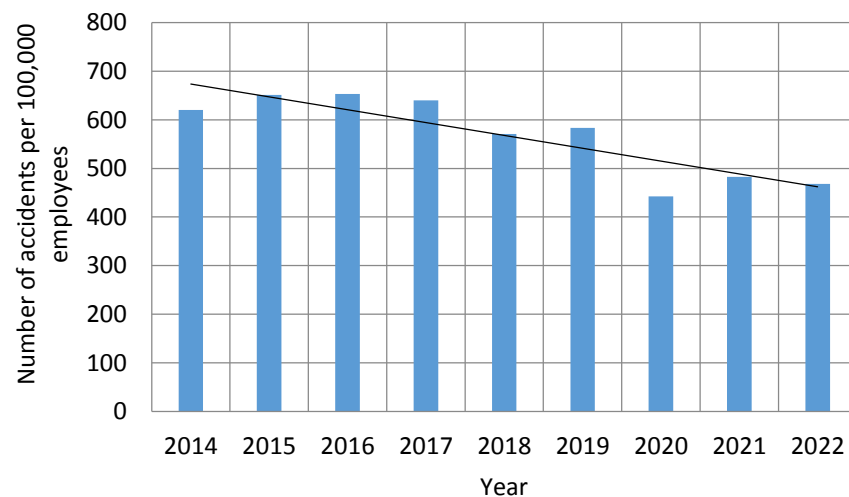


Figure 3. Accident rate averaged over 20 industries in Poland.

Source: own elaboration based on Eurostat.

Averaged across Poland's 20 industries, the fatal accident rate shows that between 2014 and 2022 there was a very large, almost 40%, decrease in the number of fatal accidents (Fig. 4).

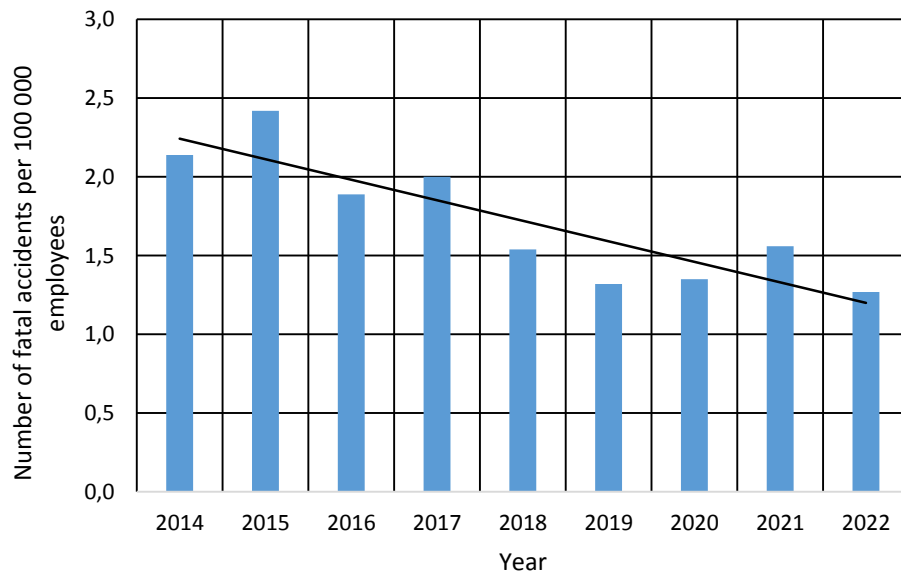


Figure 4. Fatal accident rate averaged over 20 industries in Poland.

Source: own elaboration based on Eurostat.

This decrease even exceeds the changes in this area recorded in the same period in identical industries in European Union countries. This is a very positive development.

3.2. Step 2 of the study - analysis of mining and construction accident rates in EU countries

The next step of the analysis was to analyse the accident rate limited to the mining industry. As a prelude to this step, the authors analysed the mining accident rate averaged over the European Union countries. As can be seen in the graph, the value of the index has remained at a similar level since 2014, with no major changes in decline or increase (Fig. 5).

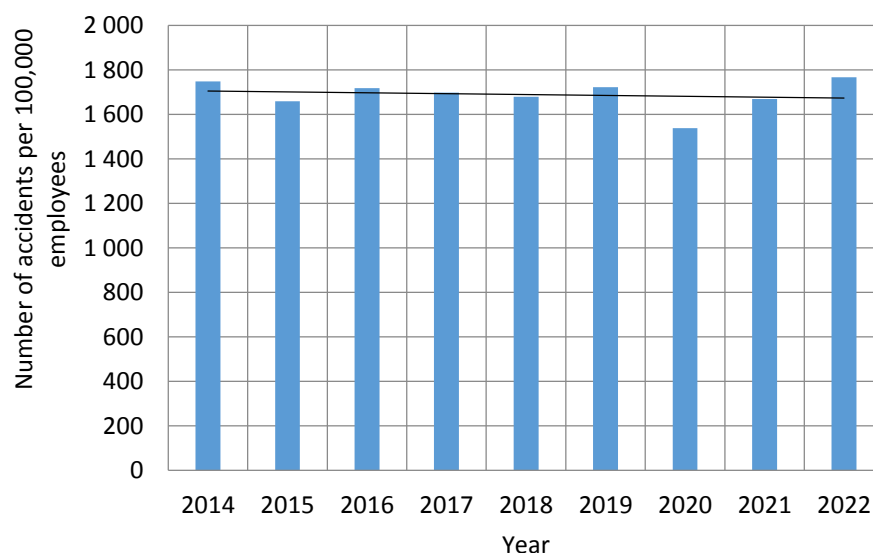


Figure 5. Mining accident rate averaged over EU countries.

Source: own compilation based on Eurostat.

Further analysis, including the fatal accident rate in mining, averaged over the EU countries, shows, as in the 20 industries analysed earlier, a clear downward trend (Fig. 6).

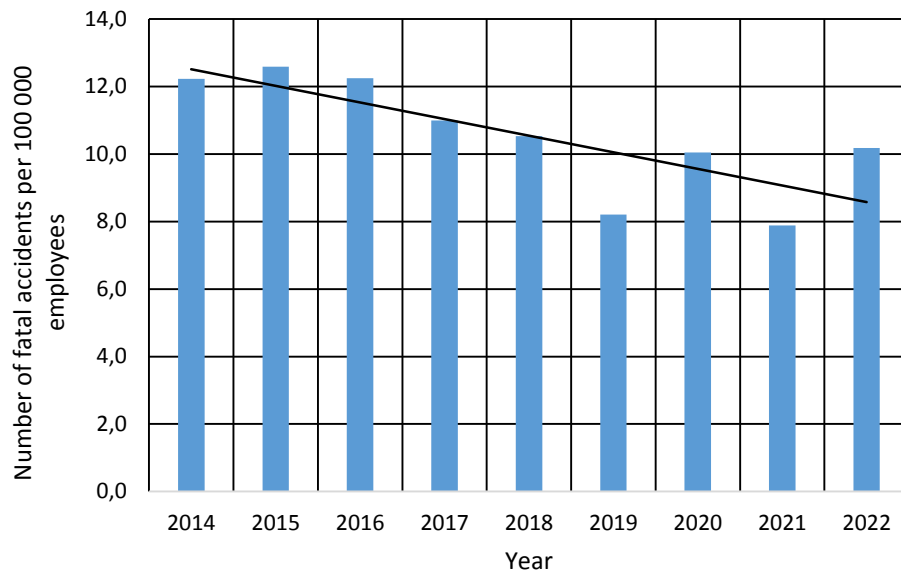


Figure 6. Fatal mining accident rate averaged over EU countries.

Source: own compilation based on Eurostat.

Searching for the sources of the accident rate increase in the Polish mining industry, the authors decided to compare accident rates in that industry with those determined for the construction sector, which also has a high accident rate due to the numerous hazards and high occupational risk at workplaces. The accident rate in the construction industry averaged over the European Union countries per 100,000 employees once again showed a clear downward trend in the analysis (Fig. 7).

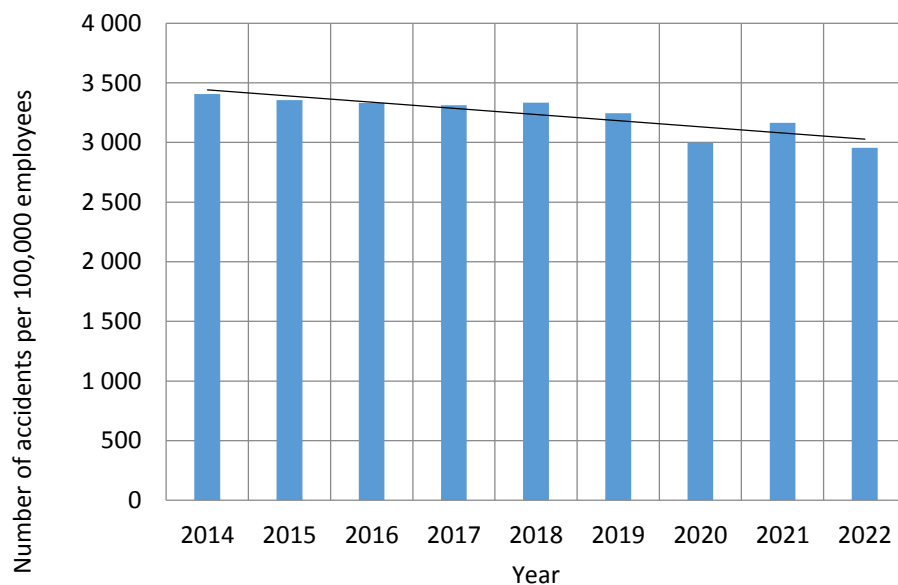


Figure 7. Accident rate in construction averaged over EU countries.

Source: own compilation based on Eurostat.

An analysis of the fatal accident rate in construction, averaged over EU countries, also confirms a downward trend, as does the overall accident rate (Fig. 8).

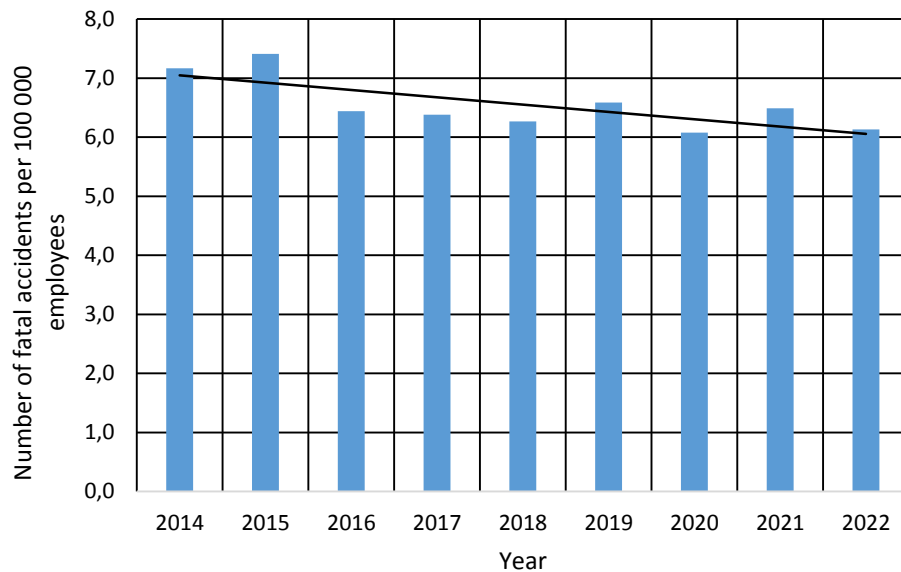


Figure 8. Fatal accident rate in construction averaged over EU countries.

Source: own compilation based on Eurostat.

3.3. Step 3 of the study – analysis of average accident rates in mining and construction in Poland

The analysis methodology adopted led the authors, at the outset of the third stage of the study, to determine the number of accidents in the Polish mining industry by type of mining. The aim of this study was to find out what percentage of the total number of accidents in the Polish mining sector is coal mining. As the analysis of accident rates in the mining industry has shown, accidents in coal mining are the dominant accident category (Fig. 9). On this basis, the authors assumed that the determined negative trends of changes in the total accident rate and in the fatal accident rate relating to mining in Poland are dominantly influenced by causes and trends occurring in hard coal mining.

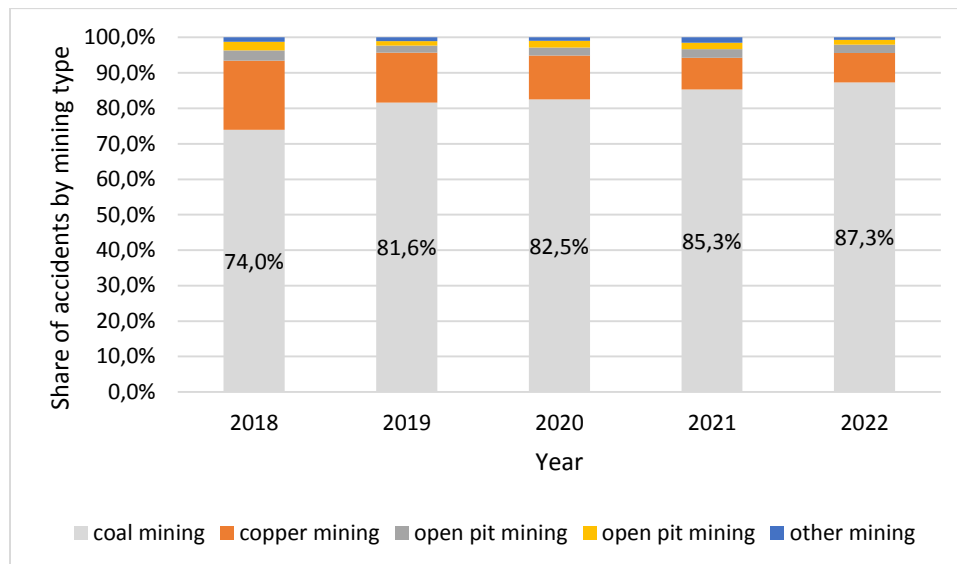


Figure 9. Share of underground mining accidents in the total number of mining accidents in Poland.

Source: own elaboration based on WUG.

The authors then carried out a final assumed analysis of the average accident rates occurring in mining and construction in Poland.

In the analysis of the total accident rate in the Polish mining sector from 2014 to 2022, it is the first analysed indicator to show an increasing trend (Fig. 10). Interestingly, the analysed indicator for the mining industry of the EU countries does not show such trends, so it is a situation without a supra-national trend.

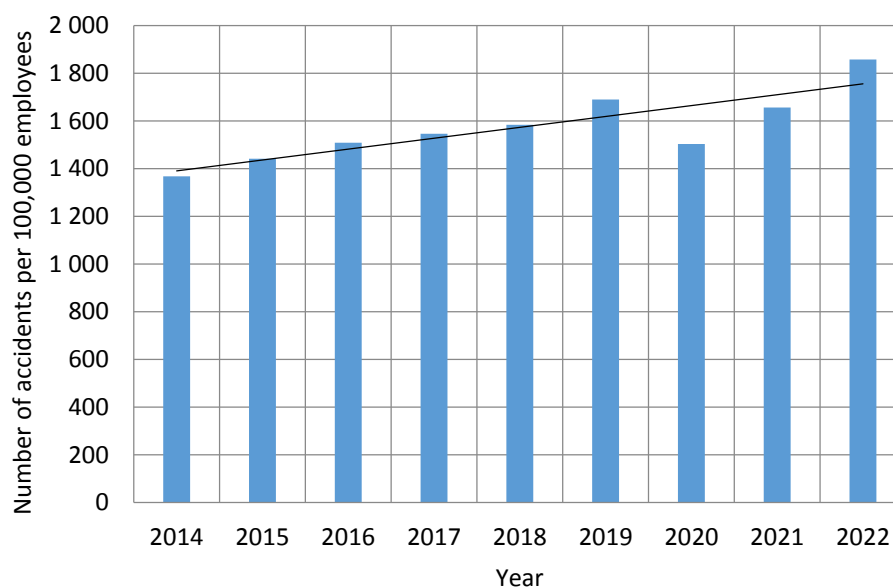


Figure 10. Accident rate in mining in Poland.

Source: own elaboration based on Eurostat.

Unfortunately, the negative upward trend is also confirmed for the analysed fatal accident rate. In the Polish mining sector, there was a marked increase in the rate in 2022 compared to 2021, but also compared to the beginning of the analysed period, i.e. 2014 (Fig. 11).

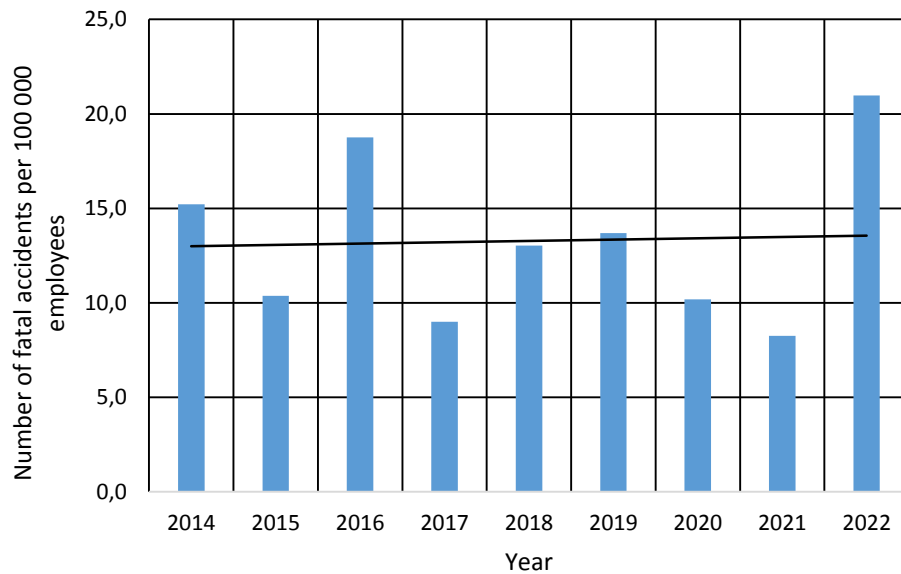


Figure 11. Fatal accident rate in mining in Poland.

Source: own compilation based on Eurostat.

The general accident rate in the construction industry in Poland per 100,000 employees, unlike in the mining industry, shows a clear downward trend over the same analysed period (Fig. 12). The average value of the overall accident rate in the construction industry fell by a spectacular almost 50% over the analysed period.

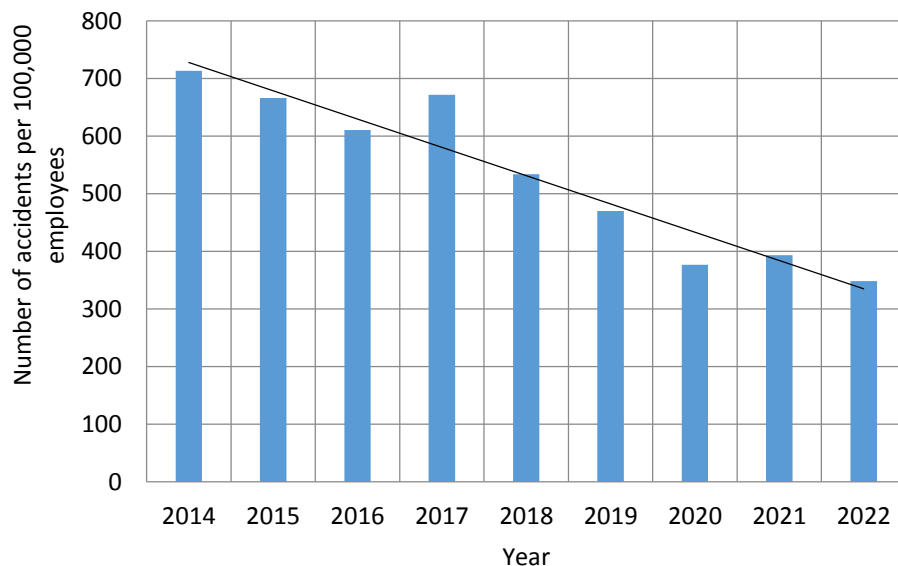


Figure 12. Accident rate in the construction industry in Poland.

Source: own elaboration based on Eurostat.

The next step of the analysis based on a study of the level of fatal accident rates in the construction industry in Poland based on Eurostat statistics once again confirmed the downward trend in accident rates, which are in line with those found in the European Union (Fig. 13).

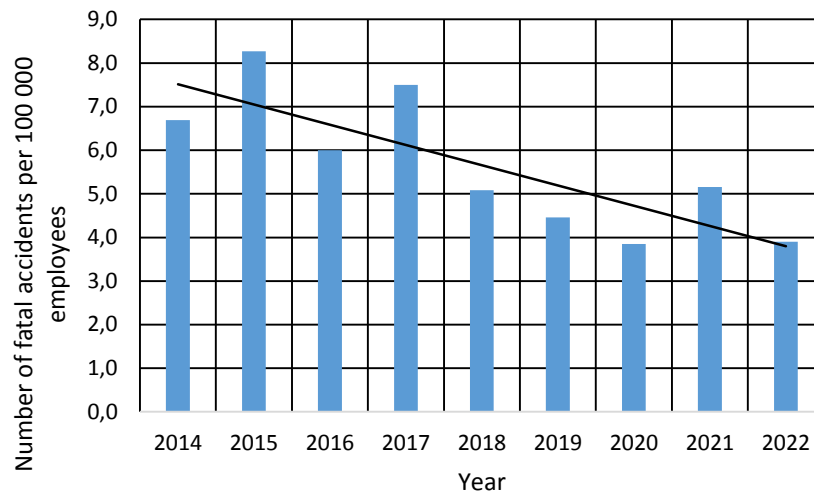


Figure 13. Fatal accident rate in the construction industry in Poland.

Source: own elaboration based on Eurostat.

In the Polish construction industry, the fatal accident rate between 2014 and 2022 also shows a very clear downward trend.

4. Results of research and analysis carried out

The comprehensive analysis of accident rates and fatal accident rates carried out according to the methodology established in the study can be summarised as follows:

- STEP 1 – analysis of accident rates and fatal accident rates occurring in EU countries averaged over the 20 industries described earlier shows a clear downward trend over the entire analysed period. The situation is similar in identical analyses of rates for the indicated industries in Poland. Declines in accident rates are pronounced over the analysed period and range from 9% to even 40% for individual indicators. It can therefore be concluded that occupational safety is increasing on average.
- STEP 2 – the results of the analysis of accident rates and fatal accident rates occurring in mining and construction in EU countries also show a downward trend.
- STEP 3 – analysis of average accident rates and fatality rates in the mining and construction sectors in Poland shows that the only sector where accident rates have been rising for years is the Polish mining industry. Even in such an accident-prone industry as indicated by the statistics - the construction industry - accident rates are decreasing. In the analysed period, the accident rate in this industry fell by a spectacular almost 50%. This is unprecedented in the EU.

The results of the detailed analysis conducted helped confirm the research hypothesis adopted at the outset of the study.

5. Summary and conclusions

An analysis of changes in the value of accident rates and fatal accidents showed that a negative trend of increase is observed only in the Polish mining sector. Such a trend is not present in the mining industry of the EU countries or in the construction industry - both national and EU-wide. Even a comprehensive analysis covering accident rates of 20 industries did not show trends of increasing accident rates. Quite the opposite - clear downward trends. It is therefore not possible to posit that the increase in accident rates in the mining industry is merely the result of the specificity of working under the numerous hazards that are present in the industry's workplaces. If this were the case, an analysis of mining accident rates in the EU countries would also show a positive - increasing - trend, which is not the case. It can therefore be concluded that the reason for the increasing accident rates in the Polish mining industry over the years is due to the complex factors that coexist in the companies of the industry. Given that more than 80% of accidents in the total number of accidents in the Polish mining sector involve accidents in hard coal mining, further analysis should focus on research into occupational safety in this industry. Interestingly, and certainly not unrelated to the accident rate, hard coal mining companies have been undergoing restructuring processes since the 1990s, which involves implementing changes to the companies in terms of their efficiency, in particular their ownership, organisation and management, including health and safety, employment, production and assortment structure, technical and technological issues, sales and supply markets. In the process of restructuring changes, which are also associated with mine closures, mergers of mines and transfer of the crews of these mines between mine divisions and between mines, there is likely to be a reduction in the level of safety culture and consequently an increase in accident rates. Interdisciplinary measures are therefore needed, including in the areas of occupational health and safety management, occupational safety culture, competence management or communication. The results of the research and analysis can be used primarily by entities and institutions that supervise occupational health and safety in mining.

The results of the research and analysis presented here allow us to conclude that further work aimed at identifying the causes of the increase in accidents in the mining industry should only focus on a detailed analysis of the causes of the increase in accidents in Polish coal mining companies.

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