*Mining Science, vol. 27, 2020, 39–46*

www.miningscience.pwr.edu.pl

Mining Science

(Previously Prace Naukowe Instytutu Gornictwa Politechniki Wroclawskiej, ISSN 0370-0798)

ISSN 2300-9586 (print)
ISSN 2353-5423 (online)

*Received October 11, 2019; reviewed; accepted February 19, 2020*

# INVESTIGATION OF THE MINING ACCIDENTS AT "STAN TERG" MINE

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**Abstract:** As the major industries, mining has high potential risk of accidents. Historically minerals have supported humane development and civilization but at the same time this industry has been accompanied by accidents, often with disastrous consequences. Number of mine accidents worldwide, as well as in the Stan Terg mine is disturbing, even more disturbing is the fact of the repetition of the causes of mining accidents. This investigation aims to analyze the causes of accidents, tending to provide the accidents prevision through risk assessment. For this purposes various data and documents, related to accidents in the Stan Terg mine have been analyzed, as well as international documents and statistics related on mining safety and accidents. Whereas, the time period of 2007–2011 is analyzed as a key study, 306 accidents have been analyzed for this purpose. Accident causes, date and time, accident location, working shift, worker's age and type of injury have been analyzed for each selected accident. Thus, for this period of time are caused 292 minor injuries, 14 serious injuries and 1 fatality accident, 60–70% of accidents are caused in the production process, 25–35 in the maintenance process, whereas about 2–5% during of monitoring or other types of works.

***Keywords*:** *accident, safety, mine, injury, occurs, causes*

## 1. INTRODUCTION

The name Trepca is mention for the first time in literature in 1303 on documents found in the archives of Dubrovnik in Croatia. The Stan Terg mine belongs to Trepca's mines, and it is one of the largest mine, well known also in Europe and beyond, for

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doi: 10.37190/msc202703

metal production as are: Pb, Zn, Ag, Au, Bi, Cd, etc. The world-famous Trepca mine Stan Terg, has yielded 2 million ton lead, 1.5 million ton zinc, 2.5 million ton silver, 4000 ton bismuth and 9 tons gold (The Auge and D. Artignan, October 2009).

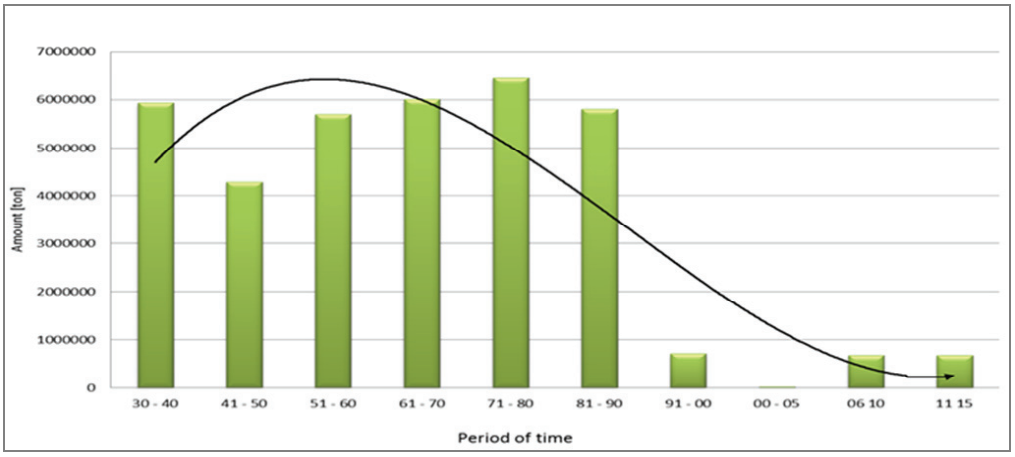


Fig. 1. Lead and Zinc ore production in Kosovo (1930–2015)

Stan Terg mine is located 9 km in northeast of Kosovo's city Mitrovica. The mineral resources in Stan Terg have been explored since 1927, while production started in 1930. There is a large accumulated experience and knowledge gathered through geologic research and studies of these ore occurrences from the aspects of body geometry, mine quality, mineral floatability, metallic connection structure and texture of the mineral composites (Zeqiri 2016).

### 1.1. STAN TERG – MINE STRUCTURE

The geology of the Stan Terg deposit consist of Paleozoic basement rocks, Jurassic--Cretaceous sediments and ophiolite rocks, while mineralization belongs to sulphide minerals with main mineralization of lead-zinc-silver, accompanied till now with about 70 different kind of minerals.

Tectonic structure consist an anticline with a fold axis dipping of 35–45 to the Northwest, most of the mineralization occurs as isolated and continue ore-bodies, along the schist-limestone contact, along the northern and southern wings of the described anticline.

As a construction rule, mining objects have been carried out (a rule that is still respected) in the footwall of the mineralized structure limestone – schist contact, hereupon in limestone as the most favourable rock for the mining.

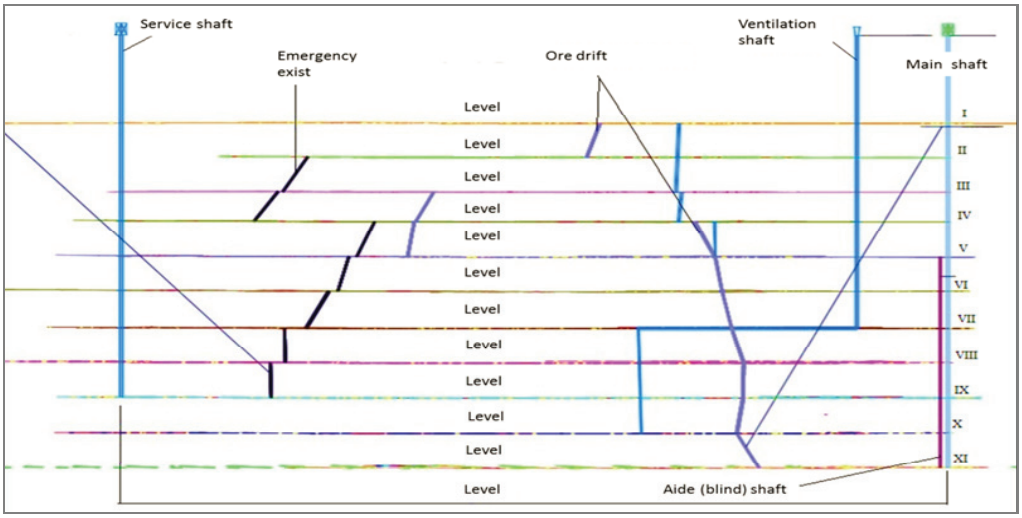


Fig. 2. Cross-section of Stan Terg mine structure

The underground mine Stan Terg, has in function almost all underground objects, as are shafts, decline adit, levels, maintenance office, accumulator plant, underground office, pomp stations, etc., while transportation is combined from the gravitational, diesel-machine, electric-machine, whereas in geometric aspect consist on three manners: decline, horizontal and vertical. As well as there have been used almost all mining methods of exploitation, from the classic one up to modern as is ramp method, whereas the exploitation advance is mainly from the bottom up. According to estimates, there are more than 200 kilometers longline of mining objects, whereas the maximum mine's depth so far is approximately to 800 meters.

## 2. OVERVIEW OF THE MINING ACCIDENTS

Mining kills and injures more people than any other work in the world. More than 15 000 miners are killed every year – and this is just the official number of deaths. Most likely, it's many more. Nobody really knows how many people are injured in mining, but it is likely to be hundreds of thousands of people every year (www.mineaccidents.com.au, n.d.).

Mining accidents and disasters are preventable. It is a tragedy that history is often repeated and the lessons from previous accidents and disasters seem to be forgotten or ignored (www.mineaccidents.com.au, n.d.).

### 2.1. THE ACCIDENTS HISTORY OF THE "STAN TERG MINE

Unfortunately it was not possible to ensure specific data related on mining accidents with regards to historic data, most likely of the last war in 1999, and certainly of the lack of data base related on accidents at this mine. According to the literature consulted, in this mine has been not registered any disaster or collective accidents, most likely of specificity of the deposit and mine structure itself. However, during 1960th in the former Yugoslavia, every year in average 82 miners lost their lives, caused 4317 serious-injuries and 159 167 injuries, from the total of the serious injuries 50% of them have remain permanent disabled. In that time only in Trepca's mines have been 749 work invalids. In that time only from Trepca's mines is caused 749 work invalids. Whereas, in average only in Kosovo during that time, yearly lost life 6 miners and are caused a lots of the serious-injuries (Janjic 1978). Whereas during interview with former mine's director who was in charge for the mine safety, it is confirmed, that during 1950–1988 in average, yearly a miner had loses life at Stan Terg mine.

### 2.2. KEY STUDY ANALYSE FOR THE TIME PERIOD (2007–2011)

According to above data, the Stan Terg mine can be rated with medium risk with regards to mining accidents, take into account its underground (UG) activity of metal exploitation. However, considering the realized production for the period of time 2005–2011 (Fig. 1), and highlighted mining accidents at the mine for the same period of time, it can be drawn to conclusion of the lack of safety at the mine, on following text are given related statistics and analyses on accident at mine.

Table 1. Summary of accidents at Stan Terg mine (2007–2011)

| L/OCC | Stope and Production | Maintenance | Monitoring | **Total UG** | Flotation | *S* | *S* out | **Total *S*** | ***Σ*** |
|---|---|---|---|---|---|---|---|---|---|
| Hit | 81 | 44 | 2 | | 16 | | | | |
| Slide | 25 | 9 | 1 | | 13 | | | | |
| Weightlifting | 2 | 3 | 0 | | 0 | | | | |
| Poisoned/ apathy | 3 | 0 | 0 | **221** | 1 | 50 | 5 | **85** | **306** |
| Other | 51 | 0 | 0 | | 0 | | | | |
| *Σ* | 162 | 56 | 3 | | 30 | | | | |

Based on each analyses of the accident of Stan Terg mine, as well as other experiences of the mines accidents, Table 1 is structured on two parts: (i) underground mining activities, and (ii) surface mining activities.

The main aim of the study was to determine the nature of accident, i.e., accidents causes, accident location and nature of the work during of accidents occurred. In this

regards, it is noted that most of the accidents are caused as result of: hit, slides, weightlifting, poisoning, and some of them it was not possible to determine based on accident's description on yearly mines book. Whereas the nature of work, during accident occurs mostly is related to production (working at stope, loading process, drift-ore discharge, etc.), maintenance and just few of accidents has occurred during monitoring of mining activity. The second part of table describes the accidents occurred on surface, and they are divided as accidents occurred in flotation, maintenance (S), and accidents occurring outside the mining area (described on the table as S-out, mainly on the way to/from work).

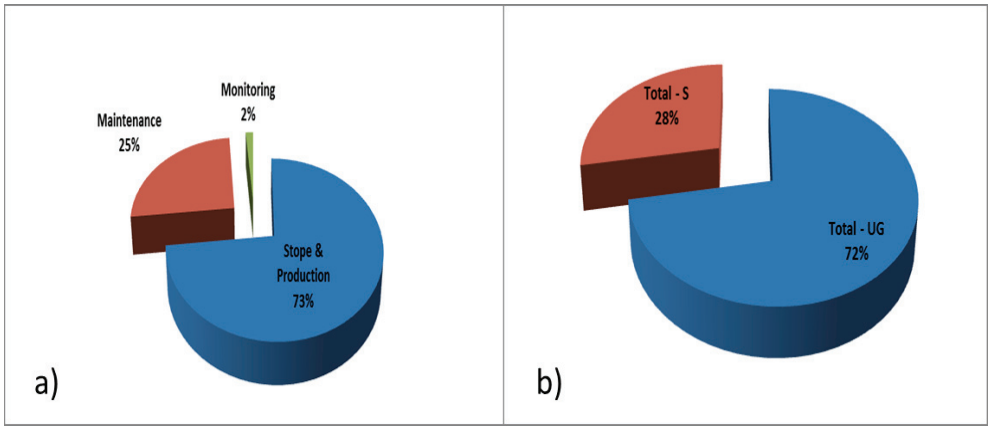


Fig. 3. Accident ratio at Stan Terg mine: (a) works at maintenance, monitoring, stope; (b) ratio between works at surface and underground

The (a) part of Fig. 3 describes underground mine's accidents, actually presents ratio between accidents occurred directly in the process of production (73%), maintenance (25%) and monitoring of the production process (2%). While, (b) part of Fig. 3 presents the ratio between underground (72.20%) and on surface (27.80%) mining accidents, in the process of integrated production.

From Fig. 3, it can be concluded that more of the two-thirds (2/3) of the accidents occurs in underground mining activities, while most of them (73%) are related with production activities, as might be: work at stope, drilling, loading, drift-discharge, scaling, etc., while 25% of accidents occurs in the process of production during maintaining the technological-line of production. Whereas 2% of accidents were caused during the monitoring of the production process.

Whereas on above text are analysed the accidents in the process of technological line of mine production, on the following text is described the main causes of accidents.

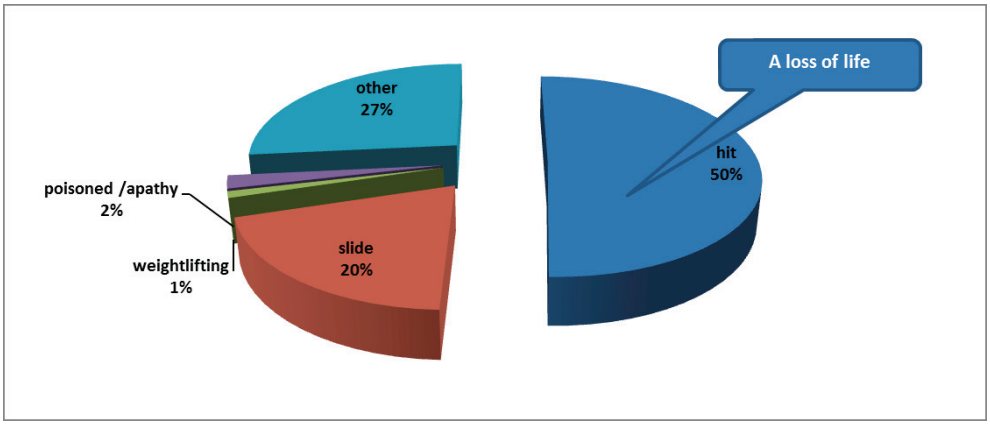


Fig. 4. Shows the main causes of accidents

From Fig. 4, it might be concluded that half of accidents are caused form "hit-agent", which may appear as; rock-fall, metal-hit, tire/air-blow, etc., it is highlighted also on the figure, that exactly the "hit-agent" caused fatality accident at the stope-work (rock--fall from the roof site). In the other hand 20% of the accidents are caused as sliding reaction, 1% from weightlifting, 2% from poisoned and for 27% of accidents it was not possible to identify the main agent that caused accident, the fact of not identifying the cause of the accident, may impede implementation of the adequate measures to be taken in order to mitigate risk during working process. However, a significant improvement in the mine safety has been noted after 2009, as a result of measures taken by the mine management, as is described on following text (Fig. 5).

Table 2. Types of accidents at Stan Terg mine (2007–2011)

| Minor injures | Serious injures | Fatality | Collective injures | Accidents per month |
|---|---|---|---|---|
| 291 | 14 | 1 | 1 (two serious injuries) | 4.46 |

In Table 2 are listed types of accident occurred at Stan Terg mine during 2007–2011 period of time. There is noted a fatal mining accident, happened at stope-work, and caused as result rock-fall from roof. It should be noted that all serious injuries are caused as results of "hit-agent" and in the process of production. There is noted a collective accidents, whereas in this case are caused 2 serious injuries, this accident is caused at the drift-discharge, as results of ore-slurry hit ("hit-agent").

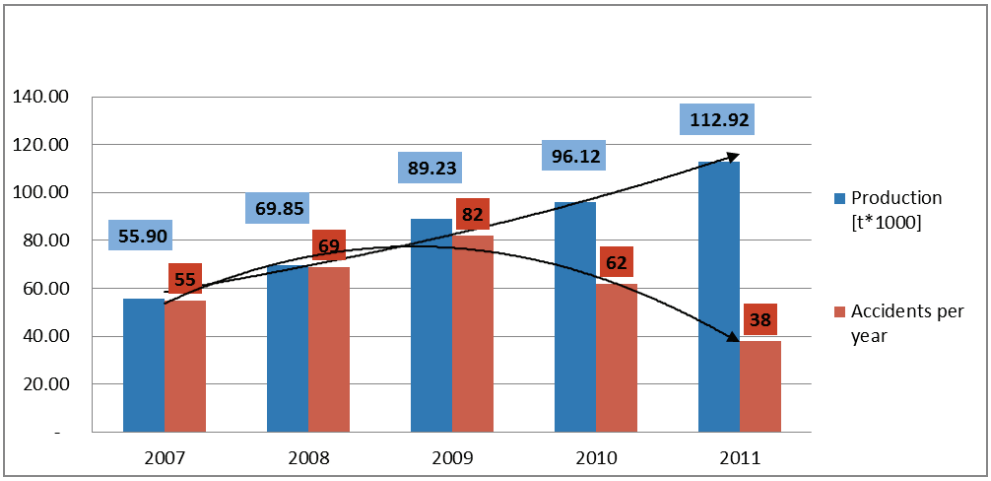


Fig. 5. Comparison between amount of production and accidents (2007–2011)

Based on Fig. 5, the accidents trends has followed production capacity till the 2009th year, when the trend of accidents starts to drop rapidly, despite of this fact, it must be highlighted that in 2010th year a miner loosed his life, as result of rock-fall, and 4 serious injuries were caused at the same time.

Based on interview with mine's representatives, despite of lack of detail investigation of the each accident, Safety Management of the Mine, has followed these measures: improving overall-supervision, documentation of procedures, increasing of alertness, improving of communication (reporting on "order" implementation) and staff training. But, according to them, in order to avoid mines accidents are needed a detailed and comprehensive study, especially for collective accidents, serious and fatal.

## 3. CONCLUSION

The outcomes of investigation shows that from total accidents, about 72% of them occurred in underground mining activities, whereas of the underground accidents themselves, about 73% are caused at stope-mining i.e. during production process. In the other hand the main causes of injuries is so called "hit-agent" with about 50% of injuries, followed by slide-reaction with about 20%. Another concern fact are accidents occurred from the unidentified agent, there are about 27% such accidents, this way it is more difficult to determine the right measures in order to mitigate accident occurs, from the safety of management at the mine.

Therefore, the higher risk may occur at production line (stope at work-loading at drift – drift unloading), whereas as trigger (cause) the investigation shows "hit-agent"

and sliding-reaction. While the reduction in the number of accidents, despite of the increasing of ore production (2009–2011), may be attributable to measures, taken by occupational safety management.

ACKNOWLEDGEMENTS

We are thankful to Stan Terg's mines representatives: Mr. Beqir Maliqi, Mr. Shyqri Sadiku, Mr. Xhevdet Tahiri and to ex-manager of the mine safety Mr. Zejnullahu Azemi, with the data support and interview, who greatly assisted to research.

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