

Zoran DESPODOV
Faculty of Mining and Geology

MODERNIZATION OF UNDERGROUND HAULAGE IN MACEDONIAN LEAD AND ZINC MINE

Summary. The paper presents the achievements in modernization of underground load-haulage equipment and suggests directions for future modernization of underground haulage in order to achieve greater efficiency and better economical operation of underground lead and zinc mines in Macedonia.

MODERNIZACJA PODZIEMNEJ ODSTAWY W MACEDOŃSKICH KOPALNIACH CYNKU I OŁOWIU

Streszczenie. W pracy przedstawiono osiągnięcia w modernizacji podziemnej odstawy w macedońskich kopalniach cynku i ołowiu. Sformułowano także kierunki dalszej modernizacji w tym zakresie. Zwrócono uwagę na zwiększenie efektywności i lepszej opłacalności eksploatacji systemów odstawczych.

1. Introduction

There are three mines for exploitation and processing of lead and zinc ore in the northeastern part of Macedonia which are in operation. They are Zletovo, Sasa and Toranica underground mines. The overall annual production of the run-of-the mine ore from these mines in 1996 amounted to 849,840 tons where the annual production of metals amounted to 29,030 tons of lead, 21,560 tons of zinc and 20 tons of silver.

The mining activity began after the Second World War with the restarting of the Zletovo mine which is the oldest mine in Macedonia. This was followed by the construction and development of the Sasa mines in 1961. In 1980 these two mines secured the finances for the construction of the Toranica mine. Today, the Sasa mine produces the largest quantities of ore with annual production amounting to 500,000 tons.

The lead and zinc mines are developed with combined development workings; the Zletovo and Sasa mines with drifts and skip shafts, whereas the Toranica mine with drifts and ramp.

The mining methods used in excavating the ore are as follows:

- sublevel caving,
- cut and fill,

- room and pillar, and
- shrinkage stoping method.

The paper also gives a full presentation of the underground mine haulage.

2. Characteristics of the underground mine haulage during the period of commencement of exploitation

Most commonly the underground mine haulage in the mines for metallic mineral raw materials consists of two phases: ore handling and main haulage. Ore handling transports the mined out ore from the stope to the ore passes in the excavating block. Main haulage is the transport of ore from the central ore passes where the ore from several block excavations comes and is transported to the surface or to the processing plants.

In the beginning our mines used autoloading machines manufactured by the Atlas Copco Company in the ore handling. The most common types used were T2GH, Cavo310 and Cavo520, which used compressed air as power. They also used various scrapers the power of 14 to 24 kW. Ore handling machinery used at that time had the characteristics as follows:

- small capacity,
- limited radius of action,
- large consumption of compressed air or energy losses,
- large number of workers,
- large number of injuries of operators per ton ore produced,
- the impracticable use of the machines for haulage of the material after drifting.

However, these machines proved as satisfactory means of transportation for the mined out ore. Their advantage was that they did not pollute the drift and other facilities by harmful gases.

Locomotives the weight of 4.5 ÷ 8 t and cars the volume of 1 ÷ 1.6 m³ were used in the haulage of the ore in levels which connected the block ore passes and the main haulage facilities. Still, trolley locomotives of 7 ÷ 14 tons and cars the volume of 1.6 ÷ 3.5 m³ were used, and are still used, for haulage from the central ore passes to the surface or to the bins.

The locomotive haulage is characterized by:

- discontinuous manner of operation,
- managing grades up to 5%,
- complex organization of work,
- employment a large number of workers,
- lowest reliability,
- greater possibility of injuries at work,
- difficult locomotive and car maintenance,
- the necessity of construction of additional power stations.

However, the locomotive haulage has some advantages that results in its being the most common type of transport in our mines. Its advantages are as follows:

- long distance haulage,
- haulage in mine facilities of small radius of curves,
- ore haulage, materials and workers,
- haulage of wet and abrasive materials and those of various granulometry,
- working connection between haulage and hoist,
- relatively small investments, etc.

3. Modernization of underground haulage in lead and zinc mines

The modernization of underground haulage and the whole process of underground mining of lead and zinc ore began with development of the Toranica mine in 1987. Drilling was carried out by modern Tamrock and Atlas Copco hydraulic rockdrills. LHD diesel Man-Ghh, Schopf, Atlas Copco Wagner and Toro machines the bucket volume $1.6+3.5 \text{ m}^3$ were used in ore handling. This change from autoloader with compressed air to LHD resulted in great changes in the technology of drifting so that the drift size ranged from 6 m^2 to 12 m^2 . It increased the block excavation and the length of ore handling. This also resulted in:

- the decrease of the number of workers by 50% at the same production rate,
- rapid fall in the injuries at work,
- greater economy at work,
- greater hour capacity in haulage from 20 t/h to 120 t/h and more,
- creation of condition for managing of grades up to 25% and more,
- greater mobility.

Parallel to the introduction of LHD loaders, underground trucks were also introduced in our mines. Underground trucks Schopf-T103 type were used in ore haulage in horizontal and ramp managing haulage distance of 300 m in the Golema Reka district in the Sasa mine.

Today, underground trucks Atlas Copco Wagner-MT413 are used in the Svinja Reka district in the Sasa mine for haulage of the muck excavated during the drifting of level XV₀. The trucks will later be used for haulage of ore excavated from block ore passes to the central ore pass.

The disadvantage of diesel equipment is that it pollutes the mine facilities that results in higher ventilation costs.

Besides modernization of ore handling, our mines need modernization of the main haulage. Locomotive transport means, which are dominant, are rather old and cause production breaks that results in high operation costs. Following the model of modern mines in the world, where the main haulage is carried out entirely by belt conveyors, it is necessary to replace the locomotive transport by continuous transport means as modern technological solution. This experience was obtained during the work of the unique belt conveyor used in

our lead and zinc mines as a main underground haulage or conveyor used in the main haulage decline in the Golema Reka district in the Sasa mine.

The drift XIVB in the Svinja Reka district in the Sasa mine which is in the process of development will be the main haulage drift for the entire run-of-the mine production envisaged to yield 700,000 tons of ore annually.

The drift has a straight strike length from the surface to the central ore pass (level XIVB - level XII) amounting to 1,360 m. The drift also makes possible the installment of suspended belt conveyor since the drift is an access to the main service ramp. The installation of a primary crusher before the central ore pass is necessary so that the ore could easily be transported to the bin.

It is worth saying that because of the characteristics mentioned above the locomotive haulage used in the Probstip - Dobrevo drift should be replaced by a belt conveyor. The drift is 3,650 m long and contains three curves the radius of 500 m. Considering the fact that the minimum radius of the curve for the use of curvilinear conveyors allowed ranges from 200 to 700 m, it follows that it is necessary to introduce curvilinear conveyor without bringing changes to the drift. However, it is necessary to carry out overhaul of the drift because of deformations caused by the unfavourable physico-mechanical characteristics of the surrounding rocks. The conveyor could transport 600,000 tons of ore with the possibility to include the transport of the ore after the commencement of the operation in the Plavica deposit. All this means that the mined out ore should be crushed in the pit before it is transported by the conveyor.

Special conveyors or the High Angle Conveyors (HAC) could also be used in our lead and zinc mines. They can be used for haulage from lower to higher levels as well as haulage from parts of the deposit that are below the lowest transport level in order to avoid further deepening of the hoist shaft.

The introduction of conveyors to our lead and zinc mines will result in:

- the increase of the conveying capacity, lesser number of workers,
- reliability of operational system,
- lower power consumption,
- better security at work,
- lower dusting of mine facilities.

REFERENCES

1. Despodov Z.: Dosegašni iskustva i mogućnosti za pogolema upotreba na lentestite transporteri vo podzemniot transport vo rudnicite vo R.Makedonija, IV internacionalni simpozium o transportu i izvozu, Beograd, 1999
2. Despodov Z.: Izbor optimalnog lokomotivskog transporta u glavnim transportnim hodnicima u rudnicima olovo-cinka, III internacionalno savetovanje o rudničkom transportu i izvozu, Beograd, 1996

3. Grujić M.: Transport i izvoz u rudnicima, Rudarsko-geološki fakultet, Beograd, 1999
4. Ivanovski S.: Sostojba, problemi i prioritetni zadači vo razvojot kaj olovoto i cinkot vo SR Makedonija, Zbornik na trudovi od trkalezna masa, Rudarski institut, Skopje, 1989
5. Stevens R.M., Acuna A.: Load-Haul-Dump Units, Underground mining methods handbook, SME, 1990
6. Vukobratović T., Ignjatović M.: Primena diskontinualnih transportnih mašina u nemetanskim rudnicima, III internacionalno savetovanje o rudničkom transportu i izvozu, Beograd, 1996.

Recenzent: Prof.dr hab.inż. Jerzy Antoniak

Omówienie

W artykule przedstawiono osiągnięcia w modernizacji podziemnego systemu ładująco-odstawczego i sugestie dotyczące kierunków przyszłej modernizacji w celu osiągnięcia większej efektywności i polepszenia opłacalności eksploatacyjnej kopalni cynku i ołowiu w Macedonii. Równoległe z wprowadzeniem wozów ładująco-odstawczych typu LHD zastosowano także wozy odstawcze typu Schopt-T104, pracujące na odległość do 300 m. W Kopalni Sasa. Obecnie wozy odstawcze firmy Atlas Copco Wagner – M413 eksploatowane w Kopalni Sasa odstawiają urobek otrzymywany przy wykonywaniu przekopu na poziomie XV. Aktualnie podjęto również prace nad zamianą odstawy kolejowej odstawą przenośnikową.