Mining and unloading system of talc deposit in Rodoretto mine (Italy)

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In the talc deposit located in Fontane (Prali, near Turine, northern Italy) talc was mined in several mines which are closed now from number of reasons. At present, only the deposit in Rodoretto mine is being mined. Excavation methods used in the past resulted in relatively high accident rate; that is one of the reasons why the Rio Tinto Minerals - Luzenac Val Chisone company started to apply the excavation method with cement backfill. It is an underhand stoping with drifting and including also placement of a weak cement base in a stope [6]. The company has good experience with this rather expensive excavation method used for almost 35 years.

Key words: *talc, deposit, Rodoretto, excavation method, cement backfill.*

Introduction

At present, technical opening works on accessing the talc deposit in Gemerská Poloma in Slovakia are carried out. In the specification of the mining allotment, the District Mining Office in Spišská Nová Ves ordered to mine the deposit using the gob stowing method. Therefore, we have visited the Val Chisone deposit in Italy, where they use the excavation method that are to be used also in conditions of the deposit in Gemerská Poloma. In comparison with excavation methods used in Slovakia (open chamber, caving method), it is a highly safe excavation method, using of which resulted in absence of any serious industrial accident for the last nine years [1, 8].

Location and opening of the deposit

The deposit is located at the root of the Alps in rather complicated terrain. Especially in winter the costs on operation are higher. The finishing mill and the office are located near Prali, the town situated about 30 km from the mine. Road to the mine is rather complicated; a narrow mountain road leads there, in winter often covered with avalanches [7].

The deposit is opened by a horizontal tunnel with slight 1 % downgrade. It starts with a stone portal and continues with the opening profile of 5 x 5 m (Fig.1, 2).

Concrete is laid along the whole length of the foot-wall and it forms rather quality surface. Whole mine is tunnelled without any reinforcing elements in hard rocks (granites). At some places, where necessary, the SWELEX type bolts are placed (Fig. 3).

Second emergency exit, serving at the same time for ventilation purposes, is a chimney 270 m high, with the diameter of 3 m. The chimney is also tunnelled without reinforcement and goes through the deposit position. The chimney was not tunnelled in a conventional way, using the manipulation platform; it was drilled. An interesting fact is that neither the deposit section, led inside the talc, is reinforced, because blasting was not carries out here, so the talc was not disturbed. The chimney is equipped with a manipulation lift, which is exceptionally used. The opening is further followed by a spiral ramp, about 680 m long, with 12 % downgrade.

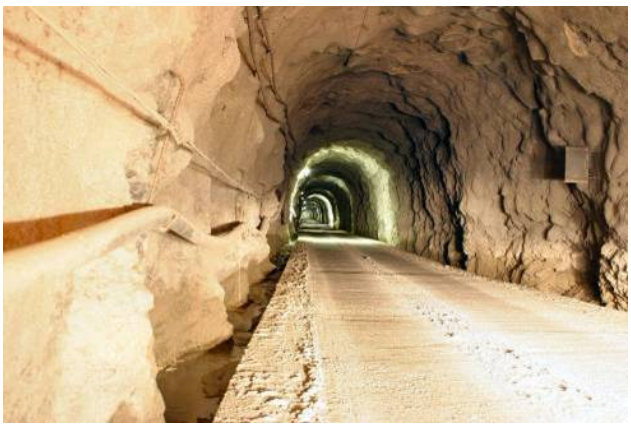

Fig. 1 . Mine entry.

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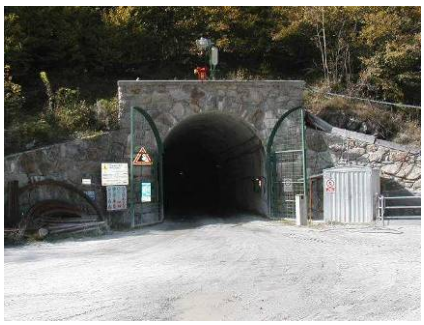

Fig. 2 . Horizontal tunnel with slight 1 % downgrade .

Mining and unloading system

Storing conditions at the deposit are comparable to the talc deposit in Gemerska Poloma in Slovakia. Significant difference, however, is in the way of opening. The deposit in Italy is mined in the superposed part and the general mining direction is downwards, whereas for lower horizons the spiral ramp is used. Similar method was used in 2001 to start the works on accessing the talc deposit in Gemerska Poloma, where the opening ramp was tunnelled as well; however, due to water problems, only later they made the opening by a succeeding tunnel, which undermines the deposit – ensuring thus gravitational drainage of the tunnel [2, 5, 6].

As previously mentioned, the deposit is generally mined downwards, whereas all stopes are founded with concrete mixture. This ensures the condition when lower-mined horizons are secured by concrete ceiling. At present, about 16 m of the deposit location is already excavated, that is 4 x 4 m of strong foot bridge (always one 4 m thick foot bridge is excavated). Out of the ramp, towards the deposit with the overall thickness of 40 m, access galleries with the profile of 3.5 x 3.5 m are driven, from which the mining gate roads are tunnelled. Access galleries (Fig. 4) are driven by gradual drilling away the so-called protective umbrella. It means that 6-9 m long drill holes are drilled directionally in the ceiling, they are lined and remain permanently in the ceiling. The span between individual drill holes is about 20-30 cm.

In some cases, they are injected with cement mixture. Under the ceiling secured in this way, access galleries are tunnelled; they are mostly reinforced with wooden reinforcement. Oak wood is used, in combination with lining with oak planks. At places where the pressure is higher, steel reinforcement is used [3, 4].

Gate roads themselves are tunnelled in a staggered way. It means that a tunnel (with profile of 4 x 4 m) is driven; the talc is excavated from it until the deposit position is completed. Whole stope is reinforced only with wooden reinforcement and wooden lining (Fig.5).

Drilling works are carried out using a single-carriage Mini Jumbo drill (Fig. 6). Number of drills depends on the material drilled. It is always decided by the workplace foreman, depending on current condition. Drive length is up to 2 m. Explosives are similarly dimensioned.

The main point is to carry out drilling and blasting works in order to reach quality fragmentation, i.e. piece rate from 15 to 35 cm. In principle, glory holes are not used, in order to avoid crushing of the talc pieces.

Fig. 3. SWELEX type bolts.

Fig. 4. Access galleries.

Fig. 5. Mining gate roads.

Fig. 6. Mini Jumbo drill.

Transport is made by conveyor loaders (Fig. 7) with the shovel volume of 1.5 m^3. During mining in stopes, grooved steel sheets are laid on the foot-wall so that loaders in stopes do not get into the foot-wall. These are liquidated after the stope is excavated. An important issue is that the excavated talc is selectively sorted by quality already during unloading. In principle, there are three types of talc: white, grey, and impure. This talc is transported into manipulation chambers, where they are stored depending on their quality. Then they are transported by trucks with the load capacity of 15 – 20 tons to further processing, which is sorting. Sorting is carried out manually, followed by sieving. Material sorted this way is then transported to the finishing mill.

Fig. 7. Conveyor loader.

Founding the stopes

All stopes are then deluged with concrete mixture. Driven and excavated tunnel is prepared for the foundation which is made in the following way. Wooden bracing is not liquidated. In some cases, so-called water props are also used in stopes. They are two-segment steel pipes (Fig. 8), one let into another, and at the bottom they are connected to a water pump which struts them by pumping into the foot-wall and the ceiling, then the segments are secured with a mechanical stop pawl. Then they are disconnected from water supply and that is how additional reinforcement is ensured. Neither this steel reinforcement is removed.

Steel net is placed on the foot-wall of a stope. The end of stope is closed by wooden planks up to the height of about 1 m. In the distance of about 6 m from the forefield a wooden barrier is made from the cieling downwards with a hole at the foot-wall, with the same width as the stope and the height of 1 m, into which

concrete mixture, transported into the corridor through piping, will flow. When the mixture is hard, the next dose of concrete mixture is transported in the first 6-metre segment. That is how the space in stope is filled up to the ceiling. It happens that a narrow 10 cm gap is left due to concrete backfill settlement. Before placing concrete, sides of a stope are covered with special foil (Fig. 9) so that the surrounding talc is not impure. In excavation of the neighbouring tunnel, the talc is separated from the foils.

Concrete is transported to stopes from the central concreting plant, to which cement is transported in tanks and blown into the bunker (size of tunnels enables that). Stone aggregate is used either from the own mining or it is mostly imported. Stone aggregate with fraction of 2-4 mm is used.

The mixture is transported from the central concreting plant through the steel piping mostly located in the ceiling (Fig. 10). Pipe diameter is 15 cm and it consists of 2m segments, connected by quick-acting couplings. In the stopes, light PVC piping is used, floating on the concrete surface.

Fig. 8. Two-segment steel pipes.

Fig. 9 . Special foil.

Concrete mixture is transported into stopes by hydraulic pumps. Daily output ranges from 100 to 150 m^3 per 8 hours. In the past, backfilling machines were used; however, they did not prove useful and that is why this system of concrete production and transportation into stopes is used.

Fig. 10. The mixture is transported through the steel piping.

Conclusion

Overall annual production in the past was 45,000 tons. It is quite interesting that they try to mine only quality talc; talc of lower quality is left unmined.

Excavated and sorted talc is transported to the finishing mill, 35 km away, where it is process only by so-called dry method – milling, separation, micro-milling. Depending on customers needs, talc is processed into fractions with size from 5-20 microns, and stored in bunkers. It is also an interesting fact that at the locality in question the talc is not processes by flotating [9, 10].

Used excavation method is highly effective. It has above all the following advantages:

- high safety level,
- high excavation rate (95 %), low pollution degree,
- possible selective mining according to quality of deposit filling,
- no secondary surface effects following the mining activities.

Disadvantage of this excavation method is represented by relatively high costs per excavated ton. This excavation method is effective only when the general downward direction is applied.

In the end, it is necessary to say that also in case of the Rodoretto mine there are high investment costs on accessing the deposit (opening through horizontal mine and a chimney).

Advantage of the deposit conditions is the fact that unloading of the material from the underground area and ensuring the mining operation is executed by trucks, which has certain advantages in comparison with rail transportation.

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