SIMULTANEOUS OPENING UP OF AN OPENCUT MINE
AND COLLIERY IN A COMBINED MINING SYSTEM

K. N. Trubetskoi

UDC 622.22'27+622.33.003:338.4

The adoption of combined opencut and underground mining systems, which share transport and winding systems, calls for new, more economic methods of extraction.

Experience at home and abroad in combined mining systems shows that schemes for opening up opencut and colliery takes are generally evolved independently, not comprehensively. No provision is made in the plans for using opening up workings in deep open pits for underground mining, or, conversely, for using the underground development workings to reach the lower levels in opencut mines. This is due to the absence of methods for opening up workings in a combined mining system making use of the same underground main roadways for the surface and underground work. I therefore propose a system combining the opencut workings with the colliery for steep seams.

The basic types of combined opening-up system recommended for the Gorev deposit can be seen in Fig. 1. They include: simultaneous opening up of the opencut mine and colliery by vertical shafts with crosscuts (1); simultaneous opening up of opencut mine and colliery by combined (broken lines) shafts, consisting of a top inclined shaft and lower vertical shaft, with crosscuts (2).

The essence of a combined system for opencut mine and colliery using vertical shafts and crosscuts is that part of the deposit is worked on an opencut principle through the top part of the vertical shaft (with enlarged section) and a concentrated system of crosscuts, worked out methodically on the outline of the opencut mine over a width equal to that of an excavator entry. The lower part of the vertical shaft should be of reduced section because it is from here that the colliery itself will be opened up.

As distinct from the preceding method, simultaneous opening up of deep opencut horizons and the colliery take by combined shafts with crosscuts involves driving two shafts (an upper inclined shaft and a lower vertical shaft) joined by a curve or with a transload transfer system.

From the operational aspect, it is better to join the shafts by a load-transfer system. A disadvantage is a slight increase in cost resulting from transfer of loads along the inclined and vertical shafts by individual winding facilities and the need for a load-transfer bunker. Nevertheless, exceptional reliability of the winding system as a whole and the comparative cheapness of the narrower shaft pay off the extra expenditure, particularly where shaft throughput is high.

Where the combined haulage system involves a skip winder in the inclined shafts, the unit for hauling the product along the roads inside the opencut network and the crosscuts to the load-transfer points is best provided by diesel trolley locomotives [1].

The locomotives move under diesel power along the face and stope roads in the opencut mine. Where crosscuts are assembled from prefabricated reinforced concrete panels, channel guides for the wheels and a water-drainage ditch must be installed; the trolley locomotive moves along these to the load-transfer point and is supplied from an overhead rail through truncated slip rings. In the case of low temperatures or very wet rock, the skips can be loaded directly from the diesels [2].

Combined opening up of deep levels in an opencut system and a colliery take using shafts and crosscuts has several advantages. The shafts used to mine out the top part of the deposit by opencut methods are later employed to open up the deep-lying part of the deposit which is accessible from underground; the drainage arrangements for the opencut mine can be solved alongside opening-up problems; mining operations can proceed at the top levels of the opencut mine independent of the method involved in opening up the lower levels; rock haulage distances on the surface are shorter; the opencut bench wall is free from skip winders and associated structures and...
facilities; the depth of the opencut mine can be extended (dimensions in plan) without altering the opening-up system (provided that the shafts are suitably distant from the outside limits of the open pit); winding continues uninterruptedly, together with the operation of the opencut mine, regardless of slips or caving at the sides; it is possible to drive the main opening-up roads (shafts, concentrated crosscut system) without regard to mining operations in the opencut mine.

Where a combined transport system involving skip winders in the colliery shaft is used, it is best to discharge the internal opencut transport facilities (bringing the rock a number of working stopes) on a concentration level which is equipped with crosscuts to link up the pit stopes with the skip winder pocket.

Experience has shown that the best place for such a concentration level is in the center of group of stopes. It is not advisable to work out more than one stope above the concentration level because complications occur when it comes to developing the lower levels and it is also more expensive to bring rock down by the opencut mine's transport facilities and then rewind it by the skip plant.

As the distance increases between the concentration levels, the expenses involved in driving and maintaining workings per ton of rock decrease sharply, but the cost of hauling one ton from the face to the pocket in the skip plant increases. The optimum distance between concentration levels is evidently that at which the sum total of expenditure on construction and maintenance of workings and additional costs involved in the mine's own transport per ton to rock transported is at minimal value. As far as the Gorev open pit is concerned, such an optimum distance (height) between the concentration crosscuts is 60 m (Fig. 2).

Both these alternatives have their drawbacks and advantages. The chief disadvantage of the first one is the much greater length of concentration crosscuts in the opencut mine and the crosscuts for the deep mining. The second alternative reduces this disadvantage and considerably reduces (20%) the amount of concentration crosscuts in the opencut pit, while minimizing the length in terms of underground mining. However, the rock has to travel further and shaft work is increased owing to their slopes.