Long hole charging and blasting

Avoiding damage to surrounding rock is no easy task for any driller or blasting engineer. But the challenge is far greater in large-scale methods where long holes are required – especially when mining at depth.

As operations go deeper into existing mines, the risk of deviation and faulty locations of blastholes increases, and seismicity and rock instability become crucial factors to deal with. Hence, today, it is increasingly important to master the skill of long hole drilling and blasting. Although bigger stopes and hole sizes usually require less specific drilling and charging per tonne ore, there are other crucial matters to consider.

For large-scale methods such as stoping, caving with long hole drilling, both upward blind blasting and between sublevel blasting, are applied. Here, parameters such as rock conditions, backfill stability, vibrations, fragmentation, unwanted overbreak, ore recovery and dilution all need to be evaluated closely. For selective mining methods such as cut and fill stoping, the face appears like a wall across the stope with an open slot at the bottom, above the fill. It is drilled with breasting holes that are charged and blasted, with the slot underneath providing space for the blasted rock to expand.

The importance of straight holes cannot be overemphasized. If deviation occurs, a number of problems may well arise, including uneven fragmentation, increased vibrations and increased dilution of waste rock/fill material or ore loss. Apart from precision drilling, it is important that the charges are carefully dimensioned to the holes. Prior to this, however, slot raises must be created between the levels or as blind raises.

Fig 5: Opening raise, offering swell volume for production blasts.

Opening slot raises

The function of slot raises is to provide a void, or free space, that can absorb the blasted rock from the charged holes. These openings also need to be large enough to accommodate rock swelling which is an effect of blasting.

Some of the typical raises include the parallel hole raise, the slot raise and the big hole raise, with variants of these (see description below). The Alimak raise, which involves handheld drilling and

climbing, is a less preferred and more hazardous raise type and is increasingly being replaced by mechanized methods in mining.

Examples of the most common raise types and how they are produced:

- Parallel hole raise: reamed cut holes of 127 mm surrounded by smaller blastholes, creating a void of a desired size and dimension that can absorb rock from the subsequent blast.
- Slot raise: 150 mm holes drilled together to create a slot surrounded by blastholes, enabling a suitable opening for the same purpose as above type, to absorb the blast.
- Big hole raise: created by raiseboring 700–2 000 mm holes.
- Boxhole raise: upward raise drilling, also known as “blind raise.”

This can alternatively be done with clusterboring technique, although it is less common. To achieve the final swelling void before the full production blasting is started, all these opening methods are followed by initial long-hole production blasting of the closest surrounding holes to enlarge this void.

As a general rule, good practice in drilling and charging will include:

- Reamed holes, charged and uncharged.
- High precision drilling.
- Detonator delay adjusted to length of raise.
- Minimized risk of unexpected detonation of surrounding holes.
- Easy and smooth blasting, to avoid damage of environment.

Mining methods such as sublevel caving, sublevel open stoping and block caving all use similar openings where the parallel hole cut, or large hole cut, is the most frequently used.

Up hole charging

Once opening raises/slots have been drilled for production ring blasting (see void Figure 5), it is important to secure blast initiation. This is sometimes done by using more than one detonator in each strategically located hole.

An example of typically charged holes in a sublevel caving fan with more than one detonator in each hole is shown in Figure 6.

Burden and hole spacing should be adjusted according to rock type, hole dimension and type of explosives used. For uphole charging, the explosive must stay in the hole, requiring the exact combination of hole dimension and explosives type. This may prove harder to solve when it comes to big hole dimensions, and wet conditions will also make this method more challenging to employ.

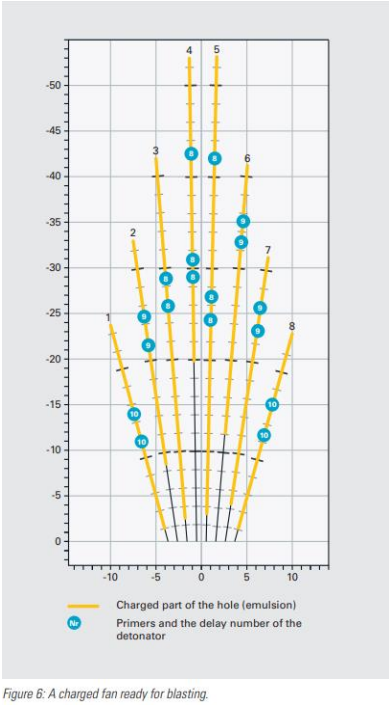

Figure 6: A charged fan ready for blasting.

Down hole charging

The most common procedure in downhole charging is to charge the entire hole and detonate one or several fans in the same round, using different delays both within the fan, and when the next is detonated.

With downhole charging, it is also possible to separate the stopes in height and blast the lower parts first. It is also known as the VCR method (Vertical Crater Retreat.)

The advantage of this approach is that the full force of the explosion can be contained in the borehole until the rock begins to break. This is done by stemming the holes, whereby fine gravel is inserted into the blasthole on top of the explosives.