ORESOME PRODUCTS

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STANDARD OPERATING PROCEDURE

Oresome Products Use ONLY			
Standard Operating Procedure No:	SOP-001	Version Number:	1.1
Date Approved:	15/03/2013		
Date for Review:	31/12/2015		

Summary:

Name of procedure	Deployment of stemming plug
Type	Vari-Stem™ blast hole stemming plug

Details

1. PURPOSE.

To provide instruction in the standard use of the Vari-Stem™ stemming plug, including any relevant information on transport, storage, manual handling and deployment.

2. BACKGROUND INFORMATION.

Blast energy can be divided into two components:
Applied energy – shock & heave energy used in material breakage;
Lost energy – air over-pressure, ground vibration & excess fines (over-blasted material).

Stemming is inert material used to confine energy in the blast hole at the top of the explosive charge. Insufficient or inefficient stemming allows the blast energy to prematurely vent at the collar, reducing the energy applied to breaking & moving the rock mass. Stemming ejection is a common cause of lost energy in the blast, especially when drill cuttings are used. Stemming plugs can reduce processing costs by achieving tangible increases in fragmentation in the stemming area by increasing the spread of the blast pattern with the same fragmentation. This can result in major savings in drilling and explosive costs, proving that stemming plugs can be a cost-efficient means of reducing costs in blasting and processing.

The amount of stemming material required for proper energy confinement, and by extension the benefit of using stemming plugs to increase stemming performance, can be quite site-specific but as a general rule the following factors affect stemming performance:

1. As rock strength at the top of the bench increases, stemming performance must increase
2. As charge diameter increases, stemming performance must increase
3. As charge energy increases, stemming performance must increase
4. As burden (horizontal relief) increases, stemming performance must increase
5. As water in the stemming area increases, stemming performance must increase
6. As flyrock becomes an increasing consideration due to proximity issues, stemming performance must increase

In theory, the fragmentation mechanism of a blast that is most widely accepted is that the reflected and colliding compression waves create tensile waves that cause fracturing in the rock mass. This all happens within several milliseconds of detonation. These fractures along with the pre-existing natural fractures in the rock are then penetrated by the gas pressure pulse from the detonation. It is this pressure pulse that rips apart the rock mass into the effective level of fragmentation. The effectiveness of the pressure pulse is directly proportional to the confinement of the explosive energy. The enhancement of the stemming column via plugs does improve confinement, thus improving effective fragmentation. So the plugs do not affect the formation of the fractures but they do effect the performance of the gas pressure pulse that does the work of breaking up the rock into its effective fragmentation.

3. Operating Procedure.

- Store boxes in a dry area to prevent premature deterioration of the packaging.

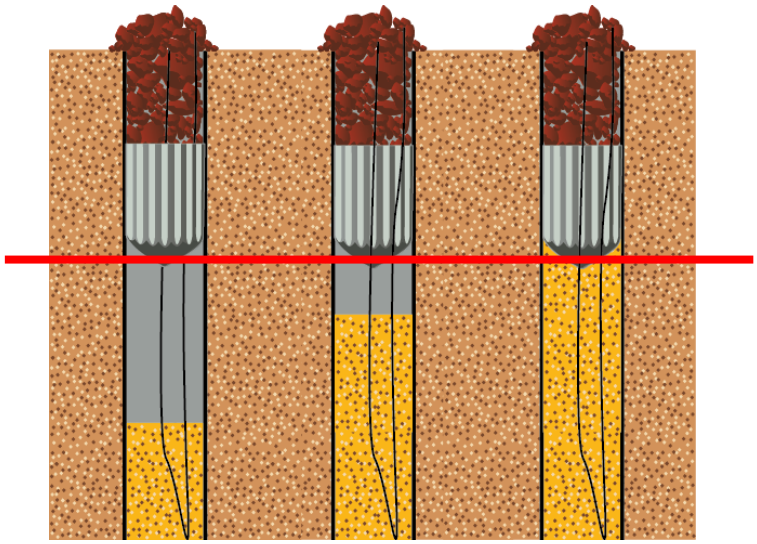
- Vari-Stem™ is not classified as a dangerous good for transport, storage & handling, so ships and stores as general cargo. It is constructed of inert plastic material and has a virtually infinite shelf life as long as the product is correctly stored and packaging is intact. The weight of each box will vary due to the number & size of plugs in a range of approximately 4.5 to 23kg, requiring only standard personal protection equipment (PPE) and manual handing procedure as required by law and/or site regulation.

- Each box contains a quantity of stemming plugs depending on the size (smaller blast hole sized units ship more to a standard box, and visa versa). A plug may contain a cardboard ring to keep the shape in tact during transport. In the 9.00”/229mm size the ring is left inside the product during deployment, all other sizes the ring is removed prior to deployment.

- If the plug has distorted in shipping and/or storage, merely stretch the plug back into shape.

- If emulsion explosive has been loaded, wait for at least 30-45 minutes for the emulsion to gas (please consult the explosive manufacturer for confirmation of this value) before loading the stemming plug. Loading prematurely can cause 'dead pressing' of the explosive that could prevent it achieving the correct detonation characteristic, or prevent detonation at all.

- Have a loading pole long enough to push the plug into position. The correct stemming hiegth is generally in a range of 20 to 30 times the blast hole diameter depending on quality of the stemming material, presence of water in the top portion of the hole, powder factor, rock strength in the upper flitch, and burden. The depth should be clearly indicated on the pole for the benefit of the operator, and to ensure consistency from hole-to-hole across the shot.



- Where a rope is attached to the plug to support it and prevent slumping when decking in larger diameter hole sizes, please follow the following method:

  - If the plug has not been modified to take a rope, drill a hole of approximately 8-10mm
  - Feeding from inside the plug come out through one hole and back inside the plug through the other to create a loop around the spigot in these larger size plugs.
  - Create a secure hitch, such as a bow line.
  - In the case of heavy stemming loads, tie a secondary hitch

- Prior to positioning the plug in the blast hole place some drill cuttings or stemming material in the plug cup (¾ filled if using cuttings, ½ full if using crushed rock stemming)[1]. In dry hole push the plug to the desired depth with the loading pole. With wet hole, pushing into position may be slower as the water needs to pass the geared profile of the plug. The geared profile of the plug is designed not to damage down lines & cords. The operator should note not added tension on the down lines wwhen pushing the plug. This procedure results is consistent stemming heights across the entire shot, which in turn contributes to consistent & improved fragmentation results.

- After using the loading pole push the plug to the desired depth representing the bottom of the stemming, manually put some stemming material in the hole, enough to fill the cup of the stemming plug at least, more is better. Tamp the stemming material to lock the plug position. As well as helping to lock the plug in position, it will also cushion any shock from stemming material dropping into the initial position.



- In wet ground, water will be displaced by the stemming material. When tamping the stemming material (especially if the stemming is drill cuttings or a significant percentage of drill cuttings) extreme care must be taken not to cause any damage to down lines and cords in the stemming area. Only trained & experienced operators should perform this task.

- If liners are being used in wet and/or badly cracked ground, push the liner to one side prior to placing the plug in the collar. Carefully push the plug into position. Ensure the stemming is well tamped to increase ejection resistance when using liners.

- After stemming has been loaded and during final inspection prior to firing the shot ensure all holes area stemmed to surface level at least, and no holes show signs of subsidence of the stemming material. Subsidence can occur when drill cuttings are used as stemming in wet ground or if the stemming plug has moved, and any change to the down lines (such as increased tension or evidence of movement) should be carefully remedied or at least recorded in case it is relevant to any post-blast analysis.

4. References.

International Society of Explosive Engineers (ISEE) Handbook, 18th Edition (2011), pp.199, 370.

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