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B-Gel Mixing Instructions

When using B-Gel in a quarry for the very first time, it is recommended that it first be tested by trimming a block or shooting a small line of holes prior to attempting a large production blast. Most quarries will use the standard B-Gel mix, however, since no 2 quarries will have exactly the same characteristics regarding compressive strength, tightness of beds, or in the case of no beds where lift holes are needed, some adjustment may be necessary. Some quarries also have a "direction" in the grain of the rock where it will split easier in one direction. This is particularly true in rock formations that have been formed in a sedimentary process.

In order for B-Gel to work properly, the blast must create enough pressure to exceed the compressive strength of the rock to open a crack at its weakest point, yet absorb all excess energy to prevent radial cracking. When pressure builds up in a line of closly spaced holes, the first crack to form is at its weakest point. This is the space between holes. Once this crack forms and the block begins to move, all excess energy is vented, thus protecting the stone from damage. The amount of time is critical in building pressure in the holes to its desired maximum. Slowing the whole process down gives the block of stone a chance to start to move once the initial crack between holes is formed allowing extra energy to be vented.

B-Gel slows this pressure build up and is adjustable by regulating the compressibility of the gel. This is done by the adjustment of the compressible part (air bubbles) of the gel. Detonating cord explodes at approximately 3 microseconds per foot. If no stemming material surrounds the cord, or even dry material such as sand or drill cuttings, most of its energy is wasted and vented into the air during the blast. This requires a high strength det-cord, (40 grams per meter or more). If the space around the cord is filled with non-compressible water, all shock energy reaches the drill hole walls and begins forming radial cracking until adjacent hole is sensed and rock begins to move. The shock wave actually travels three times faster through water than stone, so there can be considerable damage from water-filled holes. B-Gel slows all this down because of the time it takes to compress the air bubbles in the gel.

In a standard B-Gel mixture of 1% by weight micro bubbles (Pre-Mix has 48.5% by wt. bubbles), the time required to compress the bubbles to maximum pressure exceeds 100 microseconds per foot versus 3 microseconds per foot for det cord (and is even faster in water). This extra time allows the crack between holes to form and allows the block to move before damaging radial cracks can occur. There is a very narrow

window in some stone between where the first crack from hole to hole forms and radial cracking begins to occur. In this case, some adjustment in gel compressibility, drill spacing, hole diameter, or cord strength may be necessary. The proper combination of these adjustable parameters must be found, because too much energy causes damage and too little causes hole rifling (where B-Gel is ejected from holes without splitting). This narrow window occurs in some granite-type stone (this is the exception, not the rule), all other rock types have a much wider window and require less testing.

Another factor to consider is the free space (or lack thereof) around the block. If there is no place for the block to move, a crack cannot form, and the holes will rifle. It's like trying to split a board in a vice. It can't be done, or it takes so much energy that you can't help but damage it. This is also true when considering the tightness of the bottom seam if no lift holes are drilled. If the block is sitting on a loose or slippery seam, much less energy is required to move it. The burden (distance from line of holes to face) also needs to be considered. It is recommended that the burden be no greater than the hole depth. For the block to move, it requires a certain amount of energy in relation to mass. When the burden is too great, the concentration of energy per foot of hole required to move it becomes too great, which can also cause damage.

B-Gel is formulated to allow for adjusting its compressibility in the field. The thickening agent portion of the Pre-Mix is ph activated. When Pre-Mix is added to normal ph-7 water, the mixture is slightly acidic (around ph-5). As ph is increased by adding a base (ex: ammonia), the mixture gradually increases in viscosity to it's maximum at ph-7. The actual viscosity is not important in the performance of B-Gel. The viscosity needs only to be thick enough to suspend the micro bubbles and this is accomplished within a wide viscosity range. With minimal experience, this can be visually observed. As the gel thickens it becomes darker in color and if a drop is sprinkled onto the surface a small crater will form and will remain for a period of time. A fairly thin gel will suspend the bubbles for an adequate period of time required to load and shoot the det cord. If the viscosity is too thick, it does not negatively affect performance. It only makes it harder to fill the holes. In fact, special formulations may be made to facilitate filling of inclining holes for a horizontal shot by increasing the viscosity to resemble grease. A special situation like this exists when smooth wall blasting (trimming) tunnels in underground mines. This can save a lot of time and money in scaling loose rock and making the mine safer.

Remember, viscosity is not the important factor in performance. Density is, and this is regulated by the percentage of micro bubbles in the final product.