Comments on Rock blasting

The two explosion regimes of a balloon (Confinement)

By Bruno Pimentel.

Hello my friends, I hope to find you all well, and that if there is any difficulty, that it is about to be overcome!!!

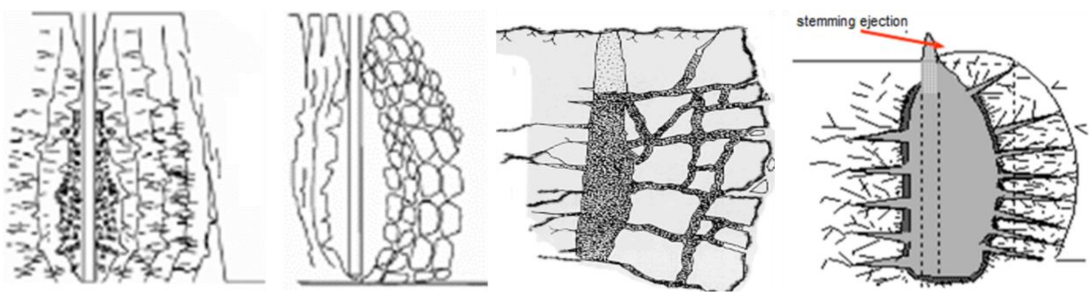
For those who have not yet subscribed to our Newsletter, I leave here the link for them to do so and so they are automatically notified with each new article, and of course, for those who have not yet seen it, please check out the previous articles:

https://www.linkedin.com/newsletters/desmonte-de-rocha-c-explosivo-6941709482355748864/

In today's article we are going to comment a little on a very interesting comparison that has to do with the confinement of energy, or rather gases, which we can say is a topic that has great relevance in the behavior and result of any blast, and is directly related to the efficiency of the use of explosive energy in the rock blasting process, and also to safety, with regard to the undesired effects that can be generated by blasting.

The importance of confinement, or even the absence of confinement in special blasts, such as pre-cut cases, makes the topic very broad, and therefore we will try to limit ourselves as much as possible to the objective of this article, which is we bring the example of the theoretical concept about the 2 blast regimes of a balloon and relate this concept to rock blasting, and at other times we will certainly return to this topic to detail it a little more.

But before going to our goal, something that we always commented and that we need to keep in mind when performing our blasts, is that we don't control the explosive or its energy during the blast process, and what we do in practice, is to try to direct the energy generated by the blast of the explosive, so that it acts according to our goals, but unfortunately in this process it is common for a large part of this energy to be wasted, or rather, to follow paths that we did not foresee or do not favor us, and therefore, in order to carry out a good rock blast, we first need to understand the behavior of the explosive during this process, and from that understanding, we try to take advantage of or direct a greater portion of its energy so that it acts according to our objectives.



Part of this understanding is related to the fact that we want the energy generated by the explosive to act as much as possible on the predetermined rock block for blasting, and for that to happen, we have to confine as much of this energy as possible, and for as long as possible, within that block of rock, so that it exerts greater force on it and thus acts more intensely in the fragmentation process.

Just to illustrate the process of the explosive energy acting on the rock block we want to break, here is an example (Berta) of the energy distribution consumed in the rock blast process:

1- Displacement < 1%

2- Fracture < 15%

3- Launch - 5-6%

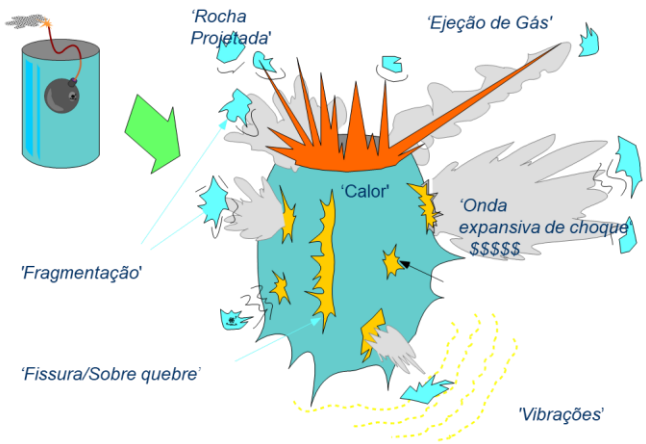
4- Fines - 1.5 - 2%

5- Flyrocks - < 1%

6- Local deformation of the rock - < 1%

7- Vibration 40%

8- Losses in the atmosphere 37- 38%



As can be seen, much of the explosive's energy produces phenomena that are not of interest to the blasting of the rock, on the contrary, they are the effect of a harmful action on the blast's environment, such as vibrations and the flyrockso itself, which we have commented on in previous articles, and largely Part of this is because the energy of the explosive “escapes” the boundaries of the block of rock we want to break.

In this example, which represents a large part of the blasts, we can see that almost 80% of the energy is spent or lost with items that do not bring benefits to our rock blasting process, and so we can say that most of the explosive energy is wasted during the blast process.

Here it is worth noting that these inefficiencies or energy leaks in the blast process can occur for several reasons, ranging from rock characteristics to inefficiencies in the execution of our blast, as our objective here is not to extend this topic too much, we leave it as example this previous article, which punctually (aiming at flyrocks) will give some examples of the factors that cause this premature escape of energy:

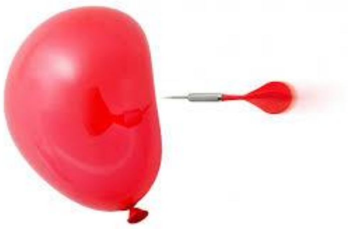
https://www.linkedin.com/pulse/flyrock-part-02-03-blasting-trainings/?trackingId=SDvExGUaSb%2Bmp%2Bh6r6gujQ%3D%3D

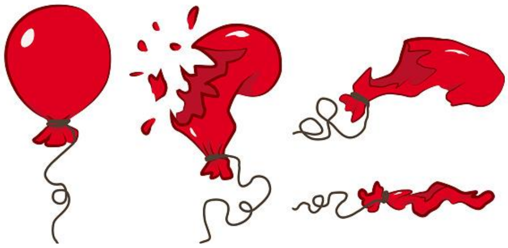
Ultralançamento (Flyrock) - Parte 02

Blasting Treinamentos no LinkedIn

In a very summarized way, on the one hand we can say that the process of using the explosive energy in rock blast is very inefficient, and on the other hand, that we have a large portion of energy that we can use in rock break, and part of this energy can be better used when we reduce the escape of this energy, limiting its performance inside the rock block for as long as possible, and this is precisely what we try to do through confinement.

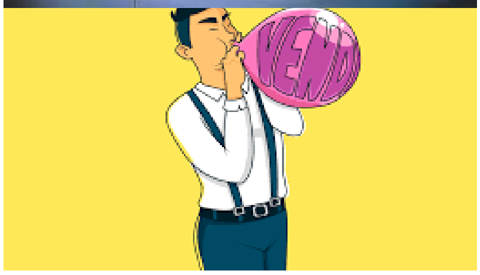
So, in order to understand a little better the importance of confinement and the use of energy in the rock blasting process, in this article we would like to make a very interesting comparison between the rock blasting process with explosives and the 2 main blast regimes of a balloon... that's right! A balloon like this party, which we see mainly at children's parties!! ;D...



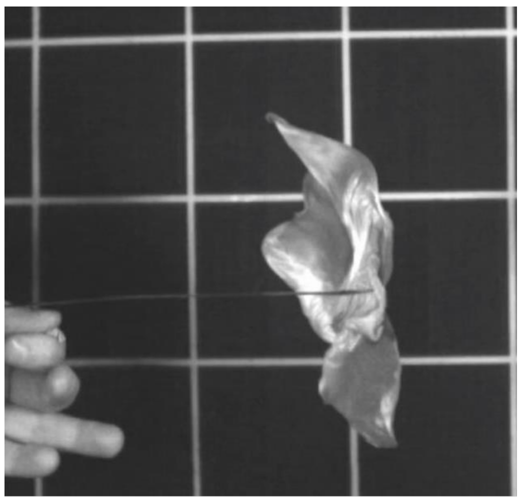


There are several ways to pop a party balloon, but we can say that there are two main ways:

1 – The first is when we use a sharp object, like a needle, and we make a hole or a cut, in any part of an inflated balloon, and this will make all the air that is under pressure inside the balloon try to come out at the same time by that point, causing the balloon to burst.

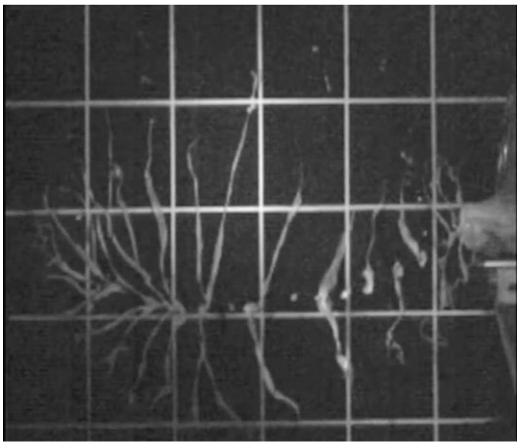


2 – The second way is to go on blowing and continue filling the balloon, until it no longer resists the internal pressure generated by the air inside it, and then it bursts. This is because the air pressure inside the balloon exceeds the resistance of the plastic, which is stretching and getting thinner, to the point that it cannot stand and bursts.



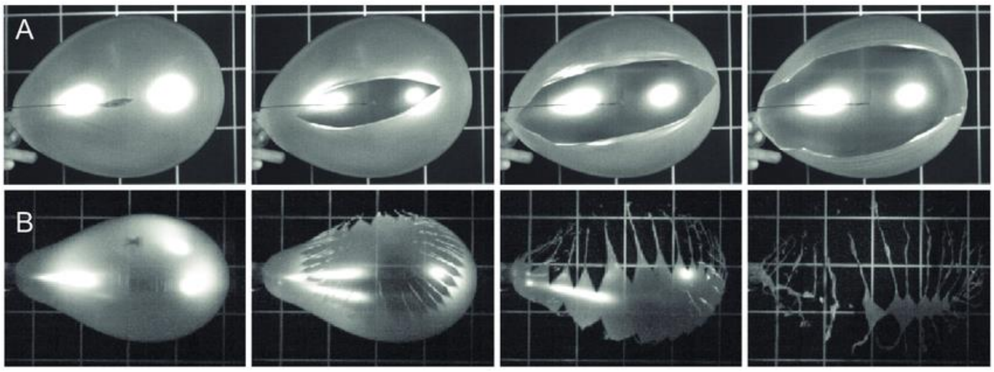
The main difference between these two forms is how the energy acts to break the balloon, where in the first case, all the internal energy (represented by the air that is contained inside the balloon) will be directed to the hole we created, that is, the point opening or weakness in the balloon, this will make the air exert greater force at that point of weakness, widening it, to make more space for its exit, so that it becomes the main point of damage in the balloon, and the consequence is that we will normally have a large tear and the balloon will be in one or a few large torn parts.

In the second case, the internal energy makes a pressure evenly distributed throughout the balloon, and as we continue to fill the balloon, this energy increases until it reaches the point where the balloon can no longer contain the air pressure, that is, the energy internally, and it breaks, usually shattering into several fragments. Where the tendency is that in this case we have more damage to the balloon, resulting in a large number of pieces, which will be more damaged and even some may be stretched, as their elasticity has been exceeded and they may not return to their initial contraction.

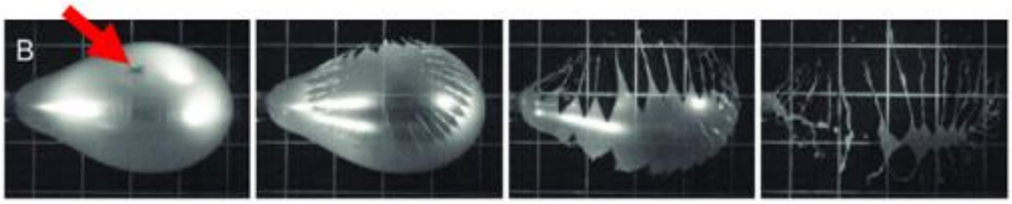


Of course, this considering the perfect theoretical scenario, because for example, in the second case, where we inflate the balloon until it bursts, the quality and uniformity of the plastic of the balloon will directly interfere in the process, because if the material is not equally resistant, and it has some thinner or damaged part, it will serve as a point of weakness and the balloon will burst at that point, and so the behavior will be very similar to the burst caused by a hole in the balloon, the difference is that in the first case we artificially created the point of weakness, by making a hole in the balloon, and in the second, the point of weakness of the material is who was responsible. While when we have a uniform material, its resistance will be evenly distributed, so when it bursts it will suffer the same damage in all parts, and thus we will have the maximization of the damage and the fragmentation of the plastic.

Here in the figure below we can see an example of the two cases, where in part A (above) we have the case where we pierce the balloon with a sharp object, and we see that all the damage to the balloon occurs from that point, while in part B (below) we see that the balloon suffers much more damage when bursting by the air pressure, to the point where we see a clear difference in the last frames of the balloon's state.



If we look carefully, we will see in this example, even in the second case (part B) of the example above, the rupture starts from a point, which is the weakest point of the balloon, but as the pressure is much greater, it is acting for much longer and evenly distributed throughout the balloon, even if the rupture starts at a point of weakness, the damage to the balloon is much greater. This is because we will hardly have a perfect balloon, in which the material has no flaws, but even so we can see the difference in the damage caused to the balloon.

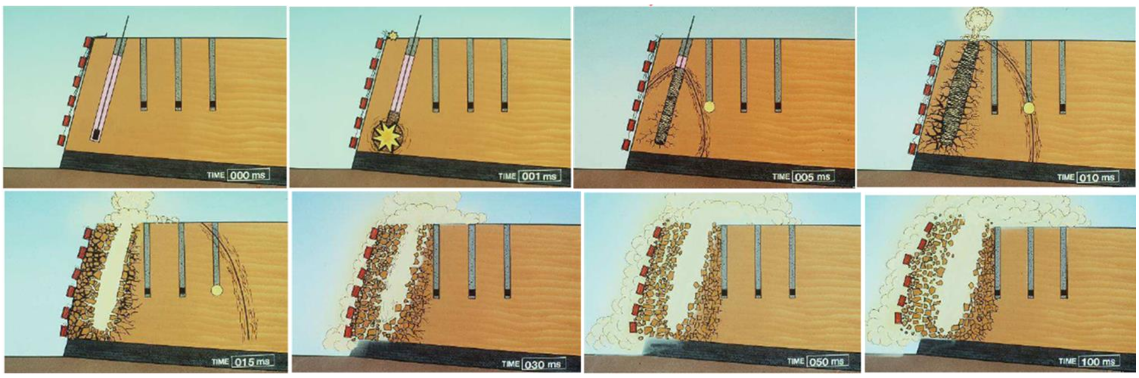


I'm also going to put here two videos that will show in slow motion these two balloon popping regimes, so you can see in more detail, before we can go on with the comments.

Video 1

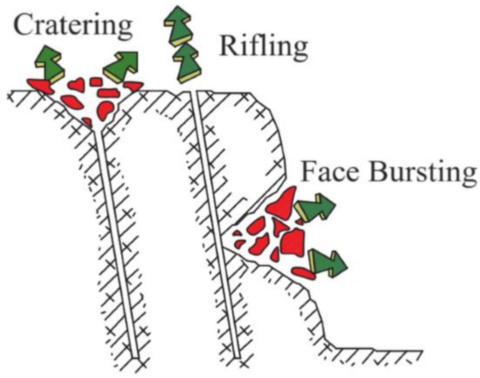
Video 2

These two regimes are very similar to the rock blasting process, where what happens is that when the explosive detonates, it turns into a large amount of gases, which, like the air, creates an internal pressure in the balloon, these gases generated by the explosive they also put an internal pressure on the rock, or the hole, and they keep expanding and pressing on the rock until it breaks.

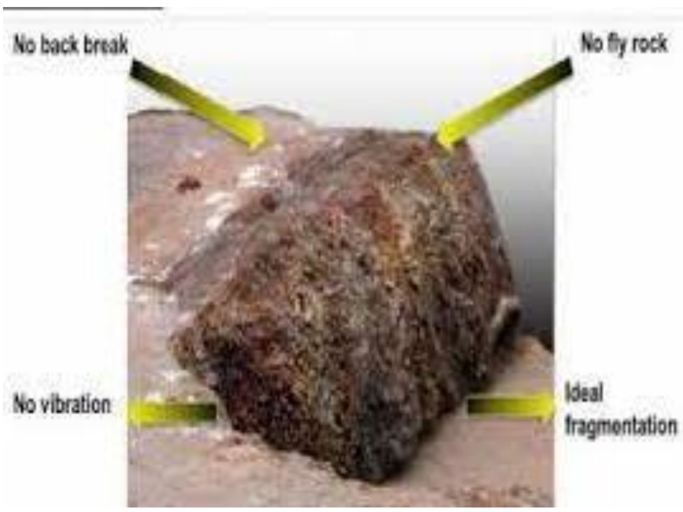


It is clear that the rock blasting process is much more complex, where we have other forces acting, in addition to gases, as is the case of shock waves, and the material is much more complex than the plastic in the balloon, but if analyzing only the punctual effect of the blast gases, we can make a good comparison with the balloons.

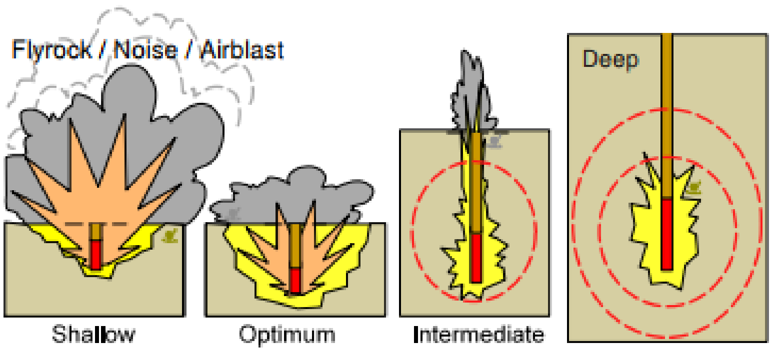
In the same way as in the first balloon blast regime, when we have an escape point or we create that point through our operational errors, such as the deviation of a hole or an inefficient stemming, the gases generated by the explosive will find that point of weakness and a good part of your energy will be directed to that point, and with that we will have a much more inefficient blast process, where due to greater energy loss, we will first have less fragmentation, with a tendency to have larger fragments, and then we run the risk of having serious unwanted effects, such as cases of flyrocks or increased vibrations, especially air vibrations, such as airwaves and noise.



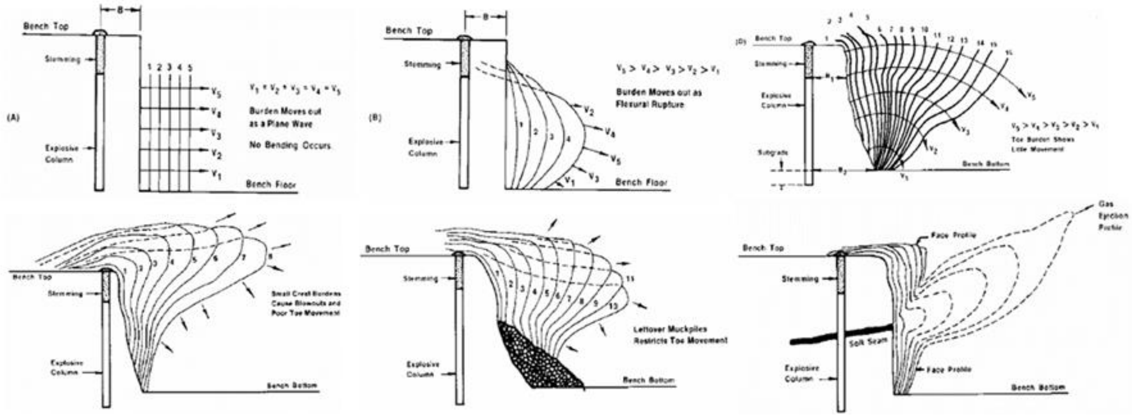
On the other hand, when the characteristics of our blast are favorable, such as balance in design, absence of anomalies in the rock and good operating practices, the explosive gases are confined within the rock for a longer period of time, and thus they expand and proportionally increasing the pressure they exert on the rock, and this makes us have a better use of the explosive's energy, and thus, in the same way as in the second regime of the balloon, the rock block to be fragmented will suffer more damage, where we will have smaller and more damaged fragments (microcracks), and at the same time, this will consume a greater amount of energy, leaving less energy to be wasted and reducing the risk of possible impacts that could be caused.



This process of containment of the gases in the rock, during the blast, is what we call confinement, and the objective is that it is adequate to the point of maximizing the action of the explosive gases in the rock, because when it is smaller than necessary , we will have what we have already commented, which is the premature escape of the gases and a lesser action of this in the fragmentation process, while if we have an exaggerated confinement, the explosive may not have enough force to break the rock, causing only damages around it and a high level of ground vibrations.



Unfortunately, we can choose how we pop our balloons, but in rock blasting, for the most part, there is even a great deal of difficulty in identifying the points of weakness that we have in the block of rock being blasted, and so it is often difficult to predict the level of confinement and even how the explosive will act on the rock that we have never detonated before, so whenever we are going to start an operation or perform blasts that are unknown to us, we need to carry out a series of observations and tests over several blasts so that we can evaluate the behavior and the best techniques for each case.



In an area and rock that we have already detonated constantly, we need to observe the behavior of our blast, measure and control our operational variables, so that we can optimize our blast, seeking to provide adequate confinement, so that the gases can act for the longest period of time possible.

On the other hand, along with maximizing confinement or harnessing the energy of the explosive, we need to evaluate our objectives, which are not always as simple as just fragmenting the rock, as we can have different control limits, such as vibrations or launch of the material, or we can have more detailed fragmentation or dilution control specifications, and so our job is always to balance our needs and how we will maximize the performance of the explosive in our blasts.

Not always our goal and the settings of our blast will lead us to what is usually called a “perfect blast”, where the blast often looks more like the fermentation process of a cake than the popping of a balloon, because in some cases , the ideal blast will be the one that maximizes our goals, while reducing the risk of possible impacts, so for example, we may need a large release of material, or separate materials for dilution control. So first we need to understand what we need, and then design our blast.

One way or another, it needs to be clear that the blast process is very, and puts a lot into it, more complex than popping balloons, and the goals can be quite different, because while for a child the best burst will be the one that makes the most noise, for us, will be the one in which we can maximize the use of explosives energy, reducing waste, as this will help us better achieve our goals, while reducing costs and minimizing risks.

That's it, we don't want to extend this theme too much, the idea was just to bring party balloons to the game, so we're finishing another article in our Newsletter.

We are receiving little feedback and suggestions, so we believe that everything is either very bad or very good, but we follow and hope that we are contributing in some way.

As always, we hope you like it and we're open to suggestions for themes that you believe can help improve the standard and security of our blasts.

Please comment and share, so that we have more and more safe and quality blasts!!

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