Detonation Theory (part 02 of 02)

By Bruno Pimentel.

Hello my friends, I hope everyone is well and enjoying our articles in some way. As always, we leave here the links so that you can check our previous articles, as well as register, so that you are automatically notified with each new article that we publish, but before that we are going to start apologizing because we will start publishing monthly, because the routine it's well pulled and we're really not able to meet all the demands.

So what we will do is publish a new article monthly, preferably in the first week of each month, and in the middle of the month we will be publishing the English version of the previous article, as we were already doing. As we get some friends who want to contribute, we will publish these articles in the middle of the month then we return to our biweekly rhythm.

Português

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

English

https://www.linkedin.com/newsletters/rock-blasting-6959820770344595456/

In our last article we brought some main points about the theory of detonation of an explosive when applied inside a hole to carry out rock blasting, so in today's article we will continue the theme talking about some factors that can affect the detonation process, as well as the main effects of detonation, so that in the following articles we can talk about the rock fragmentation process.

So, first of all, it's important to keep in mind that this whole detonation process will always be affected by several factors that will vary in each blast, where depending on the scenario, objectives and type of blast, some can influence more than others. That is why one of the main points when carrying out a blast is to have quality control in the preparation and application of the explosives, to guarantee that they can carry out their work without being affected by these factors that can be related both to the quality of the explosive itself , as with external factors that will interfere with the detonation reaction and impact the results of our blast.

As our objective here is not to go into great detail, despite raising the topic for further discussion in operations, we will limit ourselves to giving a few examples, where our first factor is the type of explosive, because for each type of explosive, we will need a different activation energy, we will have a different reaction speed, and several other factors will be influenced by the characteristics of the explosive we are using.

For example, while in pumped emulsions we will have microbubbles, in ANFO-type explosives, the air contained in the porosity of ammonium nitrate grains will play the role of “hot spots”. In the same way that each explosive will have a different reaction speed, according to its chemical components and the way they react with each other.

The density of the explosive will also affect the detonation reaction, mainly because it affects the velocity, and in turn the detonation pressure, and can also be determined by means of

sensitization of the explosives, such as the amount and size of the microbubbles present in the explosives. gasified explosives.

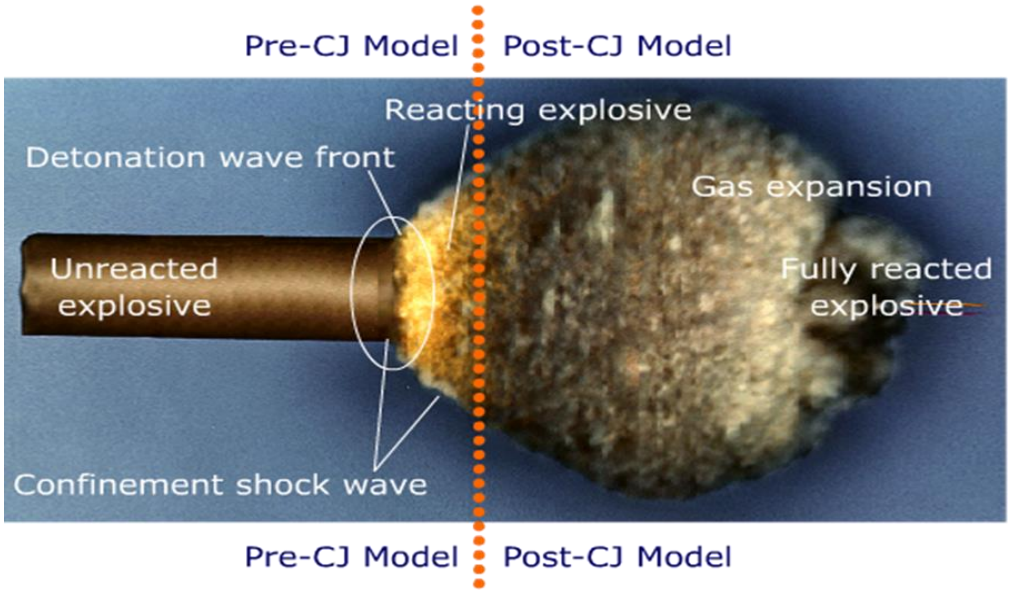
Likewise, the diameter of the explosive charge and its confinement will directly influence the detonation reaction, and directly influence the speed of the reaction.

As we have already mentioned, the initial stimulus is fundamental in the beginning of the process, being necessary that this stimulus exceeds the activation energy, as well as it will be responsible for the reaction initiation force, and, in turn, the reaction initiation speed.

Then we will have a series of other factors that can also influence, such as the coupling of the explosive charge, which is linked to confinement, we also have the quality of the mixture of the explosive components, and several other points that will directly influence the reaction or the quality of the explosive.

A very important point that cannot be ignored in the process of detonating the explosive inside the hole is the confinement, because when we have an explosive without confinement, the gases expand in all directions, and practically do not influence the continuity of the detonation, but once confined, they exert pressure on the explosive mass that is reacting, contributing to the increase in temperature, pressure and speed, and thereby accelerating the reaction, where the consequence will be an increase in the speed of the reaction.

That's why when we evaluate the detonation velocity of an explosive, we see that its detonation velocity is greater when it is confined, due to the contribution of the pressure generated by the gases.



So, in summary, we can mention some factors that will directly influence the blast process, such as:

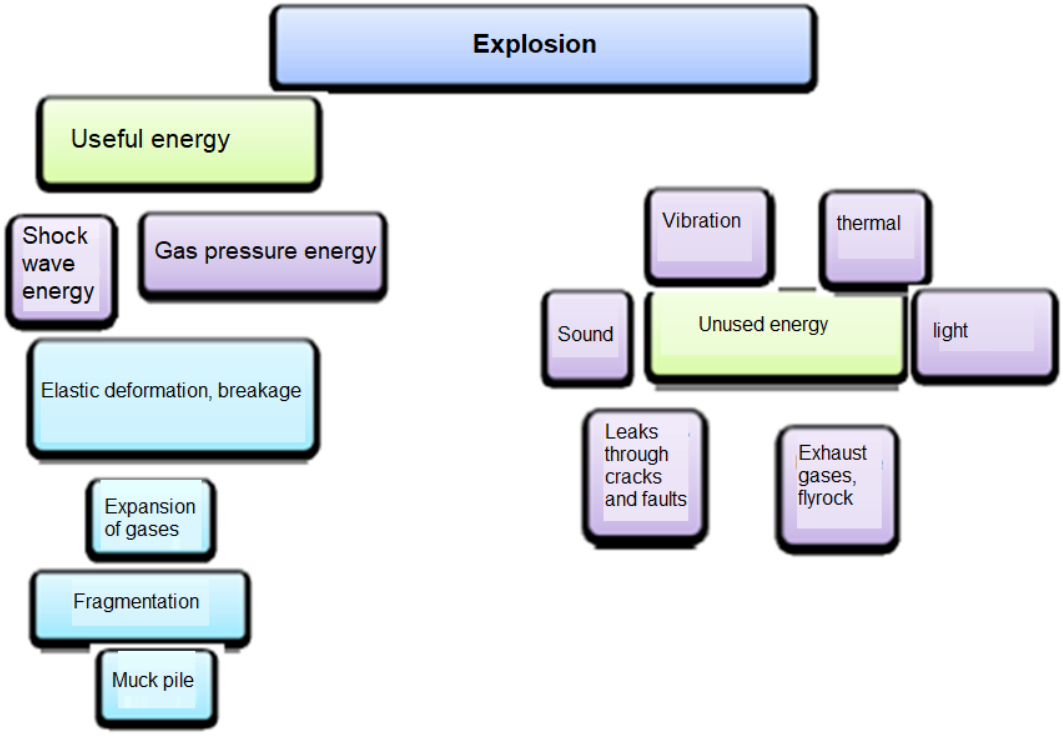
- Type of explosive
- Density
- Lockdown
- Diameter

- Initial stimulus
- Coupling
- Others

One point that we need to take into account is that during the blasting process of the explosive, it releases an immense amount of energy, normally represented by the blast's shock wave, by the gaseous expansion and by the heat of the reaction, but there are several ways of how this energy is expended during the blast, and really only a small portion of the energy is used to do useful work in the process of fragmenting the rock.

Therefore, we need to understand how the blast process occurs, and what points we need to control, to guarantee its quality, that is, what we have to do to maximize not only the release of energy from the explosive in the blast process, but also the use a greater share of that energy, so that we can maximize the achievement of the goals we need to achieve. And this we can say are the two main points when carrying out blast optimization work, where we need to generate as much energy as possible and reduce energy waste throughout the process, both to guarantee a better result and to minimize the risk of impacts.

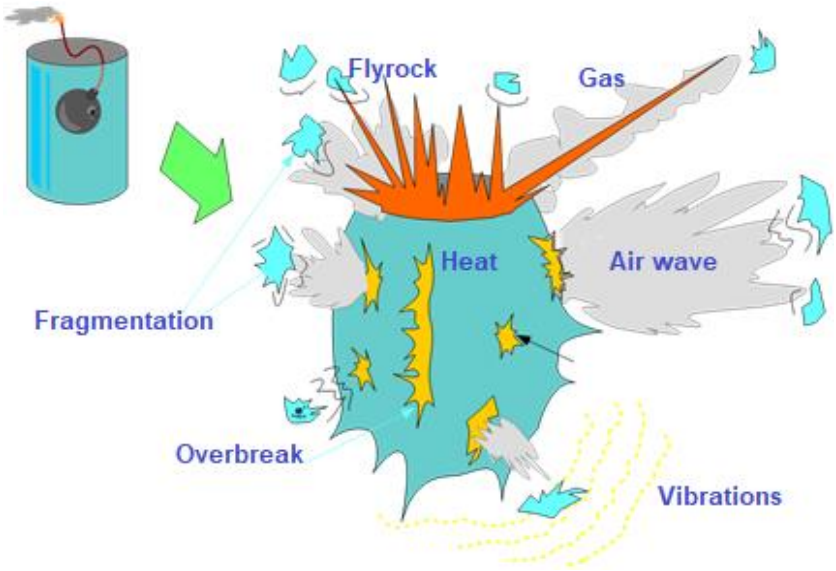
Just below we have an illustration of the distribution of energy spent in the blast process:



But in summary, we can divide the total energy of the explosive into two parts, where one part is the useful energy, which is the energy that is used in the rock fragmentation process, and the other is the wasted energy, which generates various effects, which do not contribute and can generate negative impacts.

That is why we need to maximize the use of energy, because in addition to generating a better result, we will have less wasted energy, which could be converted into impacts on safety and the environment.

We have already used the illustration below in several other articles and we always use it in our courses, as it is very representative and is part of a study carried out by Berta, which shows a distribution of the energy consumption of the explosive in the rock Blasting process.



Below we have an example (Berta) of the distribution of the energy consumed in the blasting process for a rock blast:

1- Detachment < 1%

2- Fragmentation < 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%

We can see that almost 80% of the energy is spent on the last two items, which are vibrations in the rock, and energy lost in the atmosphere, which implies that a large part of the energy of the explosive is spent producing effects that do not benefit the process. of rock fragmentation, on the contrary, are effect of harmful action to the environment of the blast;

This tells us that the rock blast process is really very inefficient, and has a large amount of lost energy, but it also indicates that we have a large amount of energy that we can try to take advantage of, reducing the waste of that energy.

For this, we need to raise the standards of our controls, so that we can carry out our detonations, within conditions that maximize the use of the energy of the explosive, generating less waste and impacts to our process.

Finally, we need to understand that the civilian explosives, which we use to blast rocks, need to have enough energy, so that during the blast, even with the waste, it can be breaking the rock,

and this fulfills our basic objectives, which are an adequate fragmentation and stack format, and without generating impacts on safety or the environment.

In this way we will be able to fulfill blast's mission, which is to allow the rock to be removed from the site, either to use the site or to exploit the rock.

For this, we need to ensure that the explosive we are going to use has the necessary energy, and that the parameters of our blast plan, and the conditions of application of this explosive, will be able to use a portion of the energy of this explosive efficiently in this process, and in addition , controlling the wasted energy, so that it does not generate impacts.

So we have two fundamental points, where the first is the choice of suitable explosive, and for that, we need to know its basic characteristics, as they will directly interfere in the blast reaction of the explosive, and thus in its release of energy. And the second point is the parameters for using this explosive, which must guarantee that we will be able to generate the greatest possible amount of energy during the blast process, and that we will efficiently use this energy in the rock fragmentation process, always controlling the wasted energy so that it does not generate impacts.

And this is precisely the quality control that we need to have in our blast, controlling the quality of the explosive that we will use, the quality of the parameters of our fire plan, the quality of the execution of these parameters, and finally, the quality of the blast itself, so that we can have good results, meeting our needs and achieving our goals.

That's it guys, let's stop here, the idea was just to make some general comments to finish our last article. As we said, the elaboration of a fire plan is still an art, which depends a lot on uncontrollable factors and leaves a lot of responsibility on the person who is carrying out its elaboration. that it is possible to count on the evaluation and support of other people, who can help us to evaluate points that we do not perceive.

In our next article, we will continue with this theme, but focused more on the process of rock fragmentation, that is, on the effects that the blast of the explosive generates on the rock and how it responds to these effects.

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