Shotcrete and Gunite

Shotcrete and gunite are important terminologies associated with the domain of civil construction. Shotcreting or guniting are techniques or processes that have proven to be of immense benefit in diverse subdomains of construction such as slope protection or stabilisation, pools, tunnels, fluid tanks, concrete repair works and many more. Many of us, including this author, have not only studied about shotcreting or guniting but also have practical experience of varying degrees in this particular area.

Yet, when it comes to defining or differentiating between these two terms there would, in all probability, be lack of unanimity. Can’t blame one though, as some of the established and experienced producers and companies involved in the application of shotcrete or gunite themselves do not seem to converge on an identical interpretation of these terms. While some consider guniting as a type (class) of shotcreting some others still regard them as two completely different processes.

Confusion brewing up already? Let’s have a bit more of that. For American Shotcrete Association (ASA), apparently, the terms gunite or guniting simply do not exist – technically. ASA only believes in the term shotcrete and according to to it there exist only dry-mix shotcrete and wet-mix shotcrete. Take your pick.

Nevertheless, what everyone agrees on is that there are two processes involved when it comes to spraying concrete or mortar pneumatically through a spraying gun (nozzle) at high velocity onto a surface. One is called the dry-mix process while the other wet-mix process. Also, whoever uses the terms gunite or guniting uses them to mean the dry-mix process only and never the wet-mix one.

The dry-mix process involves mixing cement and aggregates (fine or both fine & coarse aggregates) completely dry in a bin, rig etc and the pumping the same through a hose pneumatically (ie using compressed air by a compressor) under high pressure to a nozzle (the spray-gun). Water is introduced to the dry mix only at the nozzle (by means of a water feeding line) just before the mix blasts off the nozzle at a high velocity onto the surface being treated. On the other hand, the wet-mix process involves spraying of a pre-mixed or ready-mixed (wet) concrete or mortar under high pressure and at high velocity eliminating the need of adding any water in the nozzle or the spray-gun. Both processes have their unique advantages and requirements. But, the questions still remain as to what exactly is shotcrete and what is gunite, are they the same or different, if different, what are the differences etc etc.

So, let’s turn the heads into the ones who originally coined these terms, developed these techniques or set them in motion since and then see what shows up.
A little bit of study on the subject quickly reveals that it was the term “gunite” that came into existence first. The term was used to describe a then newly developed technique in US in which concrete was used to be sprayed under pressure through a spray-gun at high velocity onto a surfacing requiring such an application. Since the material was sprayed through a gun, the term gunite seems to have surfaced. All these happened at the dawn of the previous century.

Later, the term “shotcrete” came into being for the first time in the early 1930s when the American Railway Engineers Association (AREA) started using it to describe concrete (or mortar) nozzle-sprayed pneumatically at high velocity onto a surface either by dry-mix or by wet-mix process.

In the early 1950s the American Concrete Institute (ACI) too adopted the term “shotcrete” to describe the dry-mix spraying process erstwhile known as guniting. ACI classified the shotcreting process into two types, namely, the dry-mix process and the wet-mix process. They also accepted the term guniting for the dry-mix shotcreting process. In other words, according to ACI, guniting is a type of shotcreting only.

Contrary to that, some seem to regard “gunite” merely as a trademark only. Let’s take an example. Xerox is a popular trademark while the process involved is photocopying and not xeroxing. Similarly, this section believes that while gunite can exist as a trademark or brand name the term guniting is meaningless and the technically correct term is shotcreting (dry-mix) only. Some others don’t seem to agree however.

This author would prefer to have the following views and would suggest the same to others as well :-

The process or technique that involves pumping of concrete or mortar under high pressure through a hose to a nozzle (spray-gun) and then spraying them at high velocity onto a surface either by dry-mix or by wet-mix process is called shotcreting. Usually, shotcrete is reinforced by using steel or wire mesh, steel rebars, synthetic fibres etc. Since, the dry-mix shotcreting is also called as guniting by some (yet, not by all), better to stick to the terms dry-mix shotcreting & wet-mix shotcreting rather than guniting.

Nevertheless, if one is highly used to the terms gunite and guniting, or, if one is dealing with an entity that is hell bent on using the terms gunite and guniting, the same may be used to mean the dry-mix shotcreting method only. Also, it is to be noted that a mix sprayed under low pressure and at low velocity is usually not regarded as either gunite or shotcrete. One of the basic purpose of these processes is to achieve very high degree of compaction and thus high strength due to the high-velocity ejection from the spray-gun eliminating the need of any further compaction. This also eliminates the need of any formwork. The high velocity of the mix also ensures better adhesion with the recieving
surface. The velocity is usually well over 100 m/s, say about 150 m/s, but can be even higher if situation demands.

Also, when it comes to guniting, usually, smaller sized coarse aggregates, say max. 10mm or so, are used. For the wet-mix process use of aggregates of max. size of 1 inch or so is not uncommon.

The dry-mix shotcreting process (aka guniting) seems to be the most widely used method worldwide due to certain unique advantages it has to offer as mentioned below:

1. It’s extremely versatile. This process can be used to give virtually any shape to any element of a structure – curved, undulating, spheroidal and many more. This is a reason why this process is commonly adopted to add special features or shapes to swimming pools, spas, artificial caves & waterfalls etc. It is used in sculpting work as well. It’s versatility makes it an excellent candidate for a large variety of work such as tunnel lining, refractory lining, slope protection, repair works besides making it suitable for diverse uses in structures like tanks, dams, reservoirs, canals, docks, bridges, pipelines etc.

2. Water content of the mix can be controlled instantly and at any time at the nozzle by the crew while spraying the mix onto a surface. This enables one – at any moment – to render the mix only as much dry or wet as the situation demands by controlling the addition of water at the nozzle.

3. Dry-mix shotcrete (gunite) is quite economical, can be quickly prepared and applied unlike the wet-mix variety. It is quite suitable for overhead application where wet-mix shotcrete may not stick well and may sag or fall off.

4. If very thin linings or coatings are required to be applied on a surface or if the quantum of the work is small or in case of concrete repairs needing finer treatments such as filling up of cracks or small broken patches, damage etc, guniting would be a the choice rather than wet-mix shotcreting.

5. If the application job involves frequent stops of work for some reason or another guniting could be a much better choice over the wet-mix application.

Dry-mix process or guniting needs highly skilled crew. That’s especially true for the nozzleman as he is the one who controls and monitors the water flow at the nozzle. This demands experience and skill.

Another issue with guniting is “rebound”. While spraying the mix onto a surface some amount of the material is bound to bounce off the surface and fall on the ground. This occurrence is known as rebound
and is unavoidable in guniting or even in wet-mix shotcreting as well. The rebound-quantity is a complete waste as reuse of the same would result in an inferior product. Lesser rebound not only minimises waste but also indicates a better quality mix and thus a better product. Experience and skill are necessary qualities in order to get the better of the rebound problem partially.

The wet-mix shotcreting process also finds a lots of use. In fact, if stronger linings or coatings are the need of the hour in a particular work, wet-mix shotcrete can be a better choice than gunite as it results in a stronger product. Except where special or curved features are necessary calling for decorative or artistic finishes, wet-mix shotcreting can be applied virtually on all occasions as already mentioned earlier in this article where guniting can be implemented.

A better control over quality of the material is possible in case of the wet-mix process since all ingredients of the mix, including water, are pre-mixed before pumping the same to the spray gun. So, the mix can be precisely designed in accordance with the requirements like strength, durability etc. Also, rebound is much lesser for wet-mix shotcreting as compared to dry-mix shotcreting (guniting). For work involving large quantity of mix wet-mix shotcreting process is quite convenient, especially, if the work is continuous with no or very less stops.

At the end of the day, it’s much more important to choose the right or more suitable process (dry-mix or wet-mix) for a particular work and ensure that the same is properly & skillfully implemented rather than bothering too much about whether to call it dry-mix shotcreting or guniting.

Source: http://civilconstructionresourcez.wordpress.com/2012/07/14/shotcrete-and-gunite/