Wet-Mix Shotcrete Nozzles

by Patrick Bridger

One of the most overlooked tools in the application of wet-mix shotcrete is the nozzle. Contractors invest many thousands of dollars in pumps, pipeline, hoses, and other related tools and accessories. The nozzle is one of the most important tools of the shotcrete process, and it's very often given the least amount of consideration. It seems to me that the nozzle is so overlooked that it is considered the same as a clamp or some other simple accessory.

Concrete pumps must be able to deliver the concrete to the end of the hose, but it's the nozzle that enables concrete to be sprayed at high velocity to produce shotcrete as we know it. There are many different types of nozzles available to purchase from many manufacturers but VERY few perform well.

Nozzles are made out of many different types of materials and come in all shapes and sizes. There is, however, one common denominator in all wet-mix nozzles—the air ring. It works in a manner similar to a water ring in a dry-mix nozzle, but instead of injecting water, it injects air. There is also a major difference between a water ring and an air ring—the size of the holes. The only way to propel the concrete onto the substrate at high velocity is to inject a sufficient amount of air into the nozzle to break up the solid mass of pumped material into particles.

Example of poor velocity

The other important part of the nozzle is the nozzle tip. A nozzle tip should be designed to further increase the shotcrete velocity and provide a fairly tight spray pattern. There are many nozzles out there that are too short with very little taper. They don't provide much increased velocity and have a very wide spray pattern. The material that is on the outside of a wide spray pattern is not being projected at a 90-degree angle to the substrate and does not have sufficient velocity to wrap reinforcing steel and can leave weak, porous concrete, similar to overspray.

Example of good velocity

For those of you who use shotcrete accelerator, the nozzle is where the liquid accelerator is mixed with the pumped material. The nozzle design should allow for some mixing to take place before exiting the tip. There are a few nozzles available with a larger body and tip to create a mixing chamber. These are high-performance nozzles; they work well with accelerators. The tips are usually longer and have a considerable amount of taper, producing high velocity with a tight spray pattern.

In my opinion, while there are good nozzles available, the perfect nozzle has yet to be developed. A nozzle should be easily disassembled for cleaning—preferably without the need for tools. How many nozzles have ended up in the tool box that didn't get cleaned? I've seen a few. Nozzle technology will continue to improve over the next few years. If you have any suggestions on how to improve nozzles that you'd be willing to share, I'd like to hear from you.

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