

The Question of Bonding Compounds and Shotcrete

By Ted W. Sofis

Back when I first joined ASA, the question of bonding compounds with shotcrete came up. As a shotcrete contractor for over 35 years, I had experienced all the problems you can imagine in trying to follow specifications where the use of a bonding agent was required with a shotcrete installation. ASA is made up of a wide range of people in the shotcrete industry, including engineers, contractors, manufacturers, and suppliers, and we all agreed on something. When the question was asked, the response was overwhelming with nearly universal



With good surface preparation and gunning practices, shotcrete provides an excellent bond to the existing substrate



The dry process of shotcrete being gunned on a pier can provide a better bond without using bonding compounds. The nozzleman is filling in the corners first and working toward the middle of the repair area so he doesn't trap rebound in the corners

agreement among the ASA membership that use of bonding compounds with shotcrete was actually detrimental to achieving a good bond to a properly prepared substrate. I was not a lone voice in the wilderness.

With a good shotcrete repair, the deteriorated concrete is removed back to sound material, the concrete surface and existing reinforcing is either sand- or waterblasted to clean off scale from the reinforcing bars and create a textured profile on the concrete, the mesh or reinforcing is installed, and the repair area is washed with air and water to clean off any loose particulates and wet the concrete surface to create a saturated surface-dry (SSD) condition prior to the shotcrete placement. SSD refers to a surface that is wet without any standing water. The reason for wetting the concrete prior to placing the shotcrete is to create a better bond. A dry concrete substrate will draw the moisture from the newly placed shotcrete, possibly leaving an inadequately hydrated material at the point of contact between the existing concrete and the shotcrete repair. For this reason, wetting the repair area prior to shotcreting is an important step.

When shotcrete impacts the hard concrete surface, a greater percentage of aggregate rebounds from the surface, leaving a thin layer of more cement-rich paste at the interface between the existing concrete and the new shotcrete. As the shotcrete material builds on itself in its plastic state, the rebound of the aggregate decreases. The velocity of the shotcrete process drives the new material in place, creating an excellent bond with the existing substrate. The use of a bonding compound interferes with this process and in many cases actually creates a barrier or bond breaker.

In addition, there are other problems with bonding compounds. With shotcrete, the rebound and overspray will stick to the adjacent areas where a bonding compound has been applied. Rebound is a cement-poor, aggregate-rich, improperly hydrated by-product of the shotcrete process and is not the material that you want to

Shotcrete Corner



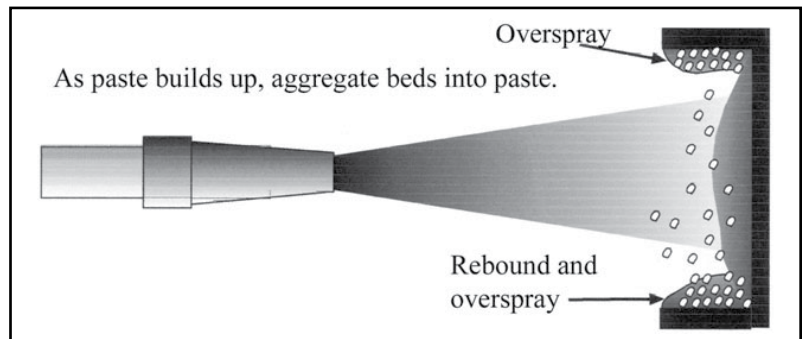
The top of this industrial sump wall is gunned in place using dry-process shotcrete. The shotcrete process provides an excellent natural bond to the substrate without using bonding compounds. In many cases, bonding compounds are detrimental to achieving a good bond with shotcrete

have at the point of contact. You cannot wash or blow off the rebound and overspray from areas and mesh where bonding compound has been applied. Using a blowpipe to remove rebound will actually cause more unacceptable material to stick to the adjacent areas where the bonding agent has been applied. Also, because shotcrete is sprayed in place gradually across a repair area and isn't cast all at once like a concrete pour, the working time of a bonding compound becomes an issue. If shotcrete isn't placed while the bonding compound is still tacky, the bonding compound becomes a bond breaker. Unless the timing between the application of the bonding compound and the shotcrete is just right, some of the repair areas where the bonding compound has been applied may have hardened by the time the shotcrete is placed. Establishing the "open time" of a bonding agent in place is very difficult to gauge and then coordinate with shotcrete placement.

In summation, when you use bonding compounds with shotcrete, you increase the risk of interfering with the excellent bond produced naturally with the shotcrete process. Rebound and overspray can easily stick to the fresh bonding compound in areas adjacent to the shotcrete placement, which will reduce the bond of subsequently placed shotcrete, creating a high probability that sections of the repair will actually have a bond breaker from the hardened bonding compound. If I've learned anything in my 35 years of gunning, it's that the simpler you can keep things in the field, the more likely you will end up with a good result.



Shotcrete is gunned at high velocity onto the receiving surface. On initial impact, a larger percentage of aggregate rebounds from the surface, leaving a thin layer of cement paste at the interface of the new shotcrete and the substrate



On its initial contact, more aggregate rebounds off the receiving surface, leaving a thin layer of cement paste at the interface between the existing concrete and the shotcrete. The material begins to build on the cushion of plastic material. The velocity of the shotcrete process drives the material in place, creating an excellent bond with the existing substrate.



Ted W. Sofis and his brother, William J. Sofis Jr., are the Principal Owners of Sofis Company, Inc. After receiving his BA in 1975 from Muskingum College, New Concord, OH, Sofis began working full time as a Shotcrete Nozzleman and Operator servicing the steel industry. He began managing Sofis Company, Inc., in 1984 and has over 34 years of experience in the shotcrete industry. He is the Chair of the ASA

Publications Committee, the Treasurer for ASA, and a member of the ASA Education Committee. Over the years, Sofis Company, Inc., has been involved in bridge, dam, and slope projects using shotcrete, as well as refractory installations in power plants and steel mills. Sofis Company, Inc., is a member of the Pittsburgh Section of the American Society of Highway Engineers (ASHE) and ASA.