Conservation Talk

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My last column on lichen prompted several excellent questions on cleaning. Each was answered directly to the person inquiring. I was delighted that it generated interest and I welcome questions, comments or letters. And, as space allows, I'd be happy to answer them in the column—with your permission for publication. So, please contact me if you have questions or observations. I was recently asked where, when, why to use gray cement. What a great topic for the second article of Conservation Talk!

As background, a quick definition. Cement is a combination of cement clinker (these clinkers are composed of limestone, clay, bauxite and iron ore sand heated in a rotating kiln at 2,770° F) with a small amount of calcium sulfate. Eight types of cement are covered in ASTM C 150 and AASHTO M 85, but 92% of Portland cement produced in the United States is Type I (general purpose) and II (resistant to sulfate attack). Why is white Portland cement white? As noted by the Portland Cement Association, color results from the raw materials and the manufacturing process. Specifically, metal oxides (primarily iron and manganese) influence the whiteness of Portland cement.

I see no reason to use Portland cement, regardless of its color. While there are many who still recommend a 1:2:6 mix of white Portland, lime and sand, this approach is very dated. I realize that a number of government agencies–both state and federal–that still use white Portland in a broad range of mixes. Even the AGS still recommends such a mix. Conventional wisdom often changes slowly.

However, a significant study in England (called the Smeaton Project)–a great topic for a future column–that looked at the interaction of white Portland cement and lime. The study found that when the Portland cement was minimized, the product had a very high failure rate. As the quantity of Portland cement increased (to what preservationists had generally recommended) there was a strong tendency for segregation–the cement and lime separate from one another, the pores become clogged and porosity declines. The dense hydraulic matrix of the Portland cement cuts off the natural carbonation that gives lime mortar its strength, resulting in a weaker, less durable material. The combination is not a good choice. The lime does little to temper the bad qualities of Portland and the Portland cement does nothing to encourage the good quantities of lime.

We have far better choices today. Remember that Portland was added to lime since air limes set through carbonation–a slow process. The Portland cement has been added to achieve a quicker, albeit chemical, set, thereby speeding the process. We can achieve this same result using NHL (natural hydraulic lime) mortars. These mortars have historically been identified as NHL2 (with little chemical set and almost total carbonation), NHL3.5 (midway) and NHL5 (little carbonation and mostly chemical or hydraulic set). As you go from NHL2 to NHL5 you increase the strength of the mortar, as well as its ability to resist freeze-thaw damage. Typically for most cemetery work a NHL3.5 mortar works very well, especially in either a 1:2 or 1:2.5 mix, depending on its use.

Naturally, there are still those situations where air limes (such as lime putty) are appropriate, but I think the use of bagged NHL3.5, either field mixed or purchased ready mixed, is a better approach for those seeking to reset monuments. One source of NHL and its ready mix is Virginia Lime Works (www.virginialimeworks.com). If you're in the north, then U.S. Heritage (http://ushg.macusa.net/heritagestore.php) is perhaps a better match (although they carry only NHL3.5). There are other suppliers, although these two have always served my needs.

Now for gray Portland cement. Most preservationists point to the "fact" that it contains soluble sodium and potassium salts, in particular potassium sulfate, which may become a source of salt damage to stonework. The potassium sulfate usually comes from the illitic clay used as a raw material in the manufacture of the cement. On the other hand, not all gray Portland cements have excessive levels. The problem is that this ratio can be determined only with testing. Unfortunately, there is little real world testing. In addition, the Portland Cement Association comments that "white Portland cement has essentially the same properties as gray cement, except for color."

Still, Portland cement of any color is a poor choice in most conservation activities. It yields high strengths (far higher than most stones), shrinks excessively upon setting, resists migration of water and has greater thermal expansion and contraction than most stone. So there is really no reason to use Portland cement except to repair of Portland cemetery items. ♦