Vacuum Assisted Pressure Injection vis-à-vis Unassisted Pressure

We much prefer to discuss our own technology rather than that of others, and this has been our policy and practice for over twenty years. But that has changed due to web-site claims on behalf of vacuum assisted pressure injection.

The marvels of vacuum assistance for the injection of cracks, and the dangers and limitations of high-pressure injection are cited. Because certain of these claims that refer to competitive technology are misleading, unsubstantiated, and simply not true, their propagation is a disservice to the industry. They deserve to be refuted.

The following discussion of the two techniques is intended to disabuse those who as a result of such claims, have or may, become enamored with the lofty promises of vacuum assisted pressure injection, or chary of the perils of pressure.

Vacuum Assisted Pressure Injection and Unassisted Pressure Injection both achieve penetration by creating a differential pressure across a fluid, and both methods inject the resin under pressure. The difference is that vacuum systems generally use lower pressures and feature a vacuum pump to develop suction to assist the penetration of the pressurized resin.

Lily Corporation does not endorse vacuum injection because we believe vacuum assistance to be unnecessary and rarely useful.

Vacuum proponents' claim that vacuum assisted pressure injection assures filling of “dead end” cracks and anfractuous fissures that are not penetrated by pressurized injection. The reason is that unvented voids do not allow trapped air to escape so that resin can enter. Unassisted Pressure injection “can ultimately only fill up 30% of dead end cracks” and “can cause blow outs” of the concrete due to the high pressure, they say. But by using vacuum, the air is evacuated beforehand so that the resin readily fills the voids. And besides, the chance of further deterioration in a (crack) condition is significantly greater following unassisted pressure injection than with vacuum assisted pressure injection.

Lily's responds that, considering the compressibility of air and the porosity of concrete, the likelihood of air pockets preventing penetration of a highly pressurized resin into a crack defies common sense. Let's begin with Physics 101. Boyle's Law (P 1 V 1 = P 2 V 2) reveals that 1 cubic inch of air compressed under a modest injection pressure of 250 psi is reduced to .06 cubic inches, or 6% of its original volume. Unless the void is quite large, the bubble is reduced to a very tiny bubble indeed. But even this tiny bubble will not survive because of the porosity of concrete.

Concrete is so obviously porous that a testing laboratory is not necessary to demonstrate the fact. Splash a cup of water against an untreated concrete wall and observe how little reaches the ground. And consider that such a surface is finished smooth and tight, as compared with the rough open surface exposed within a crack. Literally dozens of products are manufactured to reduce the permeability of concrete. Because water is absorbed by concrete and vapor can pass through it without any urging, it is obvious that concrete is not very good at trapping air.

Comments

We acknowledge that the results with vacuum assisted pressure injection are often quite satisfactory. However, we attribute the success to the use of the pressure rather than the vacuum assistance. Excellent results are available at modest pressures of 30 or 40 psi with a low viscosity resin and a conscientious installer. Lily Corporation has long maintained that the results available

with high pressures are available with low pressures as well: It just takes longer. The greatest advantage of high pressures is production.

For the injection of typical in-depth cracks in concrete, vacuum technology is vastly more costly than pressure injection, more complicated that pressure injection, and contributes little, if anything, to the process. A curious vacuum tout is that cracks as narrow as .005” can be injected with vacuum assisted technology. That's a pretty fat crack! Even Lily's Low-Pressure Injection system often fills cracks as narrow as .001” at a pressure of less than 1 bar (17 psi).

Another claim is that pressure injection causes “blow outs”. Pressure injection is not, and never has been, touted for the injection of cracks between unrestrained elements. If a “blow out” occurs, it is due to a misapplication of the technology, such as attempting to repair a spall by injection. Delaminations of floor overlays are often repaired by pressure injection, but only in conjunction with the prior pinning (restraining) of the overlay. A crack in a reinforced concrete element is not likely to be damaged by typical epoxy injection pressures. If the vacuum folks know of a single verifiable instance where a reinforced element has been damaged by the epoxy injection of a crack within restrained segments, we will feature it here.

Vacuum touts inform us that pressurized injection fills only 30% of a crack that is not vented, that concrete is saturated more thoroughly due to the vacuum effect, and that the chance of further deterioration in a (crack) condition is significantly greater with pressure only than with vacuum assisted pressure injection. The puffery continues with: “vacuum injection provides greater strength to the structure compared to other methods (pressurized injection) , ensuring a greater life span.” Such claims are hogwash. There is no credible evidence to support them.

There may very well be applications where vacuum assisted pressure injection has a place, such as repairing shallow craze cracking or drawing resin beneath precarious tile settings but the injection of typical cracks in concrete is not one of them.

Such claims are unsubstantiated, but they are also demonstrable if true. We believe that the industry can be well served by a comparative demonstration of the technologies at a mutually selected venue such as a testing laboratory or university. Lily Corporation will not only welcome (and relish) such an opportunity, but participate in the sponsorship as well.