The Expanding Role of High Purity Nitrogen in Fire Protection

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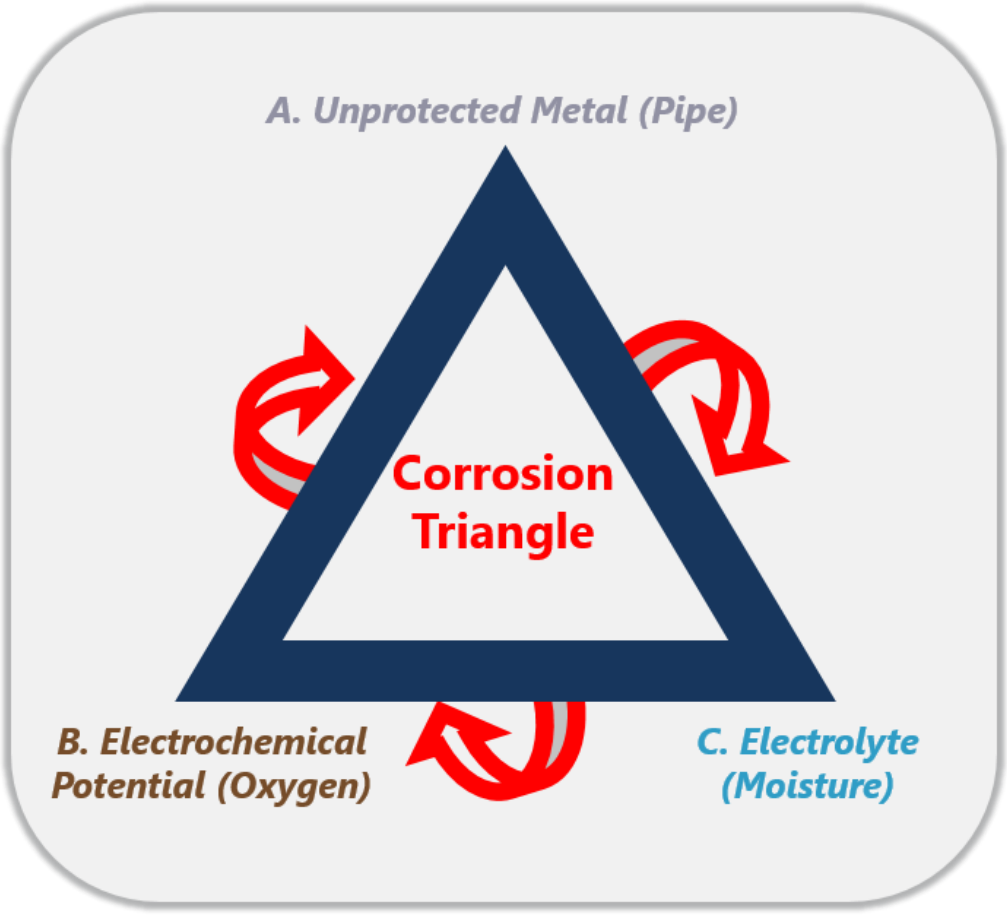
Compressed air is out. Nitrogen is in. This is both an observation of evolving standard practices in the fire protection industry, and a summary of the solution to corrosion issues in dry and pre-action sprinkler systems.

The use of high purity Nitrogen as a supervisory gas is not new to fire protection. Use of high pressure cylinders can be traced as far back as the 1970's. Nitrogen generators have been utilized in the industry for over a decade. But over the past several years, the technology has experienced exponential growth in its adoption rate. Specifying engineers and installing contractors alike have now seen the impact of replacing compressed air with high purity nitrogen. For those unaware or unfamiliar, the following will be an introduction to what is rapidly becoming the standard across the industry.

The science behind why Nitrogen is superior to compressed air for use in dry and pre-action fire protection systems is simple. Just like the fire triangle, there is a corrosion triangle. Electrochemical corrosion takes place any time unprotected metal[1] interacts with moisture[2] (electrolyte) and oxygen[3] (electrochemical potential).



You cannot avoid the metal in this equation. Even in dry and pre-action systems, you cannot dodge the moisture aspect either. Therefore, the most effective way to inhibit the corrosion process is to replace the compressed air (Oxygen) with high purity Nitrogen.

Corrosion tests performed by various metallurgists and corrosion experts have shown just how effective this process is in terms of extending sprinkler pipe life. The longest-running 3rd party test in the industry shows the introduction of Nitrogen at 98% purity to triple the expected service life of schedule 10 black steel; from 20 years to more than 60. Likewise, it shows Nitrogen can take schedule 10 galvanized from 10 years of service life to over 150. These controlled tests mirror what contractors and fitters have experienced in the field for years; galvanized pipe in conjunction with an air compressor is more susceptible to corrosion than black steel. However, it also shows that using high purity Nitrogen mitigates that issue and extends the service life of the piping beyond the expected life of the building itself.

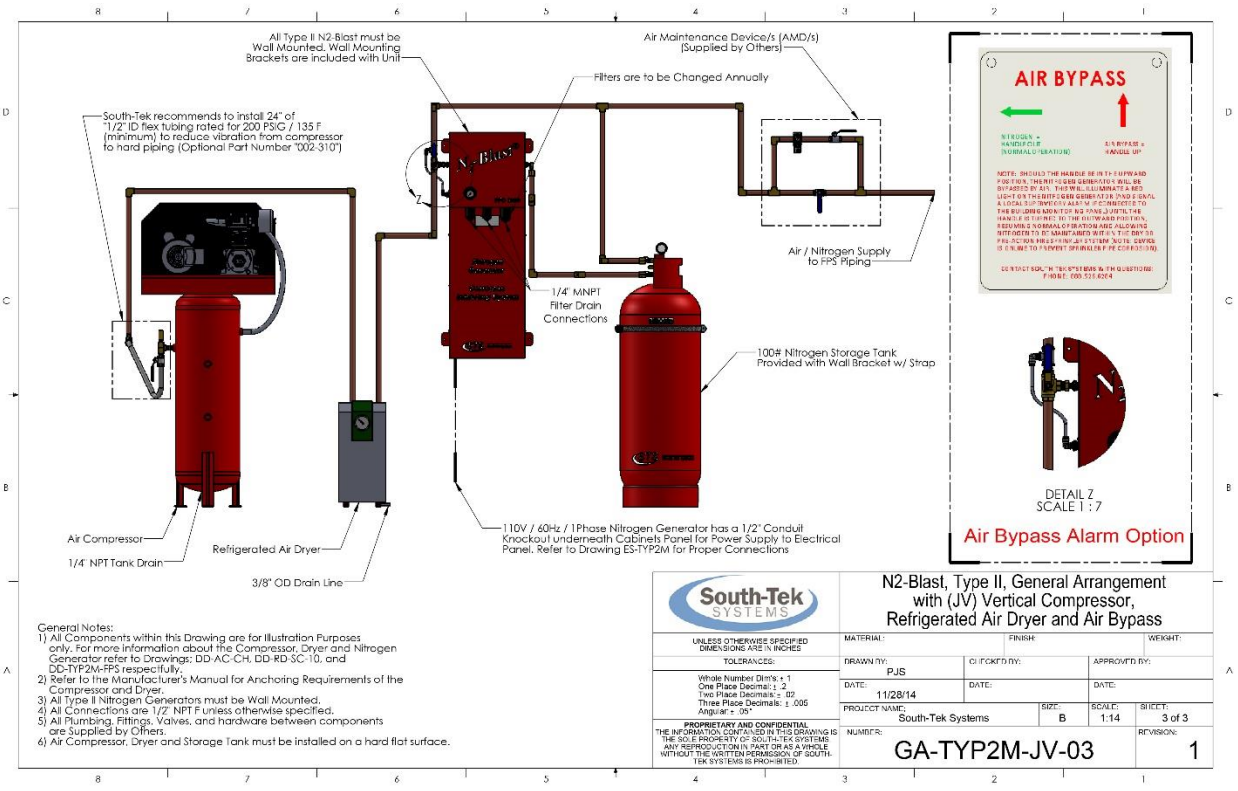
With these results one can wonder why Nitrogen is not already the standard instead of an option. While things are definitely trending in that direction, there are still hurdles to overcome. The largest of which is simply education and awareness.

There are still some in the industry that consider Nitrogen an expensive, or unnecessary alternative due to either rumor or past experience. Some engineers continue to specify galvanized steel because they are unaware of what the installing fitters and contractors know, and what the various studies have shown. Some contractors are wary of their ability to install and maintain a Nitrogen generator for fear of complicated and rare components. All of these thoughts and feelings are mitigated by actual exposure to the technology.

Whether it be through interactive webinars online, or onsite training, the truth about the simplicity of installation and operation of Nitrogen generators is easily accessed.

Nitrogen generators have come a long way since their introduction to the industry over a decade ago. Advancements in technology have made them more dependable and more cost effective than many realize. Companies specializing in Nitrogen generation technology have taken the standard purity in the industry from 95% to 98%, thus improving the effectiveness of the corrosion inhibiting process. The separation process of Nitrogen from atmosphere has also improved, increasing Nitrogen production and purity. The introduction of the more efficient PSA, or pressure swing adsorption, separation technology has eased the load on feed air compressors and increased the lifecycle of both the nitrogen generator and compressors involved. Adjustable purge devices have allowed specific flow rates customized to each particular zone/system. This reduces runtime on both the generator and compressor. All of these improvements have resulted in a more effective and longer lasting alternative to compressed air.

While the design of the technology has improved, the way the system operates remains simple. Regardless of the size of Nitrogen generator, the startup process remains the same. An air compressor brings the sprinkler system up to pressure within 30 minutes per NFPA code. After the fill process is complete, the Nitrogen generator then takes over supervisory pressure (note that some companies choose to utilize a "buffer" tank to prevent excessive equipment run time and short-cycling while maintaining supervisory pressure). An air maintenance device with a regulator, not a pressure switch, is required for each individual dry or pre-action valve. A purge device is placed at a remote point on each dry or pre-action system as well. In general, this arrangement is very similar to that of a traditional air compressor, but you're displacing the corrosive oxygen within the piping by introducing high purity Nitrogen.



While many new design/build specifications are already including Nitrogen, about 65% of generator installations occur in pre-existing systems. If a customer has experienced ongoing corrosion issues, selective pipe replacement with the introduction of a nitrogen generator is the most cost-effective and proven means of arresting corrosion and maximizing the life of the system. In some cases, where the present air compressor is still operable and the total capacity is less than 1,250 gallons, a generator can be simply installed between the existing air compressor and air maintenance device. The existing air compressor can meet the 30-minute fill requirement of the largest zone, and the Nitrogen generator can maintain supervisory pressure during normal operation. This is a plug-and-play solution for the contractor to offer their customers in lieu of costly pipe replacements.

Having covered the ease of installation, we should mention the basic maintenance requirements of a nitrogen generator, which are little more than those of a standard air compressor. The maintenance items include changing the filters once per year or every 1,000 hours (whichever comes first), checking for 98% or greater nitrogen purity at the purge devices, and monitoring the equipment run-time, which should not exceed 3 hours per day.

With countless installations in high visibility projects around the world, there is no shortage of references when looking for proof of the success of Nitrogen generators in the Fire Protection Industry. From data center pre-action systems, to attic systems in assisted living facilities, or parking garage dry systems, Nitrogen generators can be found in every region and every market. The results are there both in science and application. As this technology moves closer to becoming the standard, the only question that remains is, are you going to be the one that brings it to your customer? Or will someone else offer it first?