

Industrial cryogenics: The drilled ball valve advantage in cryogenic application



An interview with Brandon Sumners, Applications Engineer at Airgas, an Air Liquide company

Valve World had the pleasure of speaking with Brandon Sumners, Principal Applications Engineer for Airgas. Airgas, an Air Liquide company, is the leading U.S. supplier of industrial, medical and specialty gases, as well as hardgoods and related products; one of the largest U.S. suppliers of safety products; and a leading U.S. supplier of refrigerants, ammonia products, and process chemicals. As an Air Liquide company, the world leader in gases, technology and services for Industry and Health, Airgas offers customers an unrivaled global footprint and industry leading technology and innovations. Sumners took a few moments to discuss his role as part of the Chemical, Environment, and Technical Solutions team of Airgas' ALTEC Engineering Solutions group, his history in the industry and the unique role of industrial cryogenics, as it applies to chemicals, refining, concrete applications and more. Whether answering emails or making site visits with clients, at the end of the day, explains Sumners, "The key is to combine our expertise in the industrial gas industry with the customer's application, in order to optimize their processes."

By Melanie Gogan

A native of West Texas, Sumners received an academic scholarship from Texas Tech University that led him to pursue chemical engineering, a slight contrast from his original goals of a career in a laboratory. Sumners explains, "In chemistry you make things in beakers and jars in a lab. In chemical engineering you do the same thing, but you are making it in thousand gallon vessels, through pipes and on a bigger scale entirely. I got excited by that!"

An internship opportunity with Dow Chemical down in Freeport, Texas, eventually led to a permanent position with the company after graduation. Here, Sumners assumed the role of Catalyst Engineer for high density polyethylene – in the plastics industry – in Louisiana. Looking for a shift away from the 24-hour high-repetition production environment at Dow, Sumners later joined Airgas in 1998. Marking his return to his chemical

engineering roots, Sumners began at Airgas as an Applications Generalist involved in cryogenics, chemical, refining and environmental gas applications, making the move in 2006 to Air Liquide's ALTEC Materials & Energy Group. Following Air Liquide's acquisition of Airgas in May 2016, Sumners joined the Airgas ALTEC Engineering Solutions team as Principal Applications Engineer. Sumners currently works mainly with industrial



chemicals and refining applications, developing and managing projects with customers predominantly within chemical plants, refineries, water treatment plants and construction environments. His specialty: industrial cryogenics as well as ambient temperature atmospheres and the inerting and blanketing of chemical processes.

Industrial cryogenics

Industrial cryogenics – or the science of low temperatures – involves the use of liquefied industrial gases, like nitrogen, helium and hydrogen, at or below -238°F (-150°C) and used as refrigerants to modify the physical properties of materials or to maintain temperature during process steps. It is in these processes, explains Sumners, that the use of specialized valves are crucial.

Refining applications

Sumners spends a lot of time providing solutions to refiners along the US Gulf Coast and elsewhere, primarily in the use of oxygen. Oxygen is used in numerous

catalytic cracking processes for reducing oil from the long chain hydrocarbons into the smaller chains, such as ethylenes, ethanes and butanes. While cryogenic applications are not predominant in the actual refining process, Sumners notes that cryogenic technology does play an important role in quality control and testing. The use of liquid nitrogen, be it in gas chromatographs or mass spectrometers, is common practice for refiners, used to cool a product stream which has been pulled off of the refiner for product testing and analysis.



CryoCrete™ cooling for concrete applications

One interesting area that Sumners supports is an application called CryoCrete™, which is the cooling of concrete with liquid nitrogen. Sumners explains that while it is not often considered, most of the mass engineered structure that one sees, like roadways and bridges, have used a temperature-controlled “cured” concrete that will aid in the prevention of structural cracks due to thermal stresses. He adds, “These types of cryogenic applications require really specialised valves able to withstand those low temperatures, not to mention the rigors of being used in the environment and in the industries where they are used.” A good example, explains Sumners, is evident in the southern US states, where it is extremely hot. Engineers must basically

reduce the temperature of the concrete before they pour in order to avoid thermal stress cracking. While many will use ice or chilled water to cool the concrete, this solution can only go so far. The liquid nitrogen application that Sumners recommends to his customers has the ability to be injected at -290°F (-179°C), allowing it to cool the concrete very rapidly and attain whatever temperature target that is required.

It’s not only hot climates that may require this kind of cryogenic cooling treatment either. Sumners recollects a project in which Airgas assisted in the pouring of the San Francisco Bay Area Bridge, where the temperature of the water can be around 45°F (7°C). In effect, Sumners explains, the goal wasn’t to battle the heat, but instead to get the concrete to the same temperature as the water to prevent thermal stress cracking.



Airgas ASU in Minooka, IL

Detergents, spices, plastics and rubbers

Cryogenics also plays a huge role with heat sensitive products, like detergents, spices and certain polymers or rubbers, which are subjected to added heat through friction caused by the grinding process. The additional build-up of heat, explains Sumners, can further damage the actual quality of the product. Sumners adds, "As the world leader in gases, technologies and services for industry and health, gas purity is something that is extremely important to us. Often I am brought in to help our customers troubleshoot purity or contamination issues. Valves could be leaking. Connections could be leaking. Hoses could be leaking. It's in everyone's best interest to take a look at all of these components in order to recommend a good quality replacement part. Airgas has an unwavering commitment to provide customers with high-quality, sustainable products in a safe and reliable manner." By using liquid nitrogen to cool products, producers are not only preventing damage to their product, this process also embrittles the product, providing greater control of particle size. This is a key feature in the production of extremely fine powders.

Valve construction – drilled for expansion

In contrast to gaseous applications where carbon steel valves may be used, in order to withstand the necessary cryogenic temperatures and provide wear resistance, explains Sumners, cryogenic valves are typically constructed of stainless steel. One of the things that is interesting about cryogenics and liquid gas, he further explains, is that when it is captured, it actually expands. Since it's a cryogenic liquid, ambient temperatures can easily heat up the liquid and cause it to boil. Nitrogen in particular can reach pressures above 20,000 psig when it is captured in a ball valve. So, when one closes the valve, trapping liquid in the internal area of the ball, the liquid generates pressure that could result in a discharge. According to Sumners, "All of our ball valves are drilled so that the liquid can actually expand and the gas can escape... so you hear what is termed a 'drilled ball' or 'drilled ball valve,' which is very common for us when we discuss cryogenics." For the most part, says Sumners, it's the vendor that will perform the necessary drilling. Occasionally,



Airgas and Air Liquide use CryoCrete™ technology to inject liquid nitrogen into a redi mix truck to ensure optimal pour temperatures.

however, field technicians will modify it themselves. Sumners remarks, "I have seen field service techs who have not received the right valve, modify the ball by drilling it in the field to prevent build-up of the pressure as it vaporises."

Unique extended handle

Usually specially ordered, these stainless steel cryogenic valves also have an extended handle. Sumners explains that the valves typically build up ice which creates a gigantic ice ball around them. This requires a 12-18 inch extended handle for operator use.

Packing materials

In addressing some of the changes Sumners has witnessed in more than 18 years in the industrial gas industry, he remarks upon the new, innovative and more exotic valve seat packing materials that have been introduced into the valve market. "That's one of the things we are always dealing with in our industry – the issue of leaks, where we must also consider the lifespan of the valve," he says. Sumners points to the development of different polymers, like Viton, that are more resistant to chemicals. This is where providing customers with quality vendor recommendations is key, explains Sumners. When walking into a chemical facility, a plant or refinery, the results of Sumners "gas audits" - an examination of their

gaseous systems – will determine leak rates and optimization potential. It's necessary to look at the valves, flanges, connections and couplings, says Sumners, in order to go back and provide recommendations to customers.

Tank blanketing valves

Without proper volumes of nitrogen in the headspace of a vessel containing a flammable substance, explains Sumners, there is potential for a speed reaction, so it is important to ensure that the nitrogen introduction system is well designed. To address this situation, Sumners explains, there has been a move in the industry toward "tank blanketing valves." These are typically very low pressure regulators that allow customers to maintain nitrogen pressure pads in a process vessel. In the past, a normal gas regulator would be used and set to one-half or one pound per square inch of pressure. These new tank blanketing valves, he explains, allow operators to control down to inches of water column, which is extremely low pressure, while also helping decrease the amount of nitrogen the system is using, contributing to overall efficiency. "So by decreasing the nitrogen flow, we are helping customers save the product, because it's not sweeping out and going into the vent header," Sumners concludes – a clear move toward safety and efficiency in the industrial gas business.