Nitrogen Case Study #1

Laser Metal Cutting
Agri-Fab®
Trifecta® Gas Supply System
Replaces PSA System

Highlights:

Location — Sullivan, Illinois
Scope of Project:

- Bulk nitrogen tank and 600 psig

Trifecta installation to supplement a nitrogen pressure swing absorption (PSA) unit that was no longer able to meet the increasing nitrogen demands of the plant. An additional 3000 gallon portable nitrogen unit also had to be brought in due to the increasing nitrogen demands of four lasers.

Application:

Laser cutting applications entail focusing a beam of coherent light onto the metal workpiece. The concentrated energy of the beam heats the metal above its melting point, but that alone does not produce a clean cut. Assist gas, either nitrogen or oxygen, is used to exclude regular atmospheric air and blows away the molten material. Blasting this gas at high velocity, and pressure blows away the metal that has been melted by the laser. It also helps take the heat away from the metal sheet. With oxygen, the laser power is magnified, and more heat is produced. This allows for faster cutting speeds. The disadvantage is that oxidation occurs on the cutting edge, and more cleanup is needed if the metal is going to be further processed. When lasers use nitrogen for cutting, the material is melted solely by the laser power and blown out of the cut by the energy of the nitrogen gas stream. Unlike cutting with oxygen, the melt-shear removal is the only active process since inert gases do not react with the molten metal, and no additional heat is generated. The nitrogen purity is important if a clean cut edge is required with virtually no oxidation. Even small percentages of oxygen contamination will result in yellowing of the cut edge as a result of oxidation. High purity nitrogen (99.995) provides a superior edge quality, free of any impurities. This can also lead to significant cost savings for secondary operations because this edge is highly receptive to powder coat paint or welding and eliminates any need for further prep work. This is not the case when cutting with oxygen.

Project Background:

Agri-Fab installed a pressure swing absorption unit (PSA) approximately seven years ago to service a single CO_2 laser. The manufacturing engineer, who was the key decision maker in making the purchase, stated that the "PSA vendor did not do an adequate job at detailing all the costs that would be incurred to operate the new PSA system." The customer was basically led to believe that their existing in-house compressor could be used to supply the air to the PSA system, and the primary costs of operating the system, after the initial capital outlay to purchase the system, was power. Experience later taught him that there were significant additional costs to include maintenance, downtime, and utilization of inside floor space. This was estimated to drive the payback period to well over 10 years. As their business grew, more capital expenditures were required to purchase a major upgrade to the main air compressor. In addition, there was more and more demand for nitrogen cutting vs. oxygen cutting due to the superior quality of the cut edge. In time, they were forced to find a way to get additional capacity to support larger and more powerful lasers. They now had a much better understanding of the large capital expenditure it would take for a larger PSA system and the high monthly maintenance costs to support it. Agri-Fab then decided to reach out to their existing industrial gas supplier for alternatives.

Solution:

The existing gas supplier introduced Agri-Fab to the Chart Trifecta® Gas Supply System and explained the major benefits. These benefits included higher nitrogen purities, higher flow rates, higher pressures, less initial capital outlay, and lower maintenance costs. Due to pressure requirements of their newest fiber optic laser, Agri-Fab made the decision to go with the largest Trifecta unit, 15,000 SCFH with an MAWP of 600 psig. This Trifecta unit also offered them the flexibility to run four lasers (three CO_2 lasers and one fiber optic laser) at higher production capacities for longer periods of time. The current Trifecta unit is servicing the account 24/6, and the manufacturing engineer stated that "we cannot afford to be down for one minute. We want our gas supply to be just like the city water that we consume. It should be readily available when the valve is turned on." The plan now is to add more nitrogen bulk storage and some redundancy in the nitrogen supply system in order to guarantee uptime service for 24/7.

"If I was going to start all over in this plant, or open up a new laser business and needed a reliable source of nitrogen, my first choice would be one or two Chart Trifecta units." Adam McReynolds, Manufacturing Engineer, Agri-Fab, April 3, 2018.