Reducing Helium Usage and Associated Costs: A Case Study

By Paul Nesdore

How a helium recovery system can monitor and save helium and its associated costs.

The Challenge

Millennium Industries is a fuel rail manifold manufacturer with the capacity to manufacture over 12,000 fuel rails per day. A fuel rail is essentially a pipe (usually resembling a rail) used to deliver fuel to individual fuel injectors on internal combustion engines. Formerly, the company manufactured their fuel rails to withstand 75 psi. However, due to the stringent CAFE (Corporate Average Fuel Economy) standards for fuel economy and efficiency, and new direct injection fuel delivery methods the company was faced with having to manufacture new products to withstand pressures from 2,200 – to 2,600 psi. Greater test pressures meant greater helium usage.

The Solution

In order to avert the additional helium costs associated with the higher test pressures, Millennium installed a helium recovery system that would reclaim up tp 98% of the helium used. Even with the cost of the recovery system and the installation to retrofit three machines, the cost of the new system was recouped in a little over a six-month period.

Why Use Helium?

Helium has unique properties that make it valuable for use in a wide range of applications. Its properties make fine leak detection possible, which has led to the adoption of helium usage in mass spectrometry helium leak detection technology, enabling many companies such as OEMs, tier one automotive part manufacturers, etc. to produce quality product while remaining competitive.

Helium is present in the atmosphere at only around five parts per million, and this low amount results in lower instrument background and therefore better test sensitivity. Also:

It is inert. The only danger when using helium is simple asphyxiation but only when used without adequate ventilation.

It is light. Helium will dissipate quickly allowing fast cleanups of the mass spec and ultimately shorter test times. (See Table 1 for He characteristics).

Who Uses Helium Leak Detectors?

Helium leak detection is one of the most widely used methods of nondestructive testing in use today. Current applications span a diverse field of products and industry. Bio-tech companies use helium leak detectors to test implantable medical devices such as pacemakers to insure that the outer packages are protected from bodily fluids and to protect patients from possible contamination from leaking batteries and other materials. Automobile manufacturers use helium leak detection technology to test items such as air bag initiators, radiators and air conditioning units. Semiconductor fabs widely employ leak detectors to leak test process equipment.

Because of a pending shortage of helium, "recover and recycle" is the mantra.

Percent by volume in air	0.000524%
Standard atomic weight	4.002602 g•mol^{-1}
Density	0.1786 g/L (at 0 °C, 101.325 kPa)
Melting point	−457.96 °F (at 2.5 MPa)
Boiling point	4.22 K, −268.93 °C, −452.07 °F
Atomic number	2
Critical point	5.19 K, 0.227 MPa
Atomic volume	31.8 cc/mol

Table 1. Properties of helium

Why Recover and Recycle Helium?

Helium is not an infinite resource, however. Because of a delicate balance between helium availability and increasing demand, it is essential that the helium-producing industry work with helium end users to conserve, recover and recycle this valuable resource. Products for recovering, storage and recycling helium offer manufacturers an opportunity to significantly reduce their production costs. This concern is particularly timely as the market is currently experiencing a serious helium shortage linked to the US BLM's (Bureau of Land Management) reduction in allocation of crude helium. Already some suppliers have announced 15% helium price increases due to the shortage.

Assessing Helium Recovery Options

Helium recovery features a group of high efficiency gas recycling systems that significantly reduce tracer gas operating costs. The decision to invest in a helium recovery system is often determined by its financial feasibility.

Here is a sample calculation to assist in determining if the system can be justified.

Application: Helium leak test of A/C components

Internal volume of product: 100 in^3

Production rate: 500/hr

Tracer gas test pressure: 200 psig

In this sample application, the helium gas usage is 393.7 CFH. If we assume two shifts per day the helium consumption is 6,300 cubic feet. If the cost of bulk helium is at $20/100 cubic feet, then the daily cost of helium is $1,260. At these levels the equipment purchase price is recovered in less than two years.

How It Works

Gas recovery systems consists of ASME coded pressure tanks, a set of compressor(s), gas analyzer, microprocessor controls and all necessary valves, gas regulation and piping (see figures 1 and 2).[1]

The gas recovery operation includes these major steps :

1. The tracer gas in the product is vented into the vacuum surge tank (T1).
2. During each stage of compression the tracer gas is passed through a set of high efficiency water-cooled heat exchangers to remove the heat generated during compression. A two compressor system uses three volumes (T2A and T2B make up volume 2)
3. The final compressor outputs to tank (T3) completing the recycling operation.

Conclusion

Prior to implementing the reclamation system, Millennium's helium usage in August 2010 averaged 249,000 SCF/mo. With increased production helium usage in July 2011 averaged 154,000 SCF/mo. With increases in production to 5 stations of high pressure (2,400-2,650 psi) mass spectrometer testing connected to the recovery system, the company has a monthly savings of over 100,000 SCF/mo. of helium.

If the cost of helium is $20/100 SCF, the average monthly savings would be $20,000. With a total installed system cost of $115,900 ($107k machine, $3.2k service-setup, $5.7k low pressure helium-fill option and guarding), the resulting investment payback period was a little over six months.

With the ever increasing cost of helium, the economics of installing recycle systems become increasingly attractive. Many factors need to be taken into account in deciding the most effective helium recycle solution for a given situation. The economics of recycling improve with increased volume use. A helium recycle unit can not only lower costs and protect an important resource, but can also open the door to other applications and opportunities. G&I

Figure 1. Helium recovery system (Pictured is the VIC Leak Detection 4 SCFM system)

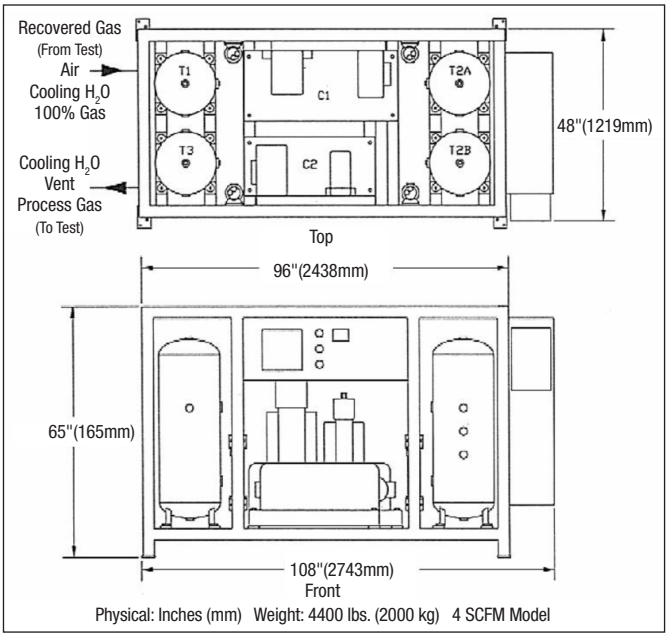

Fig. 2. A typical helium recovery system

1. For more details on helium recovery systems, see C. Wilkinson. "Helium Recovery and Recycling Systems", Gases & Instrumentation Magazine, (July/August) 2010, pp.18-20.

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