An introduction to...

Helium liquefiers

There is a growing crisis in cryogenic research, and that crisis is liquid helium. Over the last few years, cryogenic researchers and research facilities have had to accept the fact that helium, so necessary for completing their work, has been in ever decreasing supply. And this dwindling supply has been matched with ever increasing costs.

We are leaving behind the world in which helium supply could be taken for granted. New methods for recycling and conserving helium must be found and implemented if low-temperature research isn't going to suffer a cryogenic drought.

In recent years, the increase in worldwide demand for liquid helium has caused frequent price increases and supply shortages. The situation has become difficult even in the US where the majority of available liquid helium is produced. Researchers are becoming more aware of this problem and are increasingly focused on helium conservation in their future plans for laboratory operations.

Liquefier technology

For many cryogenic instruments, helium consumption is characterised by low daily boil-off and occasional significant large boil-off due to periodic transfers from storage dewars to cryogenic systems. Traditional, industrial scale helium liquefaction and recycling systems were designed to produce a minimum of 50 litres per hour, and were not a feasible solution for smaller laboratories with one or two instruments.

Recent advancements in helium liquefaction technology allowed the development of a new type of compact liquefier, which provides an ideal solution for these smaller labs. The working principle of these smaller, portable liquefiers is characterised by two cycles: the Closed Cycle, formed by cold head (at ~ 4K) and compressor, removes heat from the helium gas space and continues to cool the gas until precipitation and liquefaction take place; and the Open Cycle, where a pure helium gas source (either user instruments or gas cylinders) flows to the liquefier's dewar to be liquefied and then transferred back to user cryostats.

Medium and high pressure recovery systems

The additional challenge in helium recycling for cryogenic systems is the capture of transfer boil-off. A typical single transfer of cryogens can result in large volumes of helium gas that need to be recovered and stored.

Medium and high pressure recovery plants offer an integrated solution to this need and can provide close to 100% recovery of helium previously lost.

In a high pressure recovery system, normal and transfer boil-off is usually vented into a gas bag which serves as a temporary buffer. A compressor is used to transfer the gas from the bag into storage cylinders. This 'dirty' helium flows from the cylinders to a purifier to remove contaminants before entering the liquefier. In this way, transfer boil-off, which would usually contain too much volume to be captured directly, can now be conserved and fed into the recovery and liquefaction system.

Medium pressure plants work similarly, but replace the helium gas bag with large gas storage tanks, foregoing the long-term storage of excess helium gas into cylinder banks. The choice between these two systems depends on the number of cryogenic instruments in the lab and the expected helium recovery needs. gw

WITH THANKS

gasworld would like to thank Quantum Design for providing this equipment profile. Quantum Design's ATL160 (with a liquefaction rate of 22 litres/day) is portable, user-friendly, and requires minimum experience in low temperature instrumentation. The touch pad controller of the ATL160 (pictured) keeps daily logs of several key parameters such as temperature, pressure, volume and flow.

Quantum Design also offers direct, medium and high pressure recovery systems designed for integration with any number of liquefiers.

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