Quantum Design, Inc.

Corporate Headquarters
6325 Lusk Boulevard
San Diego, CA 92121-3733
USA

Tel: 858.481.4400
800.289.6996
Fax: 858.481.7410
E-Mail: info@qdusa.com
http://www.qdusa.com/

Medium Pressure Helium Recovery Plant (MP-HRP) Operating at University of Zaragoza

Prof. Conrado Rillo and Dr. Javier Sese, Facultad de Ciencias, CSIC and University of Zaragoza, Spain

University of Zaragoza has been active in low temperature physics for over 35 years and it was time to update our helium recovery plant based on an old Collins-type liquefier. We decided trying a new and simpler setup which would avoid the use of the large recovery balloon, high pressure compressor, large high pressure storage capacity, and complex purification techniques. The new setup has been recovering 95% of our boil-off.

The Medium Pressure Helium Recovery Plant (MP-HRP) has been in operation for several months at the Physical Measurements Service of the University of Zaragoza (sai.unizar.es/medidas/indexEng.html) which has several instruments utilizing liquid helium with an average consumption of about 100 liters/week. Figure 1 shows a scheme of the setup.

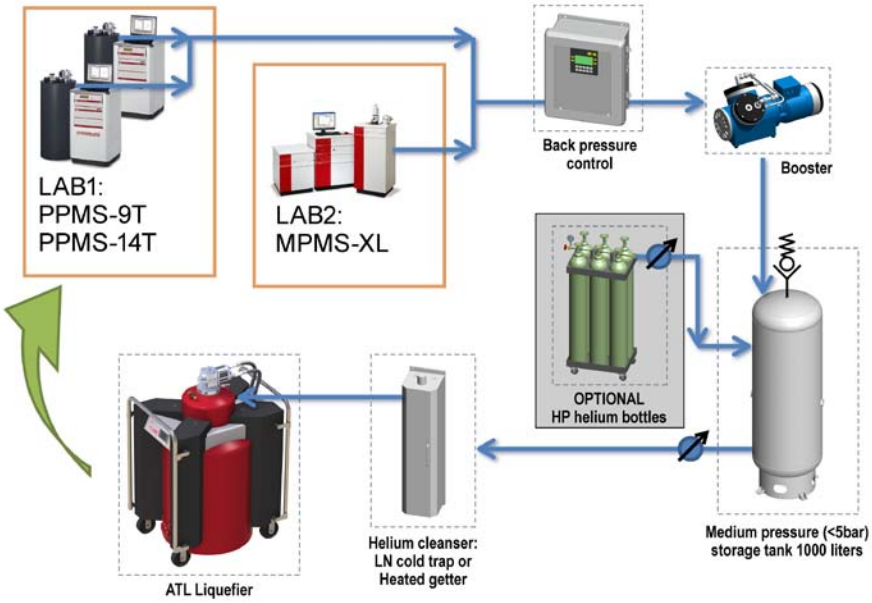

Figure 1. MP-HRP implemented to recover helium boil-off from PPMS and MPMS instruments.

This setup allows the recovery of almost 100% of the helium evaporating from the low-temperature instrumentation. The helium gas is exclusively conducted through metallic pipes to eliminate contamination via air diffusion. This is critical to keep oxygen content below 10 ppm. A back-pressure control system maintains the pressure seen by the instruments at a programmable constant value, typically 1 bar absolute (14.5 psi) with variations below 0.1%. Using a booster, the helium is then compressed and stored into a medium pressure (MP) storage tank to up to 5 bar relative (70 psi relative). This tank is feeding the ATL liquefier after passing through a helium cleanser that purifies the helium to ultra-high purity grade (impurities < 0.5 ppm of O_2) in order to guarantee the maximum liquefaction rate of the ATL. High Purity Helium bottles can be optionally added to maintain the tank pressure above a minimum (e.g. 20 psi) independently of instrument boil-off, so that enough helium reaches the liquefier to take profit of its maximum liquefaction capacity when needed.

As demonstrated in the following graphs, this simple setup is working very reliably to adapt variable liquid helium evaporation patterns to the constant liquefaction rate of the liquefier.

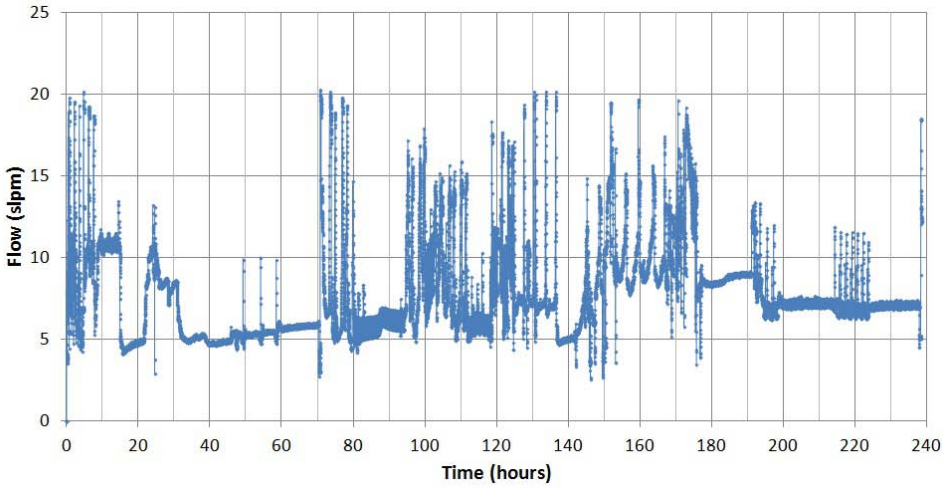

Figure 2. Typical total flow of Helium boiling off of the instruments (MPMS-XL, PPMS-9T and PPMS-14T) during a period of 10 days of continuous operation. Peaks in the flow are mostly associated with measurements performed at high magnetic fields and changes of sample temperature, which increase helium boil-off. The integrated flow over this 10 day period is 110152 liters of gas, equivalent to 157 liters liquid recovered from the instruments.

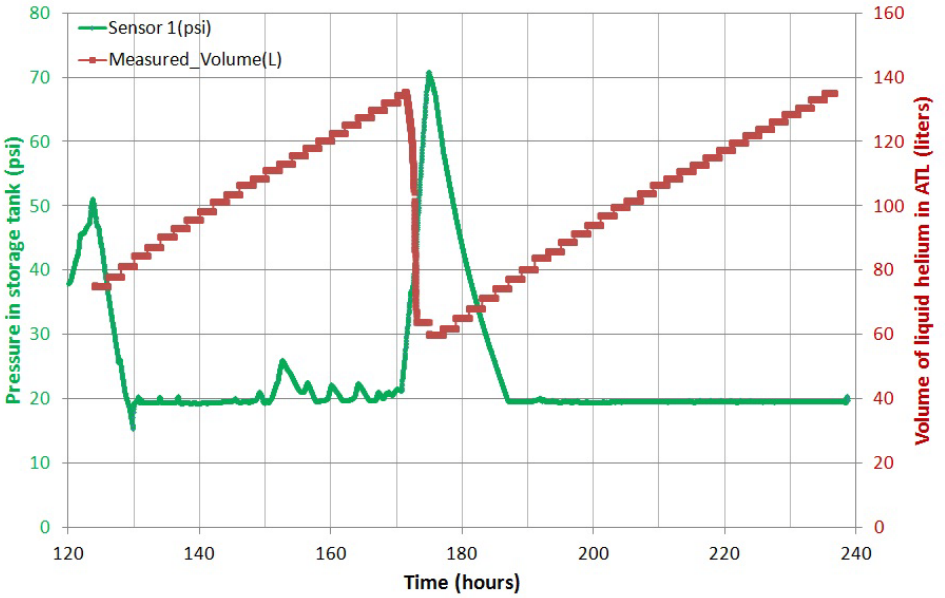

Figure 3. Pressure in the MP storage tank and liquid level in ATL for the last 5 days of the time interval shown in figure 1. All the helium from the instruments is stored, causing the pressure storage tank pressure to increase, particularly when the liquefaction of ATL is interrupted for a liquid transfer back into the instruments (e.g., at time = 170 hours when 70 liters were transferred from the ATL).

A unique feature of the ATL technology is that its maximum volume is self-controlled. When the liquid volume reaches its maximum capacity of 160 liters, the ATL continues working and starts to cool the liquid helium below its equilibrium temperature. This ´supercold´ helium (e.g. liquid at 3K and 1bar) has the characteristic of drastically reducing transfer boil-off making liquid helium transfers much easier and more efficient.

The Medium Pressure Helium Recovery Plant Setup has been in operation for more than 6 months, and ensures a 95 % helium recovery.

Developed In Collaboration With:

GWR INSTRUMENTS, INC. Universidad Zaragoza CSIC Consejo Superior de Investigaciones Científicas