

## Groundbreaking climate change research at Jungfrauoch Research Station Axetris MFCs used for CO<sub>2</sub> isotope tracking

Swiss Federal Laboratories for Materials Science and Technology (Empa) is using Axetris mass flow controllers (MFCs) in its research laboratory at the Jungfrauoch High Altitude Research Station, located at the “Top of Europe.” Axetris MFCs were chosen to fulfill the strict demands of repeatability and stability for enabling high-performance isotope tracking using laser spectroscopy.

### CO<sub>2</sub> isotope tracking to study climate change

The study of CO<sub>2</sub> isotopes provides valuable information about the effects of CO<sub>2</sub> generated due to human activities on climate change and global warming. Traditionally, various mass spectrometric techniques, such as Isotope Ratio Mass Spectrometry (IRMS), have been used to study CO<sub>2</sub> isotopes in order to classify emission sources.

Since late 2008, Empa has been operating an isotope spectrometer, based on a quantum cascade laser (QCL), at the high-altitude research station located on Jungfrauoch in the Bernese Oberland region of Switzerland. The research station is situated on the famous Swiss peak at an altitude of 3580 msl, at the so-called “Sphinx Observatory.”

### A variety of technical improvements for advancing measurement performance

Since 2007, Empa has worked continuously to develop and validate the innovative trace gas measurement setup. A number of improvements have been made over the years, so that the measurement performance of the setup could be drastically enhanced. Improvements in gas sampling and handling for the device resulted in better overall precision. Thermal control of sample and calibration gases played an important role in advancing the measurement performance.

One critical challenge to increase measurement performance was to maintain constant pressure in the reference and sample cells. Maintaining a constant pressure allows minimizing pressure effects, which may lead to spectroscopic noise. At the same



*The High Altitude Research Station, “Sphinx,” is located on the Jungfrauoch—in the Swiss Alps—at an altitude of 3580 msl.*

*“For the development of our high-precision spectroscopy setup, we were seeking small, reliable and fast MFCs. Axetris has been able to provide these crucial components which have significantly contributed to a worldwide unique trace gas analyzer.”*

**Dr. Béla Tuzson**

***Empa, Laboratory for Air Pollution /  
Environmental Technology***

time, a repeatable and stable gas flow control was required for purging the optics, and for stepwise dilution of reference gas samples to provide accurate values on internationally established scales for CO<sub>2</sub> isotope ratios. Clearly, a mass flow control solution was required, which would not only deliver exceptionally high repeatability and dynamic range (for use with different flow rates), but also deliver long-term control stability under harsh environmental conditions.

#### Axetris MFC 2022 as the ideal solution

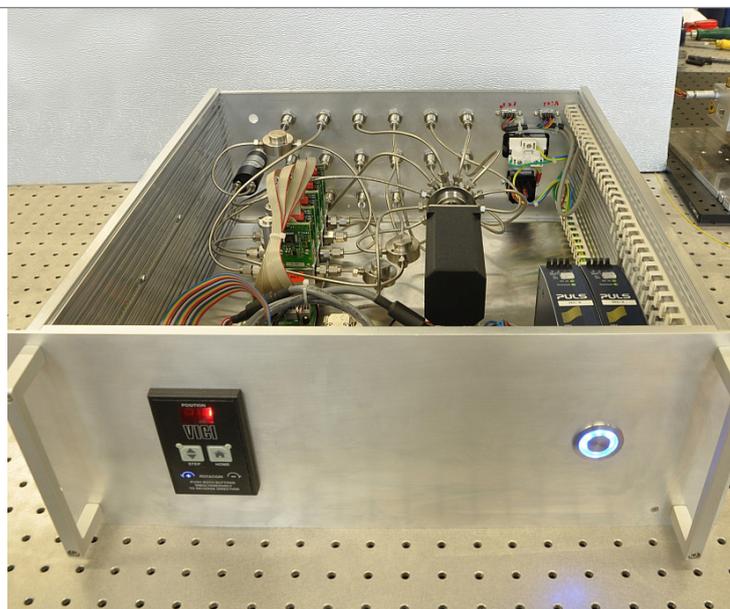
**Axetris MFC 2022**—The OEM mass flow controller based on the proprietary MEMS technology—convinced the Empa team on various critical points.

**Repeatability:** With its exceptional flow control repeatability—typically specified at  $< \pm 0.15\%$  O.R. (Of Reading)—which allowed for repeatable gas flow control for sampling and calibrating the spectrometer.

**Quick Settling Time:** The MFC 2022 achieves a lightning-fast settling time of approx. 150 ms – which allowed the team at Empa to integrate a PID loop to compensate for pressure changes.

**Stability:** The long-term stability of the MFC 2022—typically  $< \pm 0.25\%$  F.S. per year—allowed a stable flow control, which enabled long-term unattended operation, even under harsh environmental conditions.

Other advantages included the compact size of the MFC 2022, and the robust design for long-term unattended use.



*Axetris MFC 2022 built into the gas handling and measurement unit ready for deployment at the Jungfraujoch Research Station.*

#### About Axetris Mass Flow Meters and Controllers

Axetris offers OEM mass flow meters (MFM) and controllers (MFC) which offer outstanding value to the customer. The proprietary, platinum-based MEMS chip technology guarantees excellent accuracy and repeatability in combination with high speed and an extended dynamic range.

The Axetris mass flow technology is used by many leading companies in the fields of gas chromatography, leak testing, thermal analytics, mass spectroscopy, thin film deposition, plasma engineering and more.



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