

Pulsation Dampening in Catalyst Research Systems: Equilibar® Back Pressure Regulator Eliminates Disruptive Pump Pulsation

Germany's Integrated Lab Solutions has successfully used the Equilibar® back pressure regulator to eliminate pulsation from an HPLC pump as part of a liquid dosing system for a catalytic research reactor.

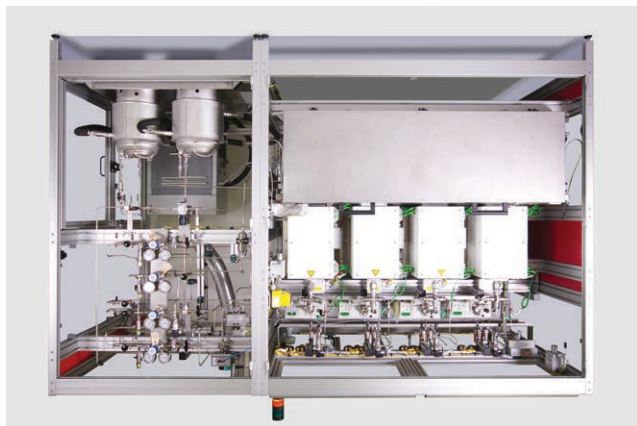


Figure 1: Integrated Lab Solutions, Gmbh designs and builds custom high throughput experimentation systems for a wide variety of catalyst research applications

Background

Integrated Lab Solutions GmbH (ILS) designs laboratory and pilot-scale chemical testing systems using a highly integrated compact design with catalyst amounts in the milligrams. Quantitative kinetic testing requires these systems to provide extremely precise low (ml/min)- to ultra-low (ml/hr) liquid flow rates over a wide pressure range extending up to 300 bars.

Using pressurized gas cylinders to generate the pressure head in this system is not feasible due to unwanted saturation of the liquid with pressurized gas. For this reason, ILS often generates the pressure head by operating a pump in recycle. Typical pump types are HPLC or membrane-type reciprocating pumps. These pumps are needed to supply a stable source of pressurized liquid for a Coriolis mass flow controller.

Pulsations of Flow to Reactor

The advantage of these particular pumps is that they provide

high pressures that are not possible with gear- or peristaltic-type pumps. Unfortunately, they have an inherent disadvantage of pulsing during each stroke of the pump head, which can result in significant errors in catalytic testing units due to oscillating vaporization or non-steady-state catalyst wetting.

ILS had previously tried a traditional spring back pressure regulator to address the pulsation problem but this led to significant pressure oscillations and variations in flow from a Bronkhorst mass-flow controller. ILS also had poor experience with commercial HPLC pulsation dampeners, which use the compressibility of liquid solvents to absorb pressure waves.

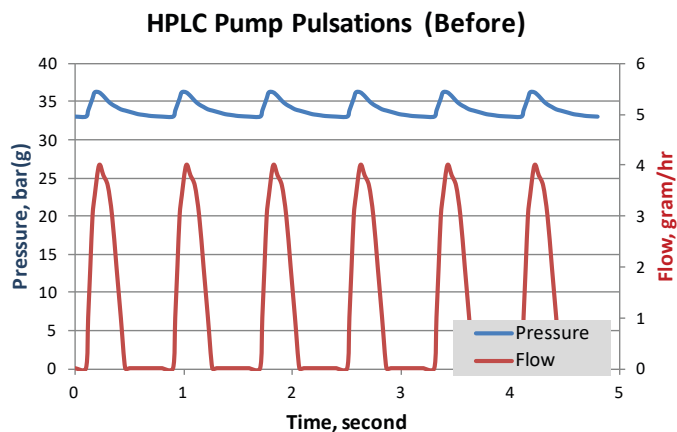


Figure 2: Graph showing flow rate and pressure pulsation created by the HPLC pump.

Solution: Equilibar® Back Pressure Regulator

ILS engineers were able to solve their critical pulsation problem by implementing the Equilibar back pressure regulator (BPR) in a circulating loop around their HPLC pump. The pump and regulator provide a nearly constant pressure source for the Bronkhorst CoriFlow micro-flow liquid-mass flow controller.

The Equilibar back pressure regulator is 1:1 dome-loaded. As such, the BPR enables a desired setpoint pressure to be communicated by means of a gas pilot pressure. One of the unique advantages of the Equilibar BPR is that its gas-loaded diaphragm acts as a pulsa-

tion dampener just prior to the diaphragm valve seat. Unlike commercial HPLC pulsation dampeners, which often use liquids such as heptane, the highly compressible nitrogen cushion works together with the precise valve action to dampen out pressure pulses.

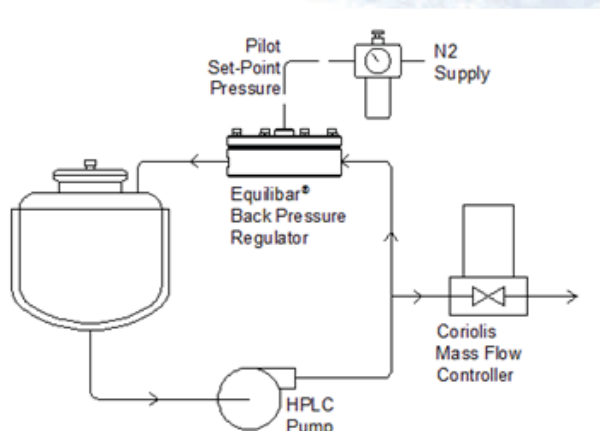


Figure 3: The schematic shown is a simplified version of the pressure control scheme used in this pulsation dampening application.

The ILS application involved the injection of water to a research reactor at 35 bar in the range of 1 to 5 grams/hour. For this, Equilibar engineers recommended the LF Research Series model and selected a supple PTFE/Glass diaphragm based on its chemical compatibility and its exceptionally wide flow rate range (100,000:1).

The unit has been in operation successfully for nearly six months.

Also Useful for Large, Industrial Flow Systems

While this application involved micro flow rates, the Equilibar® back pressure regulator can also be used in larger industrial piping systems to both control pressure and reduce pulsations.

Contact Equilibar

Equilibar is a provider for unique and innovative pressure and flow control solutions based in Fletcher, North Carolina. The patented back pressure technology is used in a wide array of processes including catalyst, petrochemical, supercritical, biopharmaceutical and other industrial applications. For more information please contact an Equilibar applications engineer at www.equilibar.com/contact or 828.650.6590.

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Jeff Jennings, P.E., is founder and president of Equilibar, LLC, a provider of high precision pressure control solutions. Prior to Equilibar, he worked as a process development engineer for 23 years. He is a licensed professional engineer in North Carolina and holds several patents. Mr. Jennings can be reached at jeff.jennings@equilibar.com or 828-650-6590.

HPLC Pump Pulsations (After)

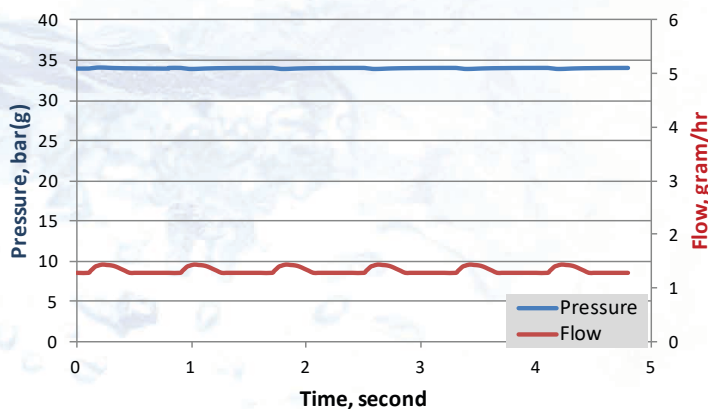


Figure 4: The graph above shows the significant improvement after adding the Equilibar® back pressure regulator in a circulation loop around the HPLC pump.

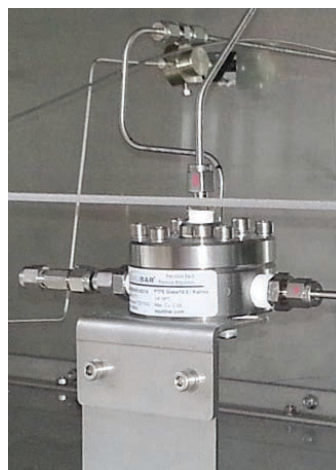


Figure 5: The image above shows Equilibar's LF Research Series back pressure regulators installed in an Integrated Lab Solutions system.