

# Back-pressure regulation for catalyst research



Application note A076-CM01-0517D



**Catalysts are substances that allow chemical reactions to proceed at lower temperatures. Even though, many chemical reactions that involve catalysts still occur under extreme conditions. For example, Fischer-Tropsch reactions, where a gaseous mixture of carbon monoxide and hydrogen is converted into (liquid) hydrocarbons at high temperature and pressure over a solid catalyst.**

In catalytic research, high temperatures and pressures are needed to prevent condensation of the chemical compounds, in order to analyse the chemical composition of the exhaust coming from a reactor. To find out under which process conditions a catalyst will perform optimally for a specific chemical reaction, a large pressure range has to be investigated. To this end, a Bronkhorst pressure controller is used to pressurize an Equilibar dome-load back pressure regulator.

- ◆ Analysis Research
- ◆ Clinical Research and Technology



*A Bronkhorst EL-PRESS Process Pressure Controller in combination with a back pressure regulator.*

## Application requirements

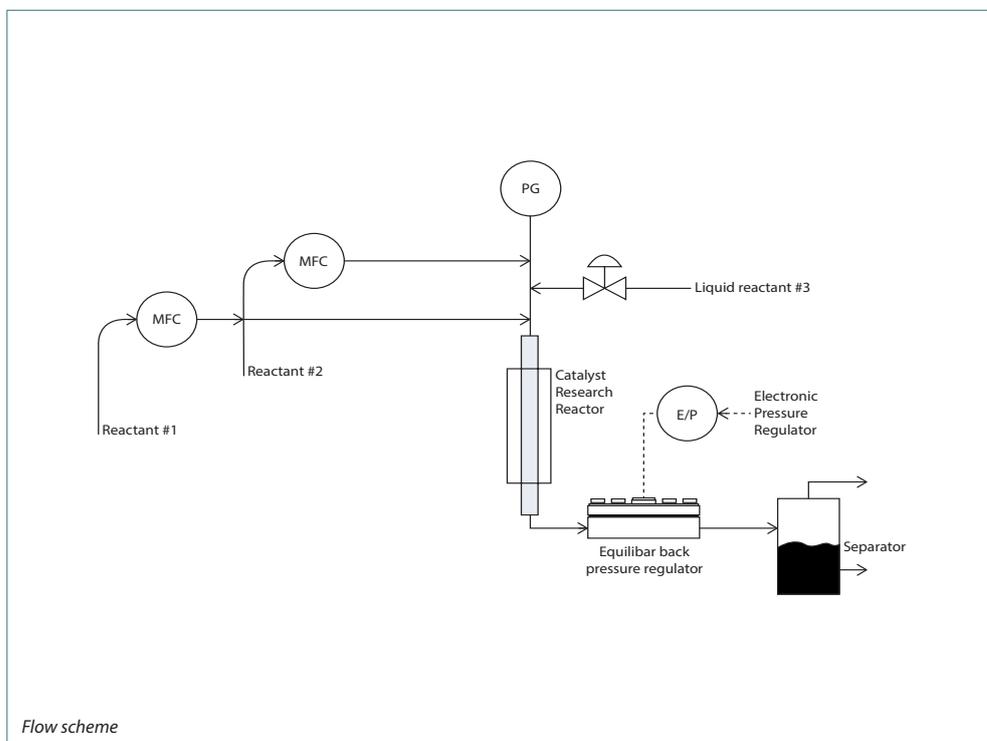
In this application an accurate control of the pressure itself and a large pressure range had to be covered. Moreover, a suitable control device should be able to deal with high pressures, high temperatures and low flows. As the valve of the pressure regulation needs to be resistant to high temperatures and several different chemicals,

a traditional spring loaded valve is not suitable. Therefore, a dome loaded regulator can be a good solution. As products can be gaseous as well as liquid, the pressure control device should be suitable for gases, liquids and two phase flow.

### Important topics

- ◆ Accurate control of process pressure
- ◆ Controller/regulator cover large pressure range
- ◆ Reduce consumption of high pressure gas
- ◆ Suitable for gas, liquid, gas/liquid combination

## Process solution



*Flow scheme*

A combination of a Bronkhorst EL-PRESS Process Pressure Controller (PPC) with two integrated high pressure solenoid control valves in a forward and back pressure control loop and a dome-loaded back pressure regulator is used to regulate the back pressure of a catalyst research reactor.

In the dome-loaded back pressure regulator, a flexible dome-shaped membrane separates a reference chamber from a process chamber. The EL-PRESS PPC determines the pressure in the reference chamber, which in turn controls the pressure in the process chamber - which is directly connected to the catalyst research reactor. A pressure sensor measures the reference pressure based on a setpoint, and the PID controller will decide whether the inlet valve should open to increase the process pressure, or the relief valve to decrease this pressure. The internal PID controller will guarantee a smooth pressure change. Set at the right pressure, the dome-loaded back pressure regulator will keep the desired process pressure.

Typical catalytic processes occur at pressures ranging from several tens of bars to a few hundred bars. Nitrogen from a gas cylinder can be used to pressurise the reference side of the dome. As 200 bar is the maximum gas pressure in such a cylinder ... ▶

... only the difference between this pressure and the process pressure can be used to control the latter. Hence, the PID controller and the small dead band will help to sparingly use the pressure difference and to reduce the consumption of high pressure gas. The valves used in this unit are capable of handling a pressure difference of 200 bar. ■



Back pressure regulator



Alternative Bronkhorst solution

## Recommended Products



### EL-PRESS Process Pressure Controller

The Process Pressure Controller (PPC) is designed to pressurise and depressurise a volume (system or device) with one single instrument. It includes a diaphragm type piezo-resistive pressure sensor for pressure measurement and two direct acting, solenoid control valves. The PPC can be applied to accurately control process pressures up to 200 bar.

- ◆ High accuracy ( $\pm 0,5\%$  of Full Scale (FS))
- ◆ Extremely high stability and reproducibility
- ◆ Pressure ratings up to 200 bar
- ◆ Standard digital signals, RS232, Flow-Bus; analog signal is optional



### EL-PRESS

The EL-PRESS series digital electronic pressure transducers and controllers for gases and liquids have a well-proven compact thru-flow design. The instruments include a diaphragm type piezo-resistive pressure sensor for pressure measurement/control from: lowest ranges 2 ... 100 mbar absolute, gauge or differential up to highest ranges 8 ... 400 bar absolute / gauge or 0,3 ... 15 bar dif.

- ◆ Thru-flow design
- ◆ Compact arrangement
- ◆ Stable control, even at varying process volumes
- ◆ High pressure capability up to 400 bar
- ◆ Metal sealed and/or down-ported versions available
- ◆ High accuracy and repeatability

## Contact information



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CM: Chemical  
01: Catalysts

T +31(0)573 45 88 00 F +31(0)573 45 88 08  
I www.bronkhorst.com E info@bronkhorst.com

