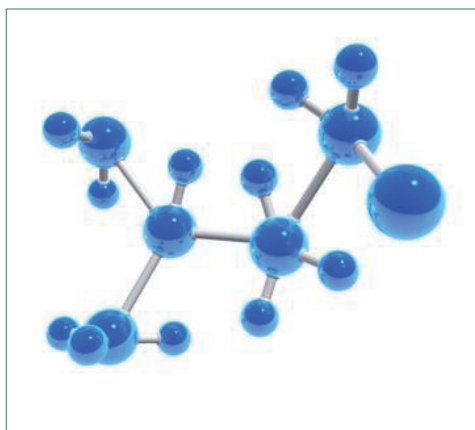


Reactor Systems



Application note A043-ANP01-1216D



In Research and Development laboratories of (petro-) chemical companies as well as pharmaceutical companies or life science companies, chemical reactors are used for many different processes.

Bronkhorst has developed a specialised combination of electronic pressure and thermal mass flow controllers for automated pressure control of reactor vessels. This standard solution can be applied for low flow lab reactor systems as well as for high flow industrial applications as for instance in hydrogenation processes in the food and pharma industry or at chemical plants, at either low or (very) high pressure (up to 400 bar).

- ◆ Synthesis of polymers
- ◆ Catalysts testing
- ◆ Hydrogenation



Compact lab reactor system for low and high pressure reactions, with interchangeable glass and steel pressure vessels (Picture: Büchi AG)

Application requirements

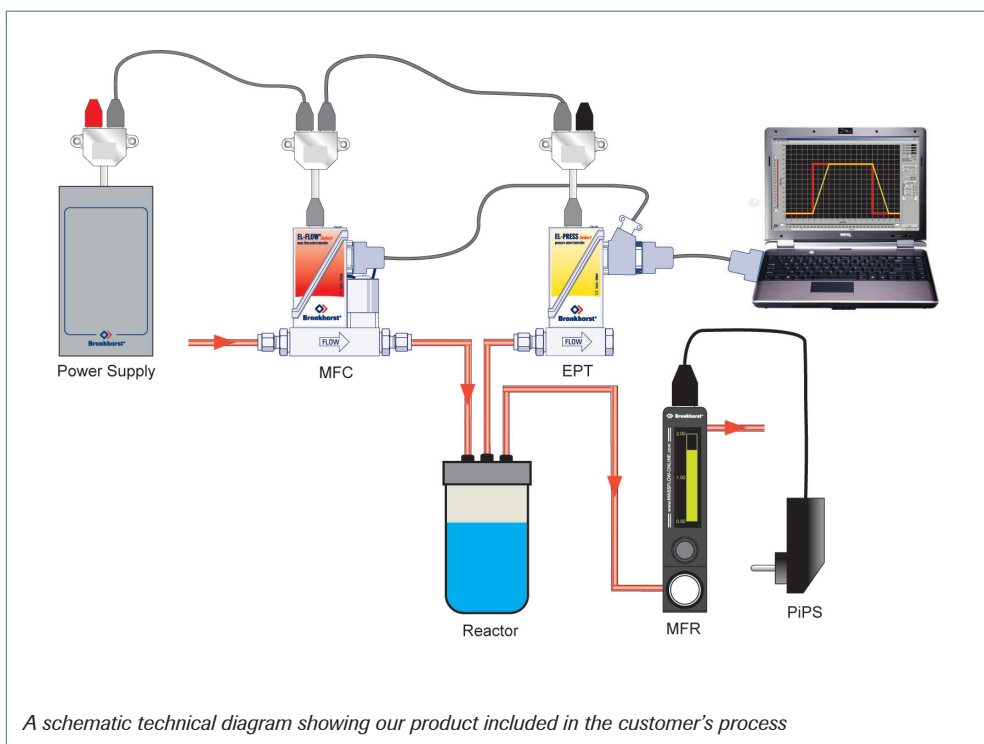
To optimize a chemical reaction, chemists must find the best combination of compounds and insert these in the optimal proportions into the reaction chamber. This reactor may be kept at a certain pressure and temperature and a catalyst may be added to accelerate the reaction.

The input of the reaction gases must be accurately measured at all times, also while pressurizing the reactor. An overshoot in flow (outside the scale of the mass flow meter) should be avoided, because this will introduce inaccuracy.

Important topics

- ◆ Accurate measurement of gases reaction and process pressure
- ◆ Programmable pressure profile
- ◆ Batch control

Process solution



A schematic technical diagram showing our product included in the customer's process

Combined Mass Flow - Pressure Control for safe and automated reactor pressure control

The proposed set-up may slightly vary per application, since the concept can be applied to both analog or digital systems. Furthermore the instruments used may be in 'laboratory style' or with rugged industrial housing, IP65 protected and optionally with ATEX Zone 2 approval. To illustrate the solution, uniquely offered by Bronkhorst, please see the adjacent schematic.

At the inlet of the reactor, a Mass Flow Controller (MFC) takes care of the process gas delivery, whilst an Electronic Pressure Transmitter (EPT) measures the reactor pressure. At the outlet of the system there is a flow restriction which could simply be a (needle) valve or, as shown in the illustration, a Mass Flow Regulator (MFR) with local display. The reactor pressure is controlled by giving a setpoint to the pressure transmitter. In the illustration this is done via RS232 by a script programmed into a PC. The integrated PID-controller of this pressure meter (Master) controls the valve position of the MFC's control valve (Slave). When building up the pressure in the reactor, the maximum inlet flow is restricted by the MFC, thus preventing a flow peak. By using the 'slave factor' option, the maximum flow can be adjusted. ▶

When the process pressure has reached the desired value, it is kept constant whilst the required amount of reaction gas is controlled with a constant flow. It is also possible to pre-set the total amount of reaction gas allowed into the system by using a batch control function. Once the total amount is reached, the set-point for the MFC can be programmed to be reset to zero, thus switching off the gas supply, independent of the process pressure. ■



Recommended Products



EL-FLOW Select

Mass Flow Meters and Controllers for gas applications have a housing designed for laboratory and clean processing conditions. The instruments are truly unique in their capability to measure and control flow ranges between 0...1 mln/min and 0...1670 l/min with pressure rating between vacuum and 400 bar – all in one range of instruments.

- ◆ Fast response, excellent repeatability
- ◆ High accuracy (typical 0,5% of Rd plus 0,1% of FS)
- ◆ Virtually pressure and temperature independent
- ◆ Maintainability and stability
- ◆ Available with analog and digital in-/output
- ◆ Standard RS232 output
- ◆ Optional: DeviceNet™, PROFIBUS DP, Modbus, EtherCAT® or FLOW-BUS protocols



EL-PRESS

The EL-PRESS series electronic Pressure Meter has a well-proven compact thru-flow design and is available in pressure ranges from 2...100 mbar up to 8...400 bar.

- ◆ High accuracy and repeatability
- ◆ High pressure capability up to 400 bar
- ◆ Suitable for gases and liquids
- ◆ Optional metal sealed and down-ported constructions
- ◆ Standard analog 0...5(10) V / 0(4)...20 mA and digital RS232 communication
- ◆ Optional field bus interface: DeviceNet™, PROFIBUS DP, EtherCAT®, Modbus, FLOW-BUS



MASS-VIEW

The intelligent alternative for VA meters, rotameters or purgemeters: thermal Mass Flow Meters for gases with flow display and electronic output signal. Mass flow control through optional needle valve. Multi-range calibration for a number of standard, pre-installed gases. Flow ranges from 0-0,2 l/min up to 0-200 l/min air-equivalent.

- ◆ Clear indication in actual flow rate, desired flow units, type of gas, totalized flow
- ◆ Bright, wide-angle OLED display
- ◆ Free of parallax errors
- ◆ Virtually independent of pressure and temperature variations
- ◆ Low pressure drop
- ◆ Fast response
- ◆ High accuracy



IN-FLOW Industrial style IP65

IN-FLOW Series Mass Flow Meters/Controllers are thermal mass flow meters of modular construction with a 'industrial style' pc-board housing. Control valves can either be integrally or separately mounted, to measure and control gas flows from: lowest range 0,2...10 mln/min up to highest range 220...11000 m3n/h

- ◆ High accuracy (typical 0,5% of Rd plus 0,1% of FS)
- ◆ Pressure ratings up to 700 bar (higher on request)
- ◆ Electro-chemical polish of all surfaces
- ◆ Rugged, weatherproof housing (IP65, dust and waterproof)
- ◆ No moving parts
- ◆ Analog or digital communication (RS232 or fieldbus interface)

Contact information



Reactor Systems
A043-ANP01-1216D

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01 : Micro Analytical Systems

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