



Bioreactor Technology: How can you upgrade your Gas Flow Control?

In recent years we have an increasing demand for reliable, repeatable and flexible gas supply systems for bioreactors. This is due to the ever more demanding, critical and delicate processes in the bio-industry where VA meters are no longer suitable and mass flow controllers are improving the process.

As an example the adequate *supply of oxygen* to the bioprocess is important. The metabolism of the microorganisms is dependent on the dissolved oxygen concentration, so that a precise control is desirable. Therefore the oxygen concentration must be lowered or increased as required by adding of either nitrogen or oxygen.

Another important variable is the *pH value*. For microbial bioprocesses this is done with the addition of liquid acids and alkalis. For cell culture, on the other hand, one uses only liquid alkalis. The liquid acid can damage the cells so you use CO₂ instead of liquid acid. There are many different bioreactor processes and each has its specific reason to use gases, but they all have in common that gas flow control plays an important and not to be underestimate role in the process. Gas needs to be measured and controlled on a reliable and safe way.

Traditionally these gas flows were done using manual VA-meters with integrated valves. But nowadays users want to automate their process. Some more demanding processes also require a higher performance (mainly repeatability). Due to these demands we often get the request to upgrade older VA-based gas supply systems to modern automated controls with this better performance.

Why are VA meter less suitable?

VA meters have no output signal and are not suitable for automatization of your process. They are extremely sensitive to changes in pressure and temperature, a small change creates a relative big error in the indicated mass flow. This uncertainty creates non-repeatability in your process. MFC's measure true mass, independent of pressure and temperature, constantly providing a predefined mass flow.

Create repeatability, accuracy, stability, reliability and implement automatic data collection!

The gas control system that grows with your needs!

Vögtlin is offering all kinds of Bioreactor upgrade modules specifically suited for your application. Systems that make your system, repeatable, consistent and independent to external influences like pressure and temperature changes. Below is an example of the most used solution. If you would like to have a suggestion for your specific needs please provide us with you details and we will free of charge make a proposal.

Gas control solutions

Vogtlin supplies complete gas mixing solutions of mass flow controllers including all required inlet and outlet configurations that can be directly connected to your reactor. In these sets we can optionally integrate all kinds of accessories like pressure sensors, non-return valves, inlet filters, shut-off valves, etc.: Plug-and-play.



Customized OEM Flow Solutions
by Vögtlin

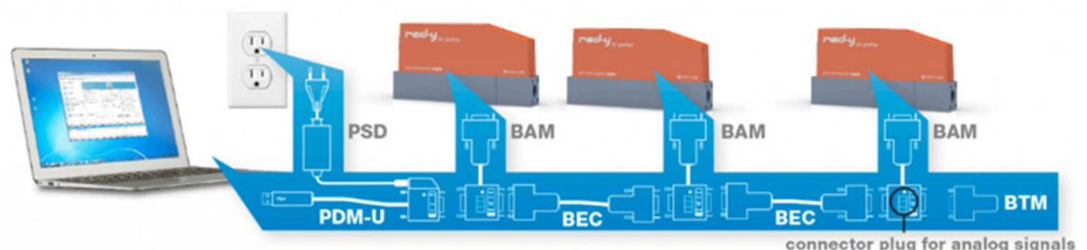
The wetted materials of this block can be anodized aluminum eco solutions or advanced 3.1 certified. FDA-compliant stainless steel. It is also possible to supply IP67 or Ex approved units.

Most customers prefer to keep their VA meter in their gas supply so that there is a visual conformation of flow. As long as there is enough inlet pressure, this is no problem. However, you might see considerable differences between them, especially if the pressure varies a lot. Due to the insensitivity in pressure and temperature the mass flow controller will be more accurate than the VA meter.

Cabling

Once the mechanical block is defined we can create the cabling system for the controls and power supply of your MFC's. You can make your own cables (Use D9 plugs) but alternatively Vogtlin has a modular system with which you quickly and simply build a complete cable system. The system is suitable for analog and digital control.

In the example diagram shown the following cables are used:



This is only one of the many possibilities of our cable system, other systems (f.i. for Profibus MFC's or gateways to Ethernet) are also available.

Control Solutions

There are several methods to control the gas flows and change the ratios.

- Manual setting
- Control box
- Standard software
- Analog
- Digital

More details on each of these options below:

Manual setting: If you choose to select the integrated display and setpoints buttons, you can adjust the required flow on the MFC's themselves with push buttons. This solution can also be added to most other control systems in case you need a back-up system in case the main system fails or if you want to have a simple way to override a system.

Control Box: The Vogtlin **control box** offers an integrated power supply and a color touch screen



to not only give individual set points, but also have functions like an integrated ratio control system and storage of pre-defined recipes. You can connect up to 10 units to one **PCU-10** box.

Standard software: Once you set-up your cabling and plug in you USB connector into your computer you can control and configure all the connected units through our **free software get red-y**. The mass flow controllers are all connected with one USB connection to your PC. Once you have installed the software, you can set and read flows and temperatures, create mixtures, and log all variables so you can review them in Excel afterwards. You can change the ranges and gasses for which the MFC is suited and optimize their operation, depending on your specific application. There are two add-on's to the basic program, one offers the above mentioned data collection and gas mixing software and the other offers the ability for the users to calibrate the units themselves.

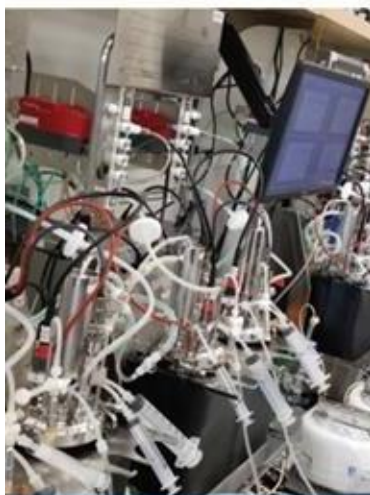
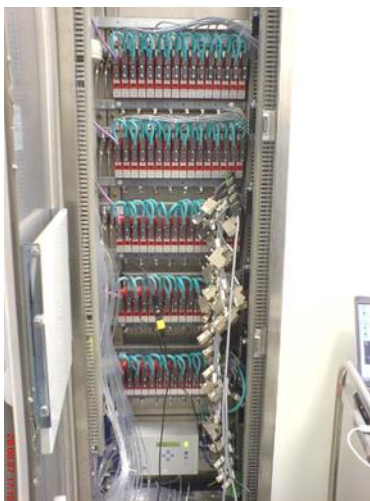
Analog: If you already have a PLC or control system and use the analog signals available, you can use the standard analog setpoints and output signals of the MFC. Most types of analog signals are available on the smart instruments (i.e. 0-5 Vdc, 4-20 mA, 0-10 Vdc, etc.). The required analog signal can be set with the above mentioned software for free.

Digital: If you already have a control system, like an embedded PC or a PLC you can communicate digitally to the mass flow controllers. Included is the most commonly used and straightforward Modbus RS-485 serial communication. You can also request Profibus as an option.

We supply several programming examples of drivers (i.e. VI's for LabVIEW) and a thorough digital manual so that implementation is a breeze. If you need support, our software specialists will be happy to support you.

Digital communications also has the advantage that you can monitor and use other variables. For instance, you can look at the valve load. If the inlet pressure becomes lower (e.g. gas leak or gas bottles getting empty) or if there is a blockage in the system, the valve load will change and an alarm can be activated before it becomes a critical problem.

Vogtlin develops and manufactures complete OEM solutions. So whatever your needs, Vogtlin has a solution for you.





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