

## Optimizing Bioreactor Production

**B**ioreactors are used in a growing number of applications, from producing bio-adaptive medicines or environmentally friendly fertilizers and pesticides, to brewing beer, refining ethanol and treating wastewater. Alicat Scientific's broad range of mass flow controllers simplifies and streamlines your bioreactor development lifecycle. Using one family of instruments with your choice of communications protocols, you can refine your research in the lab at 100 s $\mu$ lm and then take the same accuracy and precision through the ramp-up to pilot plants and full-scale production at 5000 slpm. Built without hot wires, these MFCs can handle the ingress

of liquids without being destroyed, making them well-suited to laboratory experimentation and continuous production use.

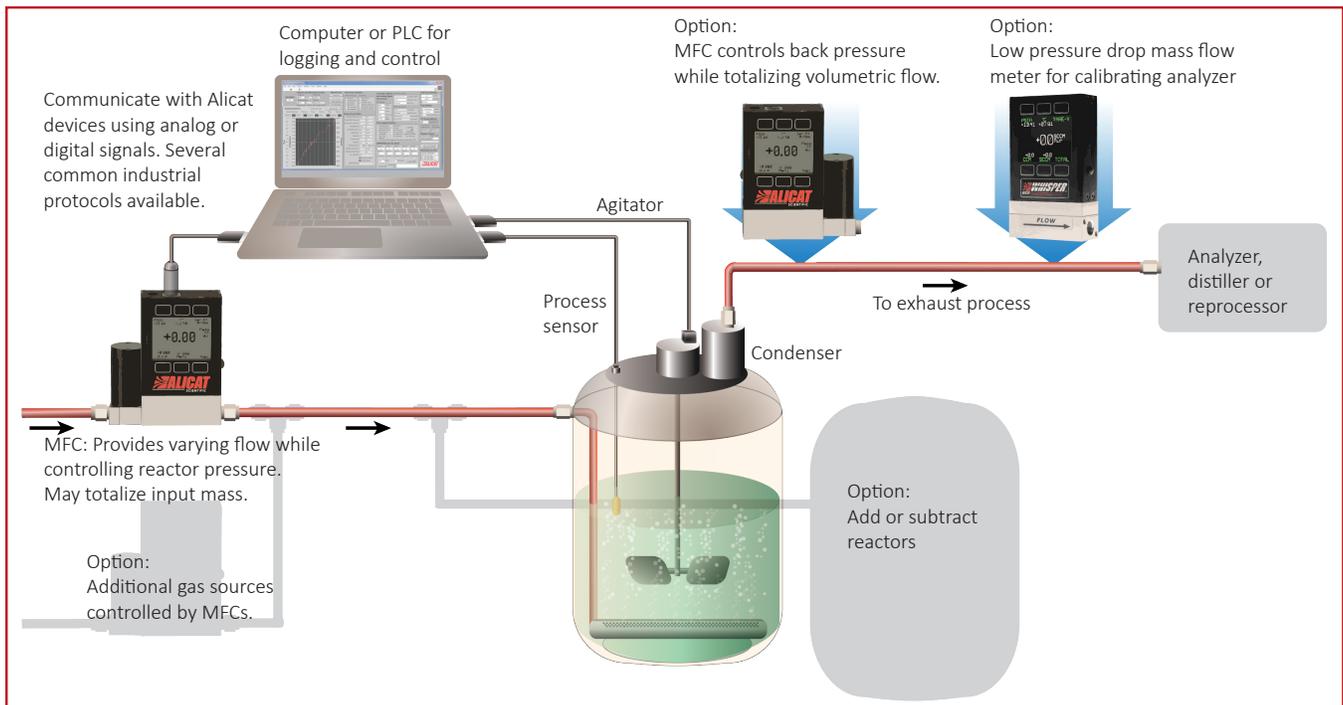
### MAINTAINING CONSISTENT GAS DELIVERY TO THE REACTOR

Though the industrial applications for bioreactors are diverse, all rely upon the consistent delivery of air, oxygen, carbon dioxide and/or nitrogen to achieve and maintain optimal growth rates in the biomatter medium. Alicat's Gas Select allows you to use any MFC to control these gases without sacrificing measurement accuracy, which in turn reduces the

need to maintain separate inventories of gas-specific MFCs when ramping up to production. If you are adding or removing bioreactors on the same gas line, you can set the Alicat to maintain a constant pressure throughout the line while still monitoring or totalizing mass flow. Standard integrated displays make setup and data collection in the lab or troubleshooting in the plant easy and straightforward.

### CONTROLLING THE HEAD SPACE ABOVE THE BIOMATTER MEDIUM

In certain reactions, when the oxygen in the head space above the



biomatter medium is maintained at a higher pressure, the oxygen molecules more easily react with the biomatter below. This condition can be achieved by using an Alicat backpressure controller at the outlet of the bioreactor to maintain an elevated pressure within the reactor. If you also want to monitor or totalize the outgassed mass, an Alicat mass flow controller can be configured to control the backpressure while at the same time measuring the flow through it. Alternatively, you can introduce additional oxygen directly into the headspace via a micro-flow mass flow controller running at mere milliliters per minute.

### MONITORING AND RECORDING BIOREACTOR OUTPUT

Applications like methane production or hydrogenation benefit from comparing the mass of gas added to the bioreactor with the mass that

has been outgassed. User-selectable units of true mass and optional totalizer firmware make it easy to compare these numbers without the cumbersome conversions from standardized volumetric flow rates. COMPOSER™ firmware allows you to recalibrate the meter on the fly as the gas concentrations change or send gas composition updates in real time from your gas analyzer. Even when outgassing occurs at atmospheric pressures, the very low pressure drop of Alicat's Whisper series will not induce backpressure while quantifying outgassed mass. When your output is markedly peaked, the wide operating range of all Alicat MFCs will let you capture both the peak flow rates and the leading or trailing edges when flow is almost nothing.

### WHY ALICAT?

- One family of instruments from lab, to pilot to production
- 200 to 1 turndown reduces ranges required
- Gas Select reduces spare inventory
- Durably withstands ingress of liquids
- Low pressure drop models for working with low pressure differentials
- COMPOSER™ gas recipe system for matching outgassing compositions
- Profibus, Modbus, Ethercat IP, DeviceNet
- LabVIEW drivers
- Control pressure while measuring mass flow

### SELECTED SPECIFICATIONS:<sup>1</sup>

#### Mass flow controller MC and Whisper™ meter MW:

Accuracy at calibration conditions after tare: up to  $\pm(0.4\%$  of reading + 0.2% of full scale) NIST-traceable  
 Repeatability:  $\pm 0.2\%$  of Full Scale  
 Operating range: 0.5% to 100% Full Scale / 200:1 Turndown  
 Typical control response times: 50-100 ms (Adjustable)  
 User selectable 98 gases at specified accuracy  
 Lifetime warranty

#### Pressure controller:

Repeatability:  $\pm 0.08\%$  Full Scale  
 Operating range: 0.5% to 100% Full Scale / 200:1 Turndown  
 Typical response time: 100ms (Adjustable)



Left to right: MC Mass flow controller with color screen. MW low pressure drop 500 SLPM Whisper mass flow meter. PC Pressure controller

<sup>1</sup> Contact Alicat for full specifications and available options



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