Microfluidic Pump Optimizes Sample Transport In Integrated Bioreactor

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Bitome uses their benchtop nuclear magnetic resonance (NMR) spectrometer to provide automated analysis of liquid cell media from any bioreactor. As bioprocess research and manufacturing grows, there is a growing need for metabolomic analysis that is quick, low-cost and minimizes loss of product. The company's miniaturized NMR spectrometer currently requires manual sample delivery and further streamlined integration between bioreactors and their product is desired. Automation of sample delivery, integration bioreactor and NMR components would allow for higher data throughput. Our group produced an automated, in-line, pressure-driven sample transport system enabling control and monitoring of bioprocessing parameters. Our novel application of a pressure-driven pump to integrate Bitome's bench-top NMR with a bioreactor allows for consistent microfluidic sample mixing and filtering prior to NMR analysis leading to higher fidelity metabolite analysis. For large-scale data analysis of this kind to be successful, it is essential to optimize the components of sample handling and processing as best as possible. Our team employed in-line pressure sensors with our pump to monitor sample transport flow rate. The use of these sensors, along with optical flow rate monitoring fed to an Arduino microprocessor providing proportional-integral-derivative (PID) control, ensures consistent flow of cell broth through the pump, filters, and mixers. Closed-loop transport ultimately returns the sample back to the bioreactor for continued culture growth, minimizing product loss.