



Retooling Existing Fermentors and Bioreactors

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In the laboratory or pilot plant, existing glass and stainless steel fermentor and bioreactor vessels can remain in working condition for many years. However, the proprietary reactor electronic controls and instruments often fail or become outdated before the vessel itself is considered non-functional. Finding replacement parts for the custom electronics and compatible instruments becomes expensive and more difficult over time. Using modern PLC (Programmable Logic Controllers) and hardware components, ILS will retool and retrofit existing fermentors and bioreactors. This retooling is a cost effective and practical alternative to discarding working hardware and purchasing new fermentor and bioreactor systems. The retrofit also provides the opportunity to choose hardware and software options that meets the customer's specific needs. All brands of fermentors or bioreactors are candidates for retrofitting including B. Braun/Sartorius, New Brunswick, Applikon, and others.

Depending on the condition of supporting equipment, the retrofit may include replacing several hardware components. This includes replacing reactor controllers and IO (input/output) boards with industrial-grade PLC components, replacing old operator interfaces with modern color HMI (Human Machine Interface) touchscreens, and replacing equipment such as agitator motors, water pumps, and heaters with modern off-the-shelf equipment. Replacing and upgrading the equipment also provides an opportunity to add new capabilities such as new on-line instruments and allows designing customer-specific software and HMI requirements. Furthermore, ILS makes each retrofitted system Ethernet enabled, which allows the systems to become networked and more accessible to end users.

Specific requirements depend on the fermentation or bioreactor type. For example, bacterial and mammalian cells require different approaches for the control and monitoring of the process. Options often include gas-mixing valves, serial and/or analog interfaces to control external pumps, scales, and other equipment. The goal is always to choose hardware and IO interfaces that provides a reliable system that works well within the site and is flexible for future growth. Software and HMI requirements follow from the IO and hardware options chosen.



The choice of hardware controllers and the design of software are significant in the overall reliability and usefulness of the reactor. PLC control hardware is widely used in discrete manufacturing and process industries. PLC hardware is considered robust and reliable. ILS will program the PLC to provide control over pumps, motors, heaters, valves, scales, and other equipment.

Care is taken to properly design and program the PLC. This includes capabilities for PID (Proportional, Integral, Derivative) control, instrument and pump calibration, HMI interfaces, serial interfaces, and Ethernet-based communication. The HMI is designed and programmed to provide operators and administrators a positive and productive user experience. This includes intuitive layouts with minimal distractions and clutter. In the case of GMP environments, functionality and documentation can be provided to meet 21 CFR Part 11 and validation requirements. Such requirements can effect the options and software/HMI design chosen.

A desirable goal of any retrofit is to provide a useful Ethernet communication. An Ethernet port on the system allows for “remote” data collection and control through the PLC. Industrial grade communication occurs through OPC (OLE for Process Control) servers and clients. Supervisory and control data acquisition (SCADA) software platform communicate through the OPC server. This allows for the integration of a complete solution where experiments and recipes are planned and executed through the SCADA system, data is collected from the PLC and stored within a database, and batch reports are generated.

In conclusion, a retooling or retrofit of existing fermentor or bioreactor can have several advantages. Retooling is a cost effective approach to reuse working vessels while providing modern hardware and software. The process allows for the choice of hardware options and software design that meets specific needs.

ILS is a Chicago area company that develops custom software and hardware for the pharmaceutical and chemical industries. See www.ils-automation.com for more information.