

Laboratory Reaction Systems

Optional Fittings

Parr Instrument Company is pleased to work with customers in the design and assembly of complete laboratory or pilot plant reactor systems, offering a full spectrum of reactor designs, ranging from simple, Stirred Tank Reactors for batch operation to Continuous Flow Stirred Tank and Tubular Systems. Parr can furnish either the essential components for assembly by the user, or a completely assembled turnkey system. Parr's experience in this field has ranged from table-top micro systems to small operating pilot plants, each with a reactor (or reactors) designed to meet the user's particular requirements. Our experience in systems includes:

Continuous Flow Stirred Tank Reactor Systems

This mode of operation requires that reactants be introduced and products removed on a continuous basis. Generally, this must be done with the reactor at elevated temperatures and pressures. Reactors used for these applications must be modified to provide sufficient inlets and outlets for the reactants and products as well as designs for maintaining continuous operating levels and pressures under flow conditions.

Continuous Flow Tubular Reactor Systems

Instead of a stirred tank reactor these systems use a tubular vessel generally packed with a fixed bed of catalyst. Reactant liquids and gasses are fed to the reactor at a controlled rate through pre-heaters and mixing systems. Products are collected from the discharge of the reactors and are cooled and separated for recovery.

Reactor Ancillary Systems

Both stirred tank and tubular flow reactors will require feed and recovery systems when operated in a continuous flow mode. Subsystems and components developed for incorporation into these systems include:

Gas Feed Systems

These systems commonly include one or more of the following components:

Intermediate Reservoirs. These gas supply tanks can be sized to the expected consumption of the reaction so that the pressure drop in this reservoir can be measured to determine total consumption by the reactor. If the pressure is measured continuously, the rate of pressure drop can be converted to reaction rates.

Constant Pressure Gas Regulators. These regulators, sometimes called forward pressure regulators, will deliver gas to a reaction to maintain a constant pressure within the reactor. They are a simple and effective means for controlling the pressure in systems where it is desirable to feed gasses to a non-flowing reactor over time.

Electronic Mass Flow Meters. These meters will measure the flow rates of gases into a reactor. They are very valuable for systems under integrated computer control.

Electronic Mass Flow Controllers. These are electronic flow meters with an added flow control valve which delivers the flow at a constant rate which can be set by the user.

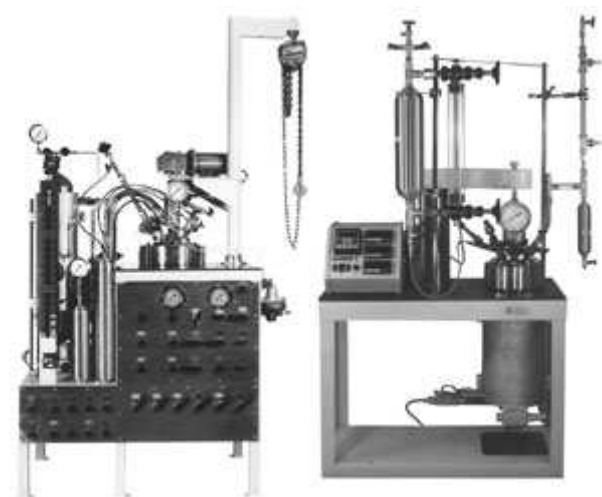
Back Pressure Regulators. These regulators are generally installed on the gas discharge line of a reactor to maintain the desired pressure within the reactor by regulating the flow of exit gases. They can be set either manually, or by gas pressure, or electronically, as required. These back pressure regulators are commonly used with mass flow controllers to ensure that the flow of gas passing through a reactor has been held at a constant pressure.

Liquid Feed Systems

There are two commonly used liquid feed systems:

Pressure Pipette Assemblies. These generally consist of a small pressure vessel from which liquid feed material can be forced into a reactor. The vessel is pressurized with nitrogen (or other gas) to a pressure greater than that in the reactor, and the liquid is fed into the reactor through an appropriate control valve. This arrangement is usually selected for systems in which liquid is introduced as a batch rather than continuously. A liquid level indicator or sight glass can be added to provide some degree of measurement and control.

Liquid Feed Pumps. A variety of liquid feed pumps are available, but the most commonly used ones for Parr reactors are those designed for high pressure liquid chromatography. These small pumps have available flow rates and operating pressure ranges well suited to Parr reactor systems. Chemical feed pumps are also available for larger systems. Most pump models are available for remote or manual control.



A 5 Gallon Reactor with a Feed System and Full Controls in a Compact Pilot Plant Arrangement

A 2 Gallon Reactor with a Liquid Filling System, Condenser, Receiver and a Bottom Drain

Product Handling Systems

The following components are commonly employed to deal with the hot, high pressure product streams leaving a reactor.

Cooling Condensers.

These can be used in various ways: to separate and return condensable solvents to the reactor from the exhaust stream; to take off condensable liquids; to cool exhaust gases before they reach a back pressure regulator; or to cool a liquid product. Many different sizes and configurations are available.

Gas/Liquid Separators.

These are generally recovery vessels which receive a mixed flow of gasses and liquids

and separate them for appropriate recovery or venting. Often they are equipped with coolers and/or reflux condensers.

Liquid Level Control Systems.

At high pressures and temperatures in small systems, liquid levels are most practically controlled by stand pipes or discharge level controls rather than by electronic controls. While some electronic controls are available, they are not always small enough or sensitive to the small level changes experienced in bench scale and small pilot plant systems. Pressure and/or temperature ratings may also be inadequate for a particular installation.

Control and Data Acquisition Systems

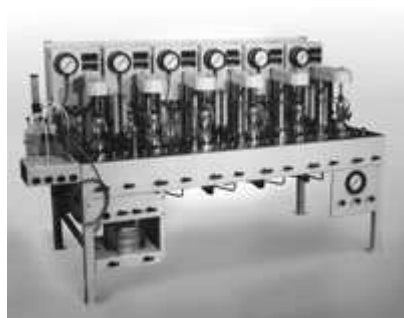
Multiple Modular Control Systems.

Simple reactor systems can be controlled with individual controllers for each of the variables in the system, such as: separate temperature zones, operating pressure, flow rates, stirrer speed, etc. Analog outputs can be included for data output and can be connected to the Parr Model 4846 Data Acquisition System.

Integrated Computer Control Systems. The Parr Series 4870 Process Controller is an example of an integrated computer control system which can control the process as well as the individual components of the system. It uses a PC for the user interface terminal, data logging and archiving system.

System Integration and Mounting

Integrated Support Stands. Support structures for the reaction vessel and its various subsystems can be designed and fabricated to provide systems which are ready to install in the user's spaces. The Parr Instrument Company technical staff is available to assist in the design, selection and integration of components for custom reactor systems.



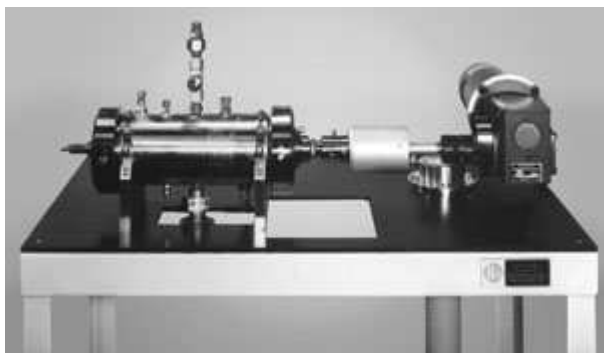
A Six-Unit Multiple Pressure Reactor



Four Interconnected Stirred Reactors with a Pressure Feed System and Full Controls Provided by Two Parr Process Controllers



Custom Built Tubular Reactor with Chilled Feed System

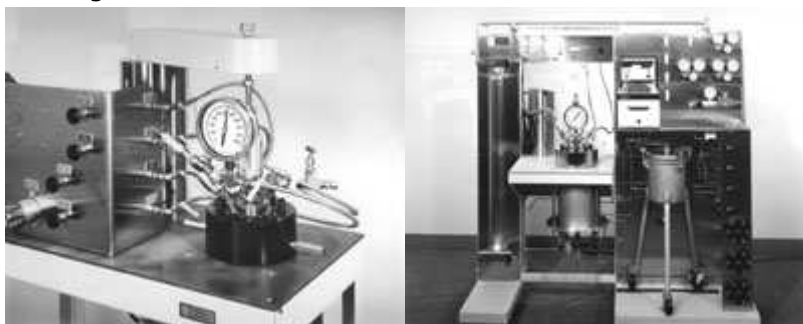


Custom Built Horizontal Stirred Reactor



600 mL Stirred Vessel with four Windows, Bottom Split-Ring Closure, and Clamp-on Cooling Block

Custom Built Catalyst Preparation System



Custom Built Gas Delivery
System with Flow Control
Metering and Back Pressure
Maintenance

Custom Built Polymerization
System