

## H-6250 Chemical Liquid Reactor Demonstrator

### Purpose

The reactor vessel constitutes a critical part of any chemical process plant. Reactor vessel kinetics is of great importance in the area of chemical engineering. One of the major types of reactors is the stirred liquid phase reactor. In order for the process engineer to optimize the product yield, a detailed understanding of the process is necessary.

### Equipment Overview

The fundamental device is the reactor vessel. This vessel has a usable process volume of 1 to 2 liters (adjustable) and is equipped with a variable speed stirrer, reagent feed ports, product outlet port, product sampling port, and temperature measurement port.

The reagents are stored in a pair of corrosion-resistant tanks, each matched with a chemical metering pump and flow calibration port. The metering pumps are equipped with an external control feature. A product collection tank (constructed out of corrosion-resistant material) is also provided. All of the tanks are covered and are provided with drain valves.

The measurement and control of temperature are accomplished with a microprocessor based PID controller and a platinum RTD probe. The controller operates an electric heating element. In addition, a cooling/heating coil is provided to carry out heat transfer studies.

The variable speed mixer, used in conjunction with removable and adjustable baffles, allows experiments to be performed studying the effects of reagent mixing.

**Model H-6250-CDL**  
Chemical Liquid Reactor Demonstrator  
with CDL option

Dimensions: 60"H x 60"W x 30"D  
Shipping Weight: 550 lbs.



The unit has provisions for gas/liquid reactions. A gas flowmeter, connected to the reactor vessel is provided. The gas tank, pressure sensor and pressure controller are not included. A port for the pressure sensor is available. This port can also be utilized to maintain an inert gas atmosphere in the reactor vessel.

### Specifications

The Hampden **Model H-6250** Chemical Liquid Reactor Demonstrator is designed to permit the investigation of the characteristics of the stirred liquid phase reactor. The unit comes equipped with all of the necessary instrumentation to study the reactor characteristics except for the analytical measurement instrumentation used to determine the feed and product mixture compositions.

With the unit, the student can determine the following:

#### A. Chemical Kinetics

##### Batch reactor:

As a batch reactor, the reaction rate (and thus the kinetic constant) can be determined with respect to temperature, residence time and mixing effects.

##### Continuous operation:

As a continuous reaction, the actual yield can be compared to the theoretical yield based upon the factors determined above.

##### Temperature control:

The effect of temperature on the reaction rate can be studied. The batch reactor can be operated at a constant temperature or with a variable temperature (e.g. a ramp temperature input). The reactor can be controlled from ambient to 80°C.

All Hampden units are available for operation at any voltage or frequency

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## B. Heat Transfer

### Heat transfer coefficients:

The heat transfer coefficients between the reactants and the heating or cooling coil can be determined. This will enable the use of mass and enthalpy balances which will introduce the student to yield optimization.

## C. Mixing effects:

The effect of mixing on the reaction may be carried out. In general, theoretical results are based on a well-mixed model of a given process. By using baffles and the variable-speed stirrer, various mixing conditions can be simulated and the mixing speed optimized.

## Equipment Specification

### Reactor Vessel

The reactor vessel consists of a transparent sided member with a maximum capacity of 2.5 liters. It is fitted with a RTD probe, a variable speed stirrer, a heating/cooling coil (stainless steel construction), a pair of reagent inlet lines, a product outlet line with an adjustable overflow, and a removable lid which will only allow carbon-dioxide free air into the reactor vessel.

### Temperature Controller

A microprocessor based PID controller which accepts a RTD input (other inputs available on request). The unit features a programmable ramp and soak function to allow the optimization of the product yield by controlling the temperature in the reactor at different values during the reaction. The unit comes equipped with a RTD probe. An optional communication interface (RS-232 or RS-422) is also available to allow computer monitoring or control of the process.

### Feed Pumps

Two electronic chemical metering pumps constructed out of non-corroding materials. The flow rate can be varied from 10 to 300 ml/min and is accurate within  $\pm 1\%$  over the operating range. The flow rate can be controlled manually or by an external 4-20mA signal. The external remote signal can come from the remote station (which allows computer monitoring of the flow rate) or from a host computer.

### Reagent Calibration Ports

A pair of outlet ports that allow the calibration of the metering pumps to be checked. However, since these are precision devices, the volumetric flow rate shall not vary significantly with time.

### Gas Flowmeter

A precision rotameter which has a fullscale accuracy of  $\pm 2\%$  and a  $\pm 2\%$  repeatability. This unit also features a polycarbonate shield for use in pressurized systems.

### Reagent Tanks

A pair of tanks, each with a capacity of 22 liters, and constructed out of corrosion resistant materials. These reservoirs include covers and store the chemicals utilized in the reactor vessel.

### Product Tank

A 75 liter tank constructed out of corrosion resistant materials. The reservoir includes a cover and stores the output of the reactor vessel.

### Stirrer

A variable speed (0-1000RPM) stirrer constructed out of stainless steel. An optional tachometer is available to allow a host computer to monitor the stirrer speed.

The unit has a self supporting frame constructed out of mechanical square tubing. The instrument panel is constructed out of code gauge steel and is mounted on a formica top. The frame is finished in instrument tan texture and the instrument panel is finished in gloss white enamel. The overall dimensions are 60" high by 60" wide by 30" deep.

The unit comes complete with all of the necessary instrumentation with the above exceptions noted. These are the analytical instrumentation to measure, and analyze the reagents and products (titration glassware, chemical reagents, etc.), the reagents used in the experiments, the gas tank, pressure sensor, and pressure controller.

## Services Required

**Electrical:** 120V-1 $\phi$ -60Hz

**Water:** supply of deionized or distilled water  
supply of water for cooling (2 liter/min)

## Computer Data Logging

In order to enhance the experiment capabilities of the equipment, a computer interface option is available. This will allow a host computer either to monitor (data logging) or control the process. The chemical feed pumps, stirrer RPM, the RTD probe and temperature controller are all capable of being monitored and/or controlled by a host computer. The bench can be configured to operate with either RS-232 or RS-422 serial communications.

Specify the **Model H-6250-CDL**. ♦

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