

CHEMICAL REACTION ENGINEERING LAB

EQUIPMENTS

1.CHEMICAL REACTORS SERVICE UNIT

DESCRIPTION

The chemical reactors service unit consists of a moulded ABS plinth which is used as a mounting for the chemical reactor to be used. It also provides the ancillary services for the reactor.

- Chemical storage vessel
- Feed pumps
- Stirrer control panel
- Hot water circulator
- Temperature control of reactor
- Conductivity measurement of reactor contents
- Reactor fitment
- Mainsplate at rear of plinth

SPECIFICATION

Peristaltic pump flow rate 0-95 ml/min per pump

Feed tank capacity 5 L per tank



2. BATCH REACTOR

DESCRIPTION

Batch reactors are used widely in industry at all scales. Batch reactors are tanks, commonly provided with agitation and a method of heat transfer (usually by coils or external jacket). This type of reactor is primarily employed for relatively slow reactions of several hours duration, since the downtime for filling and emptying large equipment can be significant. Agitation is used to maintain homogeneity and to improve heat transfer.

The Batch Reactor is specially designed to allow detailed study of this important process. It is one of three reactor types which are interchangeable on the Reactor Service Unit, the others being Continuous Stirred Tank Reactor and Tubulator Reactor.

Reactions are monitored by conductivity probe as the conductivity of the solution changes with conversion of the reactants to product. This means that the inaccurate and inconvenient process of titration, which was formally used to monitor the reaction progress, is no longer necessary.

There are two modes of operation with the Batch Reactor:

- Isothermal operation
- Adiabatic operation



3. TUBULAR REACTOR

DESCRIPTION

Tubular reactors are often used when continuous operation is required but without back-mixing of products and reactants.

The Tubular Reactor is specially designed to allow detailed study of this important process. It



is one of three reactor types which are interchangeable on the Reactor Service Unit, the others being Continuous Stirred Tank Reactor and Batch Reactor.

Reactions are monitored by conductivity probe as the conductivity of the solution changes with conversion of the reactants to product. This means that the inaccurate and inconvenient process of titration, which was formally used to monitor the reaction progress, is no longer necessary.

SPECIFICATION

Pre-Heat Coils (each)

Total length	1.2 m
Internal diameter	4.9 mm
Total volume of coil	0.02 L

Reactor Coil

Total length	20.9 m
Internal diameter	5.0 mm
Total volume of coil	0.41 L

4. CONTINUOUS STIRRED TANK REACTOR

DESCRIPTION

The continuous stirred tank reactor in the form of either a single tank or (more often) tanks in series, is used widely and is particularly suitable for liquid phase reactions. It is particularly used in the organic chemicals industry. Advantages include consistent product quality, straightforward automatic control and low manpower requirements.

The Tubular Flow Reactor is specially designed to allow detailed study of this important process. It is one of three reactor types which are interchangeable on the Reactor Service Unit, the others being Tubular Reactor and Batch Reactor.

Reactions are monitored by conductivity probe as the conductivity of the solution changes with conversion of the reactants to product. This means that the inaccurate and inconvenient process of titration, which was formally used to monitor the reaction progress, is no longer necessary.

SPECIFICATION

Vessel diameter	0.153 m
Maximum vessel depth	0.108 m
Maximum volume	2.0 L
Maximum vessel depth	0.054 m
Minimum operating volume	1.0 L



5. CATALYTIC REACTOR

DESCRIPTION

The catalytic reactor demonstrates the principles of packed bed catalysis. In such a system the catalyst is immobilised on porous spherical particles (support matrix) that



are retained within the reactor. Feed material is pumped into the reactor where it mixes with the immobilised catalyst which leads to product formation. The product, which is soluble, passes out of the bottom of the reactors. An advantage of this type of reactor compared to alternative designs such as the stirred tank and tubular reactor is that the need for an additional stage to separate the catalyst from the product is removed.

With this design re-use of what is often an expensive catalyst is simple. Additionally this approach lends itself to continuous operation.

The unit is fitted with two reactor columns as standard which are used to demonstrate chemical catalysis. A third column, which is available as an option, uses a biological, enzymic catalyst. All columns use the sucrose inversion reaction, splitting sucrose to form glucose and fructose.

Catalytic Reactor can be used to examine steady state and unsteady state reactor performance, to compare chemical and biological catalysis, to characterise the flow in a packed bed, to determine the relative effects of rate of diffusion and reaction rate (Thiele modulus), and to demonstrate the principles of flow injection analysis.

The catalytic reactor unit consists of:

- Control console
- Two packed bed chemical reactor columns with water jackets
- A packed bed biological reactor column with water jacket — available as an option

- Feed pump
- Hot water circulation system
- Optical sensor
- Flow injection analysis (FIA) — available as an option