

**BE  
SERIES**

**Batch Enzyme Reactor – BE1**

A batch enzyme reaction system utilising the industrially important glucose isomerisation reaction (converting glucose to fructose) catalysed by glucose isomerase.

The purpose of the unit is to demonstrate batch enzyme kinetics and enzyme characteristics.

The reaction takes place inside a stirred vessel where the stirrer itself is a porous basket inside which the enzyme is immobilised.

A polarimeter device, which is integral to the unit, monitors the glucose and fructose concentrations with time.

BE1: Enzyme reactor basket

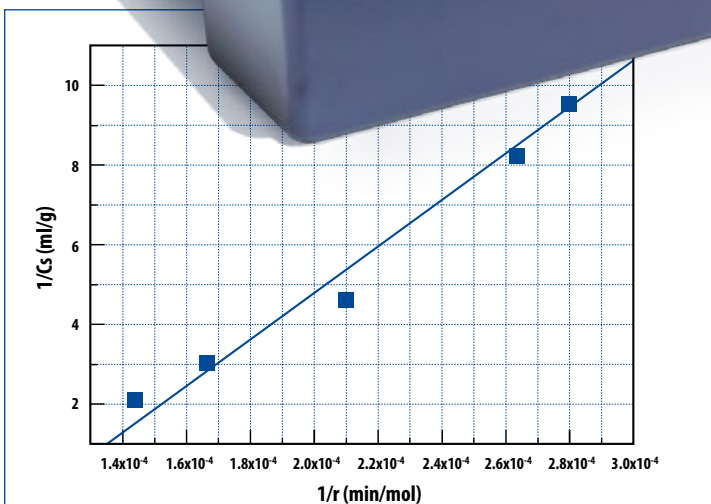


**DEMONSTRATE BATCH ENZYME KINETICS  
DEMONSTRATE ENZYME CHARACTERISTICS**

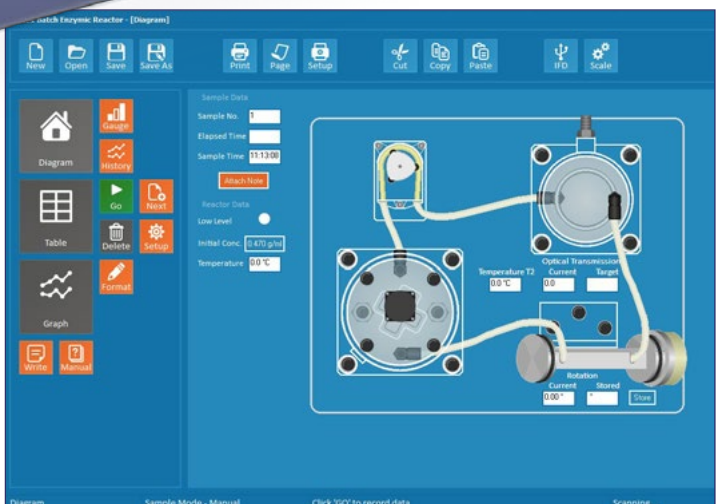
**Experimental content**

Teaching exercise included to familiarise students with the following topics:

- ▶ Determination of Michaelis-Menten constants and specific enzyme activity through Michaelis-Menten and Lineweaver-Burk plots
- ▶ Determination of glucose and fructose concentrations through polarimetry
- ▶ Effect of environmental conditions (pH and temperature) on enzyme activity
- ▶ Demonstration of the Biot-Savart law



**Lineweaver-Burke plot:**  
Reciprocal of reaction rate vs reciprocal of the starting glucose concentration (1/r vs 1/Cs).



BE1 Mimic diagram

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Issue: 4  
URL: <http://www.armfield.co.uk/be1>

Applications  
ChE IP

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## Description

The Batch Enzyme Reactor (BE1) introduces the student to the fundamentals of batch enzyme catalysis. It consists of a benchtop unit onto which is mounted a reactor vessel in which the glucose isomerase-mediated reaction takes place. The reactor itself is made of clear acrylic, which gives good visibility. A cruciform geometry impeller constructed from stainless steel mesh retains the immobilised enzyme while enabling efficient mixing with the liquid reactant (glucose solution).

The impeller is a variable-speed type and the reaction temperature is maintained using two heaters and a temperature sensor mounted within the reactor. These are linked to a PID controller, which is programmed to maintain the desired setpoint temperature. Safety interlocks prevent the heaters being activated when there is a low reactor liquid level or when the impeller is inactive.

A continuous sampling loop driven by a peristaltic pump removes liquid from the reactor and transfers it to a tubular coil heat exchanger, where it is cooled. It is then passed through a polarimeter where the angle of rotation of polarised light is measured. From this angle measurement, the concentration of both glucose reactant and fructose product can be determined. This eliminates the need for manual glucose assays. The measurement system relies on the fact that both glucose and fructose solutions rotate beams of polarised light, glucose to the right and fructose to the left. The polarimetry measurement method enables the progress of the reaction to be monitored online.

The polarimeter assembly consists of an elongated optical flow cell mounted between two polarising lenses, one of which is fixed (polariser) and the other being free to rotate (analyser). On the outside of the polariser is a light source and on the outside of the analyser is a detector, which detects the intensity of emitted light that has passed through both polarising lenses and the sample tube.

Attached to the analyser is an angle-measurement device. Both the optical transmission and the angle of rotation are relayed to electronic displays on the control console.

## Experimental content

- ▶ Understanding the principles of batch enzyme kinetics
- ▶ Understanding the factors affecting enzyme performance
- ▶ Understanding the principles of polarimetry and the Biot-Savart law

## Requirements

## Scale



Electrical supply: 220-240V / 1ph / 50Hz / 10 amp  
120V / 1ph / 60Hz / 15 amp  
220V / 1ph / 60Hz / 10 amp

## Overall dimensions

Length	1.10m
Width	0.50m
Height	0.45m

## Packed and crated shipping specifications

Volume	0.44m <sup>3</sup>
Gross weight	36Kg

## Ordering specification

- ▶ A benchtop unit comprising a vacuum-formed ABS plastic plinth with integral electrical console onto which is mounted the stirred reactor vessel sampling circuit with peristaltic pump, tubular coil heat exchanger and polarimeter device
- ▶ A temperature sensor and heater mounted in the reactor vessel and linked to a PID controller for accurate reaction temperature control
- ▶ A polarimeter device measuring optical transmission and angle of rotation
- ▶ Protection devices for all electrical circuits
- ▶ Three displays: PID temperature control (reactor temperature), display for angle of rotation, display for optical transmission or temperature at polarimeter
- ▶ Sensor signals are routed to the USB port for connection to the users own PC running Windows 7 or above
- ▶ Comprehensive instruction manual with detailed laboratory teaching exercises
- ▶ Instructional capabilities:
  - Principles of batch enzyme kinetics
  - Factors affecting enzyme performance
  - Principles of polarimetry and Biot-Savart law

## Ordering details

Teaching exercises are included to familiarise students with the following topics:

- ▶ Determination of Michaelis-Menten constants and specific enzyme activity through Michaelis-Menten and Lineweaver-Burk plots
- ▶ Determination of glucose and fructose concentrations through polarimetry
- ▶ Effect of environmental conditions (pH and temperature) on enzyme activity
- ▶ Demonstration of the Biot-Savart law

## Optional accessories

BE1-DTA-ALITE – Education software and data logging accessory. The user must have a PC with a USB port, running Windows 7 or above

## Complementary equipment

CEU:	Catalytic Reactors	W8:	Anaerobic Digester
UOP12:	Filtration Unit	W11:	Aerobic Digester

## Software

### BE1-DTA-LITE Education Software and Data Logging Accessory

Electronic outputs from the sensors are available for data logging and analysis. The Armfield data logger interfaces between the BE1 and the user-supplied computer via a USB port.

The associated software provides a mimic diagram (Fig 2) with current sensor values displayed. Also incorporated in the software are graph-plotting facilities, full instructions on equipment setup and experimental methods, related theory and full help texts.

The software requires the user to have a PC with a USB port, running Windows 7 or above.

## Ordering codes

- ▶ BE1-A: 220-240V / 1ph / 50Hz / 10 amp
- ▶ BE1-B: 120V / 1ph / 60Hz / 15 amp
- ▶ BE1-G: 220V / 1ph / 60Hz / 10 amp

**Armfield standard warranty applies with this product**

## Knowledge base

- > 28 years expertise in research & development technology
- > 50 years providing engaging engineering teaching equipment

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## Aftercare

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