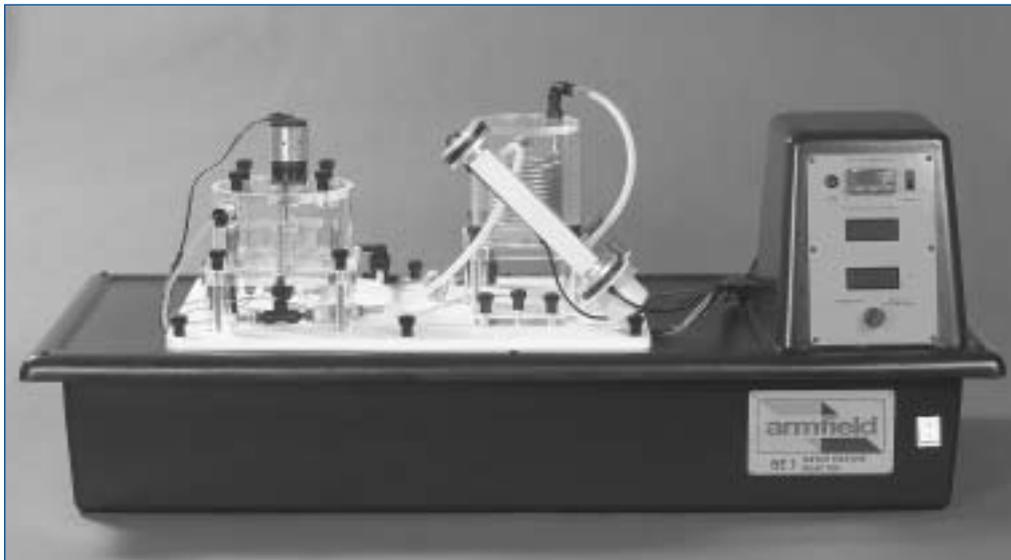




armfield

BATCH ENZYME REACTOR



BE1
issue 2

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.

INSTRUCTIONAL CAPABILITIES

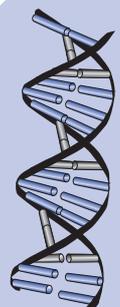
- *Understanding the principles of batch enzyme kinetics*
- *Understanding the factors affecting enzyme performance*
- *Understanding the principles of polarimetry and Biot's law.*

DETAILED CAPABILITIES

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

- *Determination of Michaelis-Menten constants and specific enzyme activity through Michaelis-Menten and Lineweaver-Burke plots*
- *Determination of glucose and fructose concentrations through polarimetry*
- *Effect of environmental conditions (pH and temperature) on enzyme activity*
- *Demonstration of Biot's law*

Biochemical Engineering



BE

DESCRIPTION

The BE1 introduces the student to the fundamentals of batch enzyme catalysis. It consists of a bench-top 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 whilst allowing efficient mixing with the liquid reactant (glucose solution). The impeller is a variable speed type. 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 set-point 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 prior to passing 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 allows the progress of the reaction to be monitored on-line.

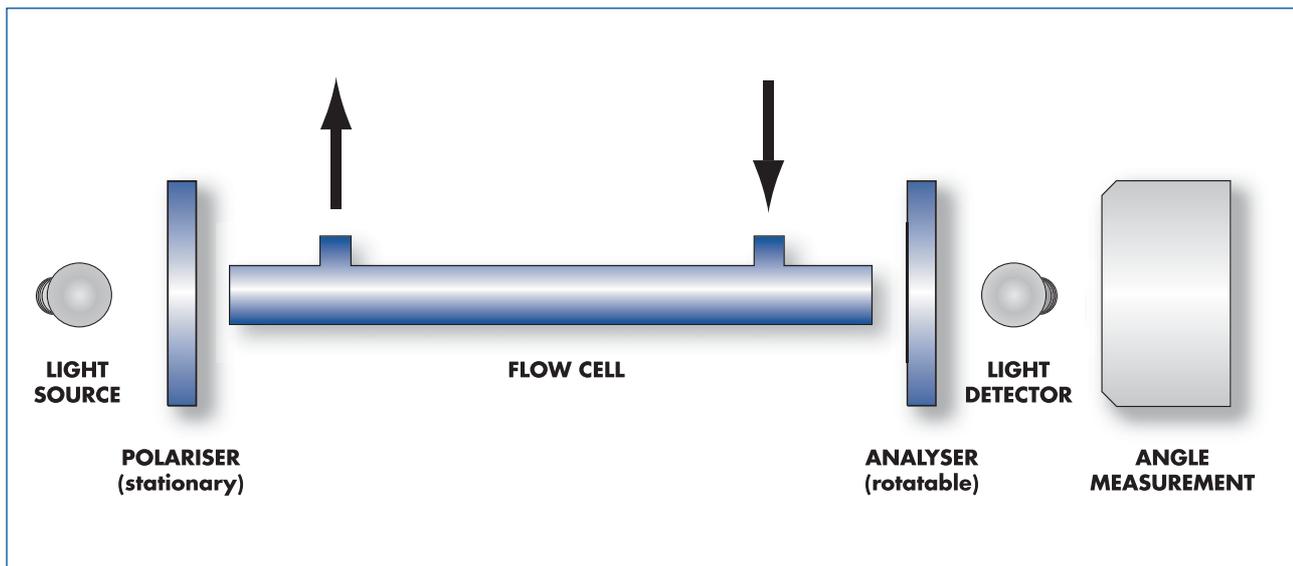


Fig 1: Diagrammatic representation of polarimeter assembly

The polarimeter assembly (Fig 1) 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.

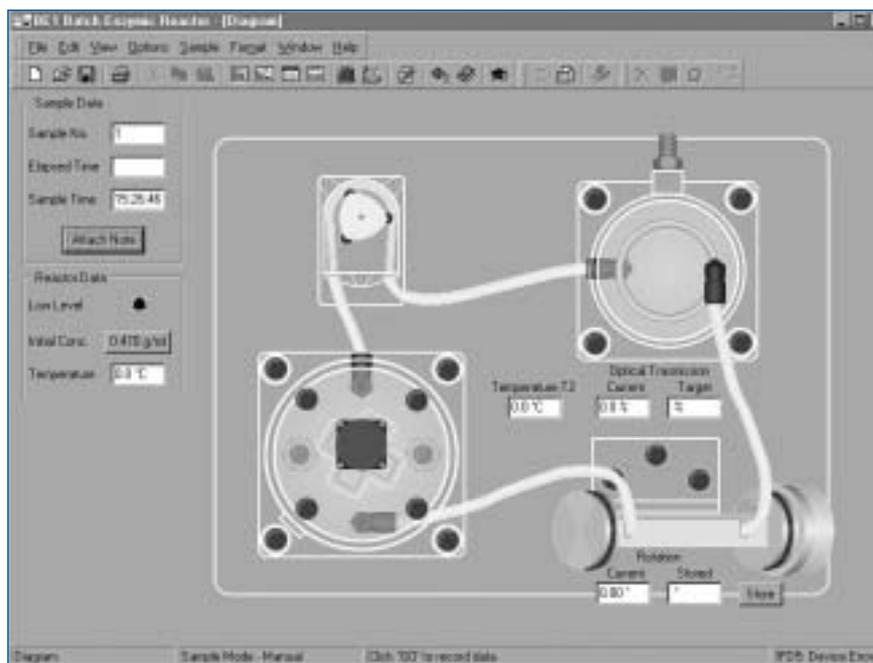


Fig 2: BE1 Mimic Diagram

BE1-304IFD 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's 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 set-up and experimental methods, related theory and full help texts. The software requires a computer running Windows 98 or Windows 2000 with a USB port.

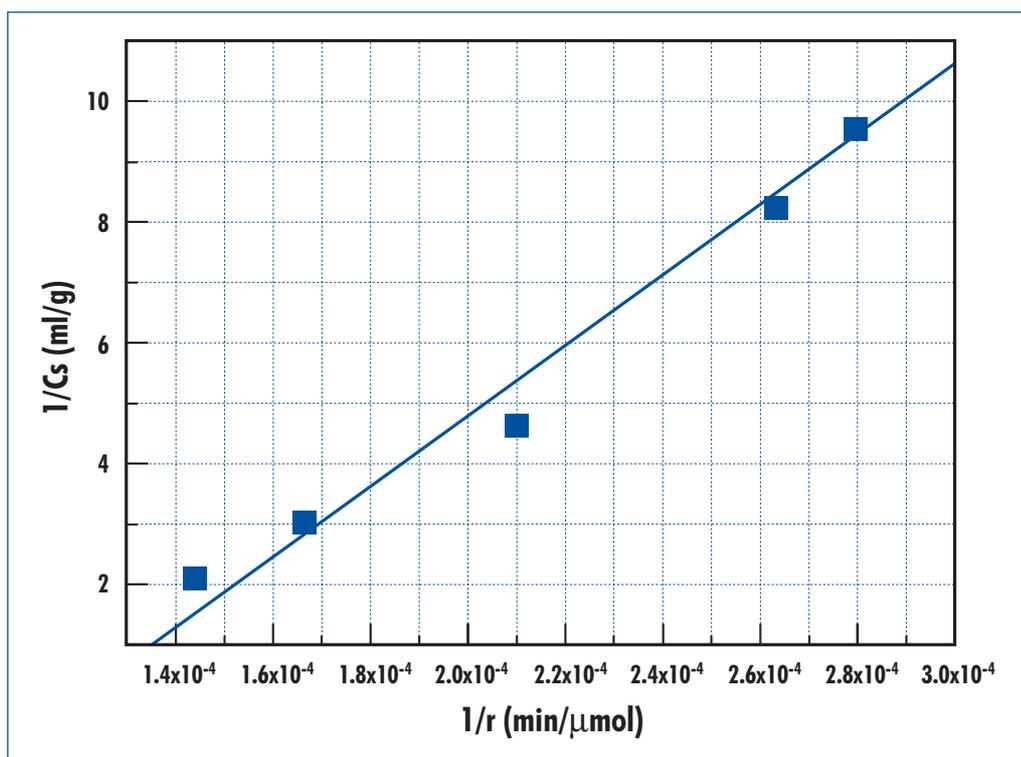


Fig 3: Lineweaver-Burke plot: reciprocal of reaction rate vs reciprocal of the starting glucose concentration ($1/r$ vs $1/C_s$).

ORDERING SPECIFICATION

- *A bench top 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 I/O port for connection to a PC*
- *Comprehensive instruction manual with detailed laboratory teaching exercises*
- *Instructional capabilities:*
 - *Principles of batch enzyme kinetics*
 - *Factors affecting enzyme performance*
 - *Principles of polarimetry and Biot's law*

OPTIONAL ACCESSORIES

BE1-304IFD - Education software and data logging accessory (requires Windows 98/2000/ME/XP computer with a USB port).

SERVICES REQUIRED

Single phase mains electrical supply:

BE1-A: 220/240/1ph/50Hz at 10A

BE1-B: 120V/1ph/60Hz at 15A

BE1-G: 220V/1ph/60Hz at 10A

OVERALL DIMENSIONS

Height: 0.45m

Width: 1.10m

Depth: 0.50m

SHIPPING SPECIFICATION

Volume: 0.44m³

Gross weight: 36kg

COMPLEMENTARY EQUIPMENT

UOP12 - Filtration Unit

CEU - Catalytic reactors

W8 - Anaerobic digester

W11 - Aerobic digester

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