

The BE3 is a self-contained, floor-standing anaerobic column reactor of a 9l volume.

It is configurable as a fluidised bed reactor and an expanded granular sludge bed reactor (EGSB). Incorporating a split heated column with central collar for instrumentation, dosing and liquid sampling.

It has a recycle pump capable of rates from 0-15 l/min and an electronic measurement of recycle rate.

**DATA LOGGER AND SOFTWARE AS STANDARD
EXPANDED GRANULAR SLUDGE BED REACTOR
GAS SAMPLE POINT**



BE3: Anaerobic column reactor

Data-logging in real time

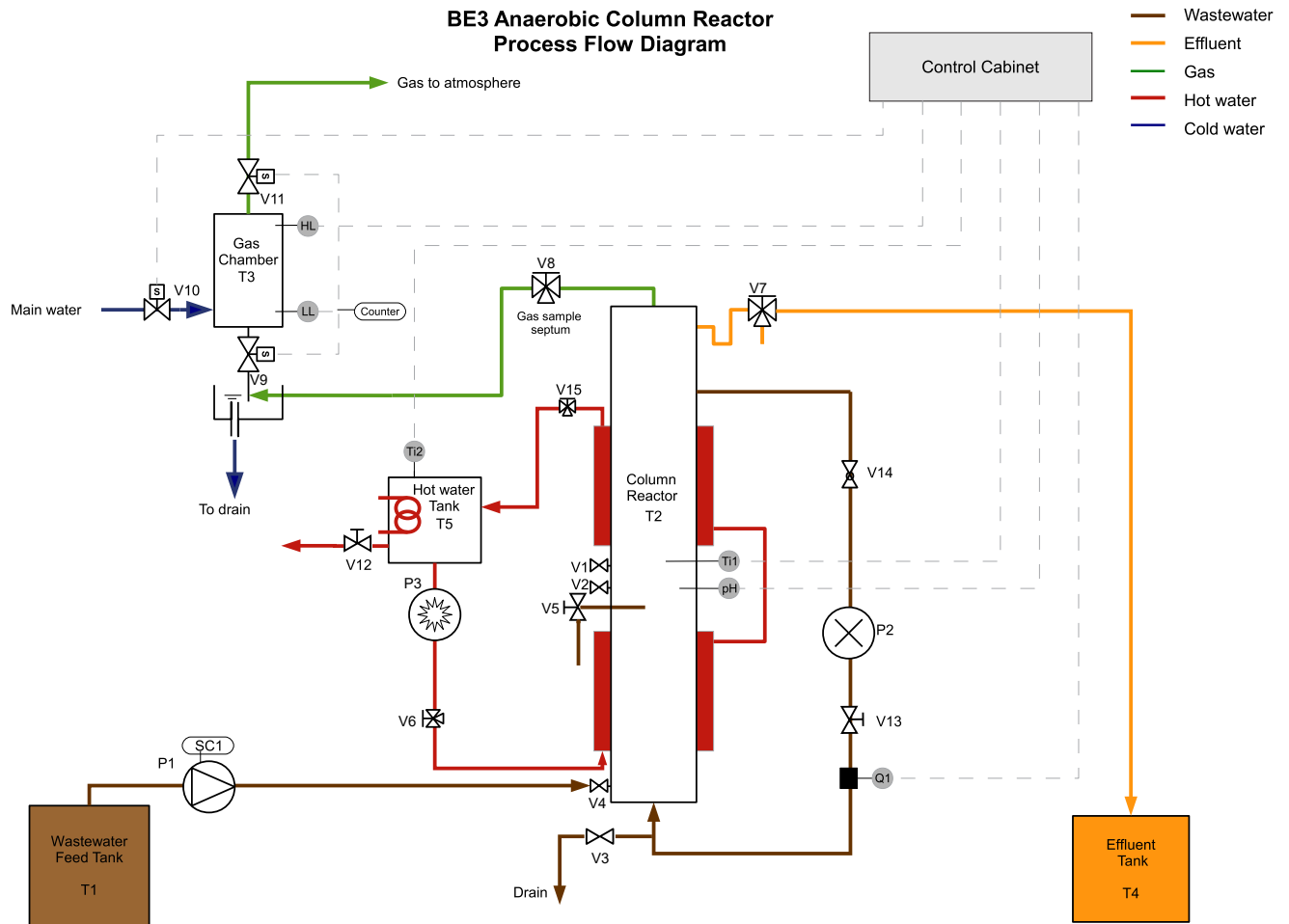


Gas measurement collection system about to reach low-level cycle point



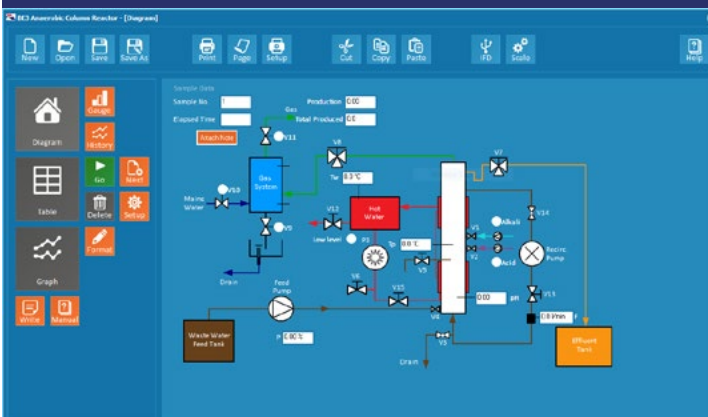
Features

- ▶ Fluidised bed
- ▶ Expanded granular sludge bed reactor (EGSB)
- ▶ Measures reactor temperature, jacket temperature and vessel pH
- ▶ Programmable logic controller (PLC) provides temperature control, pH control and gas collection (rate and totalisation) calculations
- ▶ Jacket heating system with pump and hot water vessel. Temperature is PID controlled room temperature to 55°C
- ▶ Data logger and software as standard (requires PC, not supplied)
- ▶ Automated volumetric gas collection system measures, which adds less than 10 mbar back pressure to the reactor
- ▶ Complete with automated pH dosing system to maintain the vessel pH within a predetermined range (user programmable)
- ▶ User calibration of pH and gas collection system
- ▶ Feed flow rates from 0.06-4.8 l/hr (using interchangeable peristaltic hoses)
- ▶ Gas sample point



BE3 Process flow diagram

armSOFT Software: Screen showing BE3 (diagram)

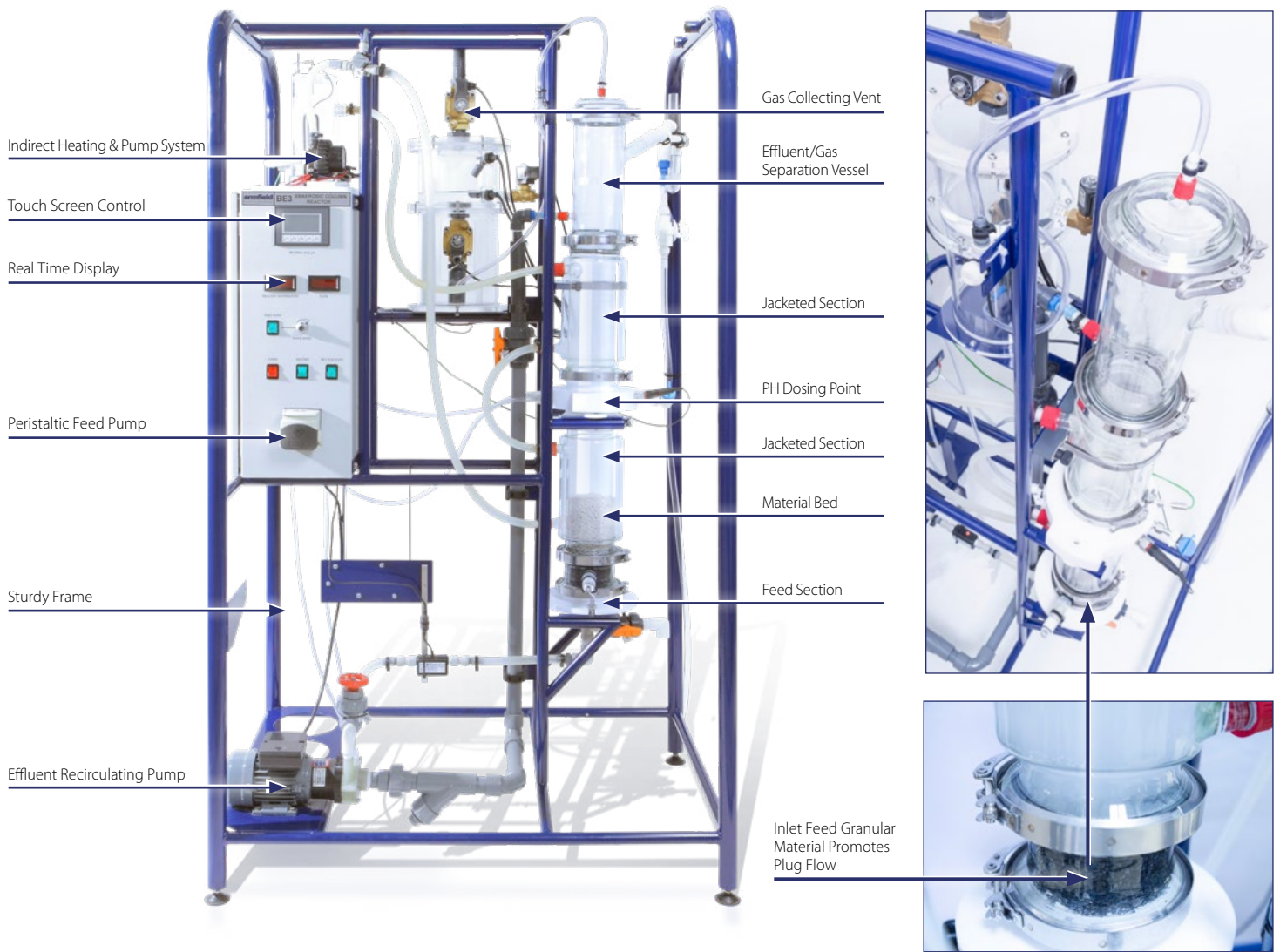


Control cabinet and pumice bed material in heated jacketed vessel



Anatomy of the BE3 anaerobic column reactor

This annotated diagram shows the layout of the Armfield BE3, these units can be operated in different configurations making them extremely versatile and suitable for both educational and research purposes.



Description

The Anaerobic Column Reactor BE3 features a tall, slender, cylindrical glass column in two sections, each section with a heating jacket. At the top of the column, a third unheated section collects the gas and provides an effluent overflow. Between the two heated sections is a manifold, which provides ports for instrumentation, sampling and dosing. The feed into the reactor is provided by a variable-speed peristaltic pump.

The temperature of the column contents can be controlled by circulating warm water through the jackets of the lower two sections. The water is heated in a heating tank, using an electric heater and distributed by a recirculation pump using PID control. Typically the reactor temperature is set to 35°C to suit the anaerobic bacteria in the feedstock.

The column contents can be recirculated from the top section to the bottom section using a variable speed pump. The recirculation can also be used to fluidise a bed of media (eg pumice) used to support the growth of biomass. Alternatively the column can be operated as an expanded granular sludge bed reactor (EGSB) with no media filling.

A novel feature of the new Anaerobic Reactors is the gas collection system. This enables the rate of gas emission to be accurately measured over long periods of time. This occurs even when very low quantities of gas are produced, while retaining low back pressure in the system so as not to inhibit the release of the gases. It operates by collecting a known volume of gas over water. When the collection tank is full the gas is automatically discharged and the water replaced. The PLC counts the number of cycles to measure the total volume of gas and measures the time between discharges to calculate the flow rate.

The reactor is supplied complete with a pH dosing system. This comprises two peristaltic pumps under control of the PLC, used to add a base solution or an acid solution to the reactor as appropriate. The user can define the range of pH values to be maintained.

Storage positions are provided for standard five-litre chemical jars, enabling the dosing solutions to be prepared in advance and left in place throughout the process, minimising the need to handle potentially harmful chemicals.

As well as the gas collection rate and volume, further instrumentation measures the reactor temperature, pH, water temperature and the recirculation flow.

This data can all be recorded on a PC using the data logger.

Complementary equipment

BE1:	Batch Enzyme Reactor
CEU:	Catalytic Reactors
UOP12:	Filtration Unit
W8:	Anaerobic Digester
W11:	Aerobic Digester

Overall dimensions

Length	1.038m
Width	0.715m
Height	1.797m

Packed and crated shipping specifications

Volume	2.0m ³
Gross weight	220Kg

Requirements

Scale

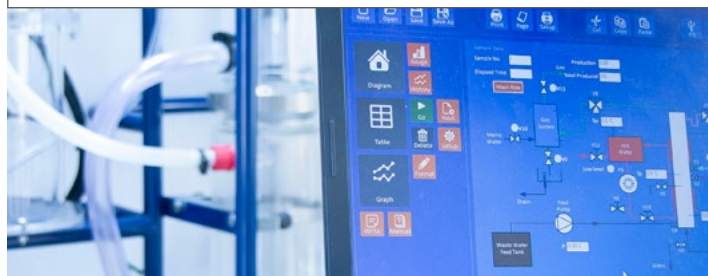


Electrical supply: 220-240V / 1ph / 50Hz / 10 amp
220V / 1ph / 60Hz / 10 amp

Water and drain: The reactors need to be connected to a supply of water (>1 bar) and to a suitable drain. The amount of fresh water used during the operation of the BE3 will be the same as that of the gas produced.

Ventilation: The gas produced can be collected (vessel not provided) or can be vented to atmosphere. In any case the reactors should be positioned in a well ventilated area and an outlet provided to vent the emitted gases outdoors.

Computer: A Windows PC (not supplied) running Windows 7 or later, with USB port is required if running the data logging software.



Experimental capabilities

- ▶ Optimising reactor start-up (acclimation of biomass)
- ▶ Effect of temperature, pH, residence time etc.
- ▶ Investigation of hydraulic loading (feed rate)
- ▶ Effect of effluent strength and nutrient deficiency
- ▶ Effect of recirculation ratio and fluidisation
- ▶ Comparing efficiency of different configurations (BE4)
- ▶ Investigation of bacteria type
- ▶ Acidogenesis and methanogenesis process demonstrations

Specifications

Reactor volume	9l
Heater power	2kW
Jacket temperature	< 60°C
Flow rate (Recycle)	15 l/min
Feed flow rate	0.06 to 4.81 l/hr
Settler volume	N/A

Ordering codes

- ▶ BE3-A: 220-240V / 1ph / 50Hz / 10 amp
- ▶ BE3-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

Benefit from our experience, just call or email to discuss your laboratory needs, latest project or application.

An ISO 9001:2015 Company



Products CE certified

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Aftercare

Installation
Commissioning
Training
Service and maintenance
Support: armfieldassist.com