

Distillation Columns – UOP3

Instrumentation and control of distillation columns have changed considerably in the recent years, prompted by the advances of computer-linked systems which are generally supported by powerful software packages which allow the operators to handle operating data.

Armfield has acknowledged these recent changes and has developed two state-of-the-art laboratory-based distillation columns which enable safe hands-on practical training for student engineers and plant operators as well as empowering research in different fields to be conducted.

Armfield have designed two distillation column options:

UOP3BM: Batch Distillation Column (Manual)

A Batch-only operated version, manually controlled, which permits a comprehensive study of the basic principles involved in the distillation process.

UOP3CC: UOP3CC – Continuous Distillation Column (Computer Controlled)

A Continuous or Batch operated version, computer controlled, which enables a full range of demonstrations from the introductory stages of a process engineering course through to the more complex demonstrations of modern control strategies

Each option comes with two different distillation columns supplied:

A packed bed distillation column

A sieve plate distillation column, including eight sample and feed ports across the column

Armfield UOP3CC and UOP3BM are the only units on the market with this sampling capability. The column is unique because it can use flammable solvents. In addition, sample ports can be utilised as additional feed positions on each sieve plate. *Correct at time of product release.*



Above right: Computer interfaced distillation column UOP3CC shown with safe area console

Key Features

- ▶ Unique eight-point sample and feed sieve and plate column
- ▶ Eight temperature measuring points along the column's height
- ▶ Reboiler, Condenser and Reflux tank designed to operate using flammable solvents
- ▶ Vacuum system enables operation at reduced pressures down to 200mbar
- ▶ Interface console enabling local control of the system (also via Software in the UOP3CC version)
- ▶ The console front panel presents all the necessary connections to control the unit using any industry-standard PID and/or PLC controllers (not supplied)
- ▶ Reflux control ratio from 0 to 100%
- ▶ A U-tube manometer is incorporated to measure pressure drop over the distillation column
- ▶ Supplied fully assembled including lagging and a comprehensive instruction manual

Features common to both UOP3BM & UOP3CC

- ▶ Electrically heated reboiler with sufficient capacity for up to two hours of batch operation. The reboiler heater is protected against overheating and by a low level alarm
- ▶ Overhead condenser with cooling water flow measurement and adjustment
- ▶ Condensate collecting vessel equipped with double overflow weirs and exit pipes to enable separation of immiscible liquids
- ▶ A solenoid operated reflux return valve to provide for 0%-100% reflux, adjustable by electrical signal
- ▶ Sampling points throughout the system for composition analyses
- ▶ Differential manometer connected to the top and bottom of the column to monitor column pressure drop
- ▶ Vacuum system with gauge to enable distillation studies at reduced pressures down to 200mbar
- ▶ Materials of construction for surfaces in contact with the process fluids are; glass, stainless steel, PTFE or similar solvent-resistant materials
- ▶ Maximum operating temperature inside the column operation is at least 130 °C
- ▶ Temperatures are monitored via fourteen thermocouple sensors located at strategic positions in the system

Features specific to UOP3CC

- ▶ Two 5 litre feed vessels with rapid changeover to permit step changes in feed composition to be made
- ▶ Peristaltic feed pump, range 0-0.25 litres/minute adjustable by voltage input variation to the pump motor controller
- ▶ The bottom product heat exchanger which may be either water cooled or used as a (variable) feed pre-heater
- ▶ Dosing feed vessel connected to the column for the continuous addition of a third liquid component which, together with the condensate phase separator vessel, enables the study of azeotropic distillation.

Control console features common to both UOP3BM & UOP3CC

- ▶ Monitoring and selectable display of at least 13 system temperatures including those of the liquid on each tray, the reboiler and across the condenser
- ▶ Monitoring, display and manual adjustment of:
 - i) the electrical power to the reboiler heater.
 - ii) the reflux ratio setting.
- ▶ Mains power connection protected by Residual Current Device
- ▶ Individual circuits protected against excess current with resettable circuit breakers
- ▶ Front panel connections to enable the user to connect 0-5 Volt industry-standard analog or programmable logic controllers to provide on-line control of the boilup rate or reflux ratio from chosen column temperature measurements. The connection points also permit the use of standard laboratory chart recorders and data loggers. (Up to two temperature measurements simultaneously)

Control console features specific to UOP3CC

- ▶ Monitoring, display and manual adjustment of:
 - i) the electrical power to the reboiler heater (also UOP3BM)
 - ii) the reflux ratio setting (also UOP3BM)
 - iii) the feed rate setting
- ▶ USB connector at the rear of the unit allows connection to a user supplied PC, via the integral USB interface
- ▶ Remote/manual switch is provided on the front panel of the console to enable simple changeover from PC to front panel control to be made by the operator
- ▶ Power and motor control circuits shut down automatically with loss of computer control signals

Experimental Capabilities - Laboratory exercises common to both UOP3BM & UOP3CC

- ▶ Pressure drop across the column as a function of boil-up rate
- ▶ Column efficiency as a function of boil-up rate at total reflux plate-to-plate temperature profiles along the column
- ▶ McCabe-Thiele construction of operating line
- ▶ Distillation at constant reflux ratio: variation of top product composition with time
- ▶ Mass balance across the system
- ▶ Manual control of reflux ratio; for example to achieve a top product of specified composition
- ▶ Comparison of packed column with sieve plate column performance

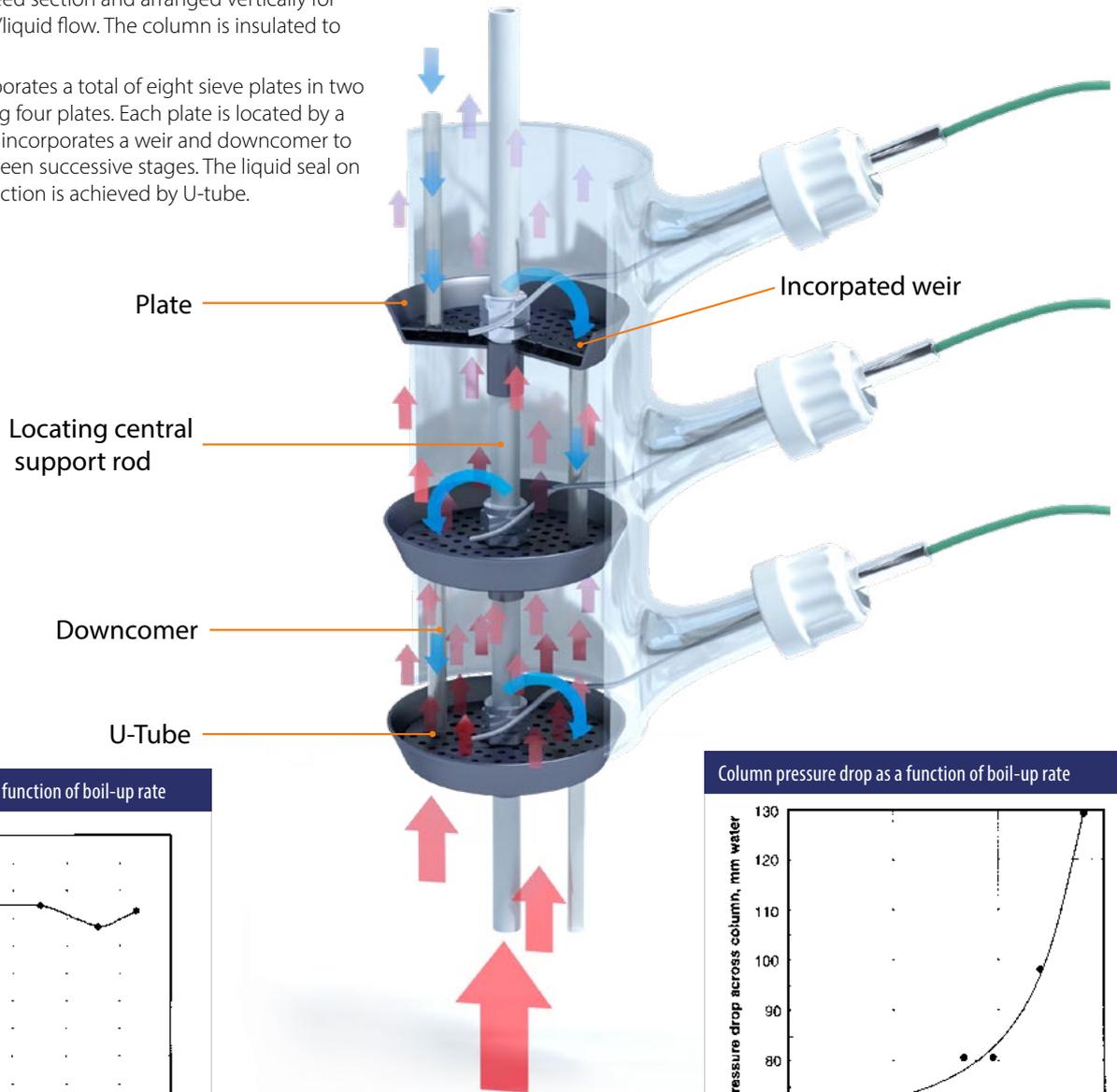
Experimental Capabilities - Laboratory exercises specific to UOP3CC

- ▶ Continuous steady state distillation including temperature profiles and McCabe-Thiele analysis
- ▶ Effect of feed pre-heat
- ▶ Effect of feed position
- ▶ Demonstration of azeotropic distillation
- ▶ Using a PID Controller (requires additional non-supplied equipment)
- ▶ Using a PLC Controller (requires additional non-supplied equipment)

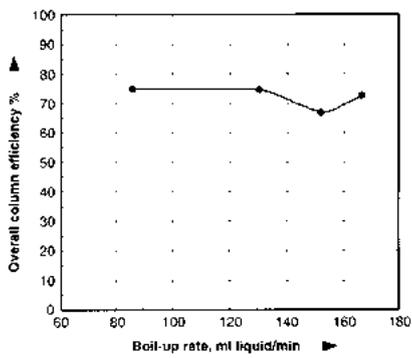
Distillation column

The 50mm diameter sieve plate column is made up of two glass sections each containing four sieve plates. The columns are separated by a central feed section and arranged vertically for counter-current vapour/liquid flow. The column is insulated to minimise heat loss.

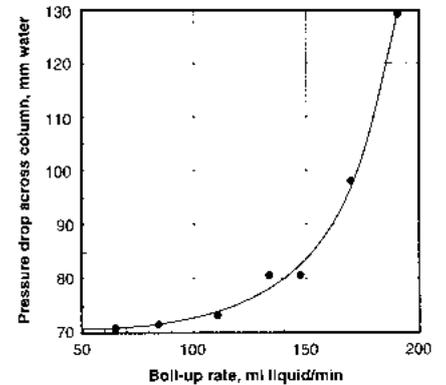
The glass column incorporates a total of eight sieve plates in two sections, each containing four plates. Each plate is located by a central support rod and incorporates a weir and downcomer to create a liquid seal between successive stages. The liquid seal on the final plate in each section is achieved by U-tube.



Column overall efficiency as a function of boil-up rate



Column pressure drop as a function of boil-up rate



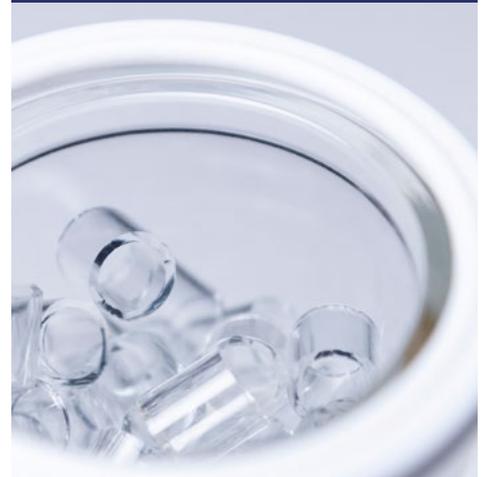
Sophisticated software package



Reflux separator during azeotropic distillation of a water/organics mixture



Packed column with raschig rings



Description

The unit is a self-contained and fully instrumented distillation facility, suitable for practical laboratory work relevant to the teaching of unit operations.

The equipment employs galvanically isolated intrinsically safe circuits and flameproof devices as appropriate to enable safe distillation of standard test mixtures such as methylcyclohexane-toluene, methyl alcohol-water etc.

The equipment consists of two interconnected units: a floor standing process unit and a bench-mounted control console.

The system includes two distillation columns supplied as standard:

A 50mm diameter plate distillation column containing eight sieve plates and downcomers. Every plate includes a temperature sensor positioned to measure accurately the temperature of the liquid on each plate. The sheaths of each plate temperature sensor are not more than 1.5mm diameter to ensure rapid dynamic response.

A 50mm packed column supplied as a separate item but readily interchangeable with the plate column by the user, for comparative studies of the two types of distillation column.

Requirements

Scale



- ▶ Unit must be placed/located on a solvent-resistant floor in an area with Zone 2 Hazardous area classification or in a well ventilated environment with two metres of clear space on either side of the unit.

- ▶ **Electrical supply:** Please see order codes below.

NOTE: Electrical supply rating must be the same as country of use

- ▶ **Cold water supply:**

15 litres/minute at 2.0bar pressure (min.)

- ▶ **Venting:**

Exhaust line to fume cupboard or to safe discharge area outside of laboratory.

- ▶ **NB:** The distillation unit is floor mounted and is supplied already connected to the bench-mounted control console by sufficient armoured cable to allow the two-metre clear space to be maintained around the column.

Essential Accessories/Equipment

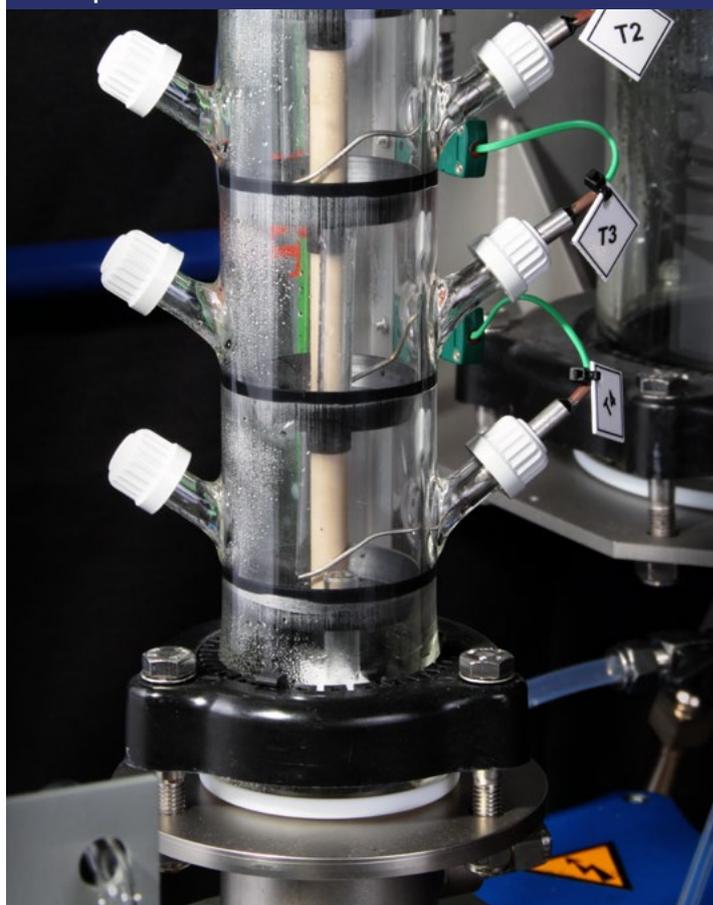
Software requires a computer running Windows 8 or above with a USB port (Computer not supplied by Armfield).

Laboratory oven to dry the crystals sample

Potassium chloride

Laboratory balance

Close-up of new column section



Overall dimensions

	Batch Distillation Column UOP3BM		Computer-interfaced distillation column – UOP3CC	
	Process Unit	Control Console	Process Unit	Control Console
Length	0.85m	0.52m	0.85m	0.52m
Width	0.80m	0.40m	0.80m	0.40m
Height	2.25m	0.30m	2.25m	0.30m
Packed and crated shipping specifications				
Volume	3.4m ³		3.5m ³	
Gross weight	425Kg		450Kg max	

Ordering codes

- ▶ UOP3BM-A: 220-240V / 1ph / 50Hz / 13 amp
- ▶ UOP3BM-B: 120V / 1ph / 60Hz / 25 amp
- ▶ UOP3BM-G: 220V / 1ph / 60Hz / 13 amp
- ▶ UOP3CC-A: 220-240V / 1ph / 50Hz / 13 amp
- ▶ UOP3CC-B: 120V / 1ph / 60Hz / 25 amp
- ▶ UOP3CC-G: 220V / 1ph / 60Hz / 13 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



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