Filtration is an extremely important unit operation being used by industries such as chemical, food and water treatment. The Armfield Filtration Unit demonstrates the principles of batch filtration using a fully functional plate and frame filter system. A continuous, tangential flow microfiltration unit using a hollow fibre filtration cartridge (a membrane technology application) is available as an option. Both types of filter are widely used in the commercial world.

The practical training exercises are appropriate to chemical and all other process related engineering courses, including technician training. An economic investigation allows the student to take experimental data and to use it to help make decisions on the size and the operation of a filtration plant in order to meet economic and output targets.
CONTINUOUS FILTRATION WITH THE TANGENTIAL FLOW HOLLOW FIBRE FILTER CARTRIDGE – UOP12-10

- All electrical sensors: pressure, optical
- The progressing cavity feed pump enables constant feed rate operation
- A controller enables constant pressure operation
- The plate and frame filter unit uses nylon as the filter medium
- Precoat and body aid filtration
- Determining important criteria for scale-up
- Commercial aspects of filtration
- Economic optimization of filtration operations
- Mass balancing
- Demonstrating filtration through membrane technology
- Understanding the principles of continuous microfiltration
- Examination of flux and transmission of a protein marker
- Measurement of foulung and the effect on filtration performance

KEY FEATURES
- The plate and frame filter unit uses nylon as the filter medium. The unit is constructed in clear acrylic which enables the entire filtration process to be observed: the feed slurry in the feed channels, the build up of filtered solids in the frame plates, and the clarified filtrate in the filtrate channels.
- The filter unit uses gaskets to prevent leakage and enable operation up to 2 bar.
- Bleed valves in the top of the frame plates enable trapped air to be removed for efficient filtration.
- An optical absorbance sensor is provided for on-line and off-line monitoring of the filtration process. It is also used to monitor the efficiency of filter cake washing operations.
- A controller enables constant pressure operation by controlling the speed of the feed pump.
- The progressing cavity feed pump enables constant feed rate operation.
- All electrical sensors: pressure, optical absorbance, temperature and the feed pump flow rate can be logged using a PC.
- Water and calcium carbonate are the recommended working materials for reasons of safety and ease of use.
- Teaching exercises are included to familiarise students with the following topics:
  - Demonstration of precoat filtration
  - Optimization of filtration performance using body aid
  - Demonstration of Darcy’s Law
  - Determination of medium and cake resistances
  - Effect of body aid on medium and cake resistances
  - Filter cake washing and dewatering
  - Economic optimization of filtration operations

DESCRIPTION
The apparatus consists of an acrylic feed tank connecting to a progressing cavity pump which feeds a slurry to the acrylic plate and frame filter press. A pressure sensor on the output of the pump measures the filtration pressure. The filter press consists of two end plates, two frame plates and a wash plate. The filtrate passes through an optical sensor which determines the efficiency of the filtration process. Filtrate temperature is also measured. The second inlet to the filter is for mains water for filter cake washing. A second pressure sensor and a needle valve control the water pressure during the washing cycle. A three-way valve allows filtrate to be returned to the feed tank or to a filtrate vessel/drain.

INSTRUCTIONAL CAPABILITIES
- Teaching exercises are included to enable the students to become familiar with the following topics:
  - Determination of clean and dirty membrane resistances
  - Determination of the transcartridge pressure drop
  - Mass balancing of protein filtration
  - Effect of transmembrane pressure on membrane flux and protein transmission
  - Effect of tangential flow velocity on membrane flux and protein transmission

KEY FEATURES
- The tangential flow filter is available as an option. It is fitted in minutes simply by removing the plate and frame filter and fitting the hollow fibre cartridge and tubular heat exchanger.
- The feed suspension is pumped from the feed tank through the tubular heat exchanger and then through a prefilter before passing into the hollow fibre filter cartridge. The heat exchanger uses mains water to remove heat originating from the feed pump.
- Material which does not filter through the membranes of the hollow fibres, called the retentate, remains in the lumen and then exits the filter and is returned to the feed tank. Material that does pass through the membranes, the permeate, is collected in the permeate vessel.
- Pressure is measured by sensors at the entrance and exit of the hollow fibre filter cartridge on the retentate side and also at the permeate exit from the cartridge.
- Temperature is measured on the retentate side of the filter cartridge. The optical sensor is used to measure protein concentration of the permeate stream.

INSTRUCTIONAL CAPABILITIES
- Demonstrating filtration through membrane technology
- Understanding the principles of continuous microfiltration
- Examination of flux and transmission of a protein marker
- Measurement of fouling and the effect on filtration performance

DETAILED CAPABILITIES
- Teaching exercises are included to enable the students to become familiar with the following topics:
  - Demonstration of clean and dirty membrane resistances
  - Determination of the transcartridge pressure drop
  - Mass balancing of protein filtration
  - Effect of transmembrane pressure on membrane flux and protein transmission
  - Effect of tangential flow velocity on membrane flux and protein transmission

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ORDERING SPECIFICATION

• A benchtop unit comprising a vacuum formed ABS plastic plinth with integral electrical console on to which is mounted the filtration system
• A plate and frame batch filter (separation area 230cm²) is supplied as standard. Both constant flow rate and constant pressure operation are possible
• An optional tangential flow hollow fibre microfiltration cartridge (plus prefilter and shell and tube heat exchanger) can be fitted. The hollow fibre cartridge has a separation area of 110cm² and a cut-off of 0.2µm
• Feed flow rate can be varied between 0-130 l/hr
• All electrical circuits are protected by appropriate protection devices
• The console contains a pump motor control and display panel
• A separate controller displays the filter inlet pressure and is used to control the pump speed. Another digital meter displays, via a selector switch, either outlet pressure, permeate pressure, temperature or optical absorbance. Sensor signals are also routed to an I/O port for connection to a PC
• An optional interface device and educational software package is available
• A comprehensive instruction manual is included with a range of fully detailed laboratory teaching exercises

REQUIREMENTS

Single phase mains electrical supply:

UOP12-A: 220-240V / 1ph / 50Hz, 10 amp
UOP12-B: 120V / 1ph / 60Hz, 15 amp
UOP12-G: 220-240V / 1ph / 60Hz, 10 amp

Plate and frame filter:
Optional mains water supply 3 l/min at 2 bar, optional pressurised air supply at 2 bar.

Tangential flow filter option:
Mains water supply 3 l/min at 2 bar.

OPTIONAL ACCESSORIES

UOP12-10 – Tangential flow filter accessory
UOP12-DTA-ALITE – Educational software and data logging accessory (requires a PC running Windows 98 or later, with a USB port).

OVERALL DIMENSIONS

Plate and frame filter: Tangential flow filter:
Height: 0.60m Height: 0.75m
Width: 1.10m Width: 1.10m
Depth: 0.50m Depth: 0.50m

SHIPPING SPECIFICATION

Volume: 0.50m³
Gross weight: 50kg

ORDERING CODES

UOP12-A: 220-240V / 1ph / 50Hz, 10 amp
UOP12-B: 120V / 1ph / 60Hz, 15 amp
UOP12-G: 220-240V / 1ph / 60Hz, 10 amp

- *Excluding DLMx range