

LIQUID/LIQUID EXTRACTION UNIT – UOP5 MkII

Liquid / liquid extraction is an important operation in chemical engineering where the separation of one or more of the components from a liquid mixture is required. Traditionally this has been difficult to demonstrate in the laboratory, requiring the use of highly toxic, expensive and / or environmentally damaging solvents. The Armfield UOP5-MkII introduces a system using Kerosene (Paraffin) which is simple, safe and inexpensive.

USES SAFE CHEMICALS



Benefits

- ▶ Touch panel for control / calibration of pumps and display of measurements
- ▶ Recommended system uses water to separate Acetic acid from Kerosene
- ▶ Operation with the organic or the aqueous phase as the continuous phase inside the column
- ▶ Location of the phase boundary is predetermined by the density difference between the phases with no sensors or controls involved
- ▶ A single valve sets the organic phase or the aqueous phase as the continuous phase as required for a particular exercise
- ▶ Simple adjustment of lower phase boundary to compensate for variation in specific gravity of the organic phase
- ▶ Sensors measure the temperature and conductivity of the aqueous phase before and after the extraction process allowing the concentration of acid to be determined and the extraction efficiency to be calculated
- ▶ Includes PC software allowing data logging of measurements and calculation of acid concentration in the aqueous phase
- ▶ No solvent recovery system is necessary using the recommended Kerosene system, (the used Kerosene can be disposed of, or else reused by performing a simple assay and topping up with acetic acid)
- ▶ Designed to handle Kerosene with a thermostat to limit maximum operating temperature for safe operation
- ▶ Pneumatic diaphragm pump used to minimise risk of ignition of the organic phase

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Applications
ChE IP

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Description

The UOP5-MkII comprises a glass separation column, 1600mm long and 50mm diameter, packed with glass Raschig rings which provide a large surface area for the extraction process. Four process tanks are included, a feed tank and collection tank for the organic phase and a feed tank and collection tank for the aqueous phase.

The aqueous circuit includes a variable speed rotary diaphragm pump with built in rotation counter that allows the flow rate to be determined. Conductivity and temperature sensors in both the feed and return lines allow the amount of acid transferred to the aqueous phase to be determined.

The organic circuit uses a variable speed diaphragm pump that is air powered and contains no electrical components allowing safe operation using Kerosene.

The Kerosene containing a trace of Acetic acid is pumped from the organic feed tank to the base of the extraction column. Demineralised water is pumped from the aqueous feed tank to the top of the extraction column. The density difference between the phases causes counter-current flow in opposite directions through the packed column where the acid is removed from the organic component into the aqueous component. The two phases exiting the column are collected in the appropriate return tank. The phase boundary can be changed between the top of the column and the bottom of the column by operating a single valve. Fine adjustments can be made to the location of the lower boundary to compensate for variation in specific gravity of the organic phase.

Temperature and conductivity sensors allow the concentration of acetic acid in the aqueous phase to be determined at the inlet and outlet of the column. From this information the extraction efficiency of the process can be calculated. All the sensor readings and calculated values are available for data logging on a personal computer (not supplied).

To obtain accurate results it is important that pure water is used for the input. The UOP5-MkII includes a float-operated level control valve allowing continuous topping up using a pumped supply of demineralised or deionised water, if available.

After use, the organic phase will retain a small amount of acid. If required, the concentration of acid can be established using titration, and then topped up with more acid ready for the next run at the required concentration.

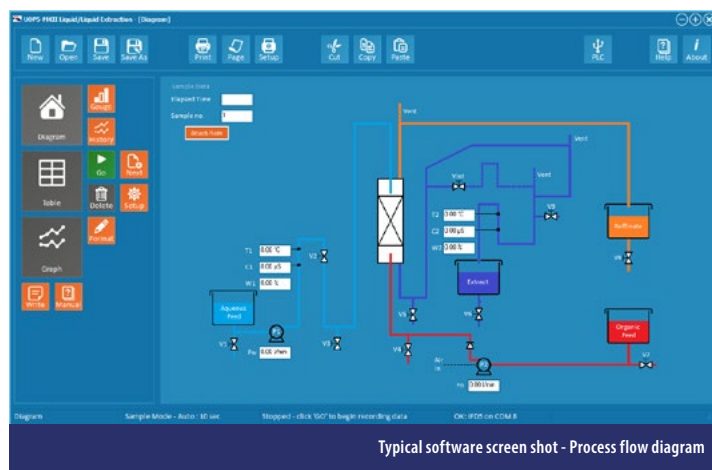
Using the recommended Kerosene system, this process can be repeated indefinitely. Alternatively the used Kerosene can be disposed of periodically and replaced. As Kerosene is inexpensive and readily available this causes no problems and a solvent recovery system is not required.

Note: The UOP5-MkII has been specifically designed for use with Kerosene. Although Kerosene is classed as flammable, it is difficult to ignite and is safe to use providing reasonable handling precautions are taken. A number of design features have been incorporated into the equipment to ensure safe operation. For safe operation, the UOP5-MkII can only be operated at an ambient temperature less than 35°C. Hence the equipment should be installed in a temperature controlled laboratory if this temperature will be exceeded.



Demonstration Capabilities

- ▶ Hydrodynamics of a packed liquid / liquid extraction column
- ▶ Differences in extraction performance using the organic phase or the aqueous phase as the continuous phase
- ▶ Investigation into the effect of changes in aqueous and organic flow rate
- ▶ Mass balances and the calculation of mass transfer coefficient



Requirements

Scale



► Electrical supply:

UOP5-MkII-A: 220-240V/1ph/50Hz, 1A
 UOP5-MkII-B: 120V/1ph/60Hz, 2A
 UOP5-MkII-G: 220-240V/1ph/60Hz, 1A

Water supply:

Initial fill with 20l of demineralised water
 (No permanent connection required)

Compressed air:

Clean, dry compressed air 40 l/min at 3–10 bar
 (Air inlet connection for 6mm rigid plastic
 pneumatic tubing supplied)

Note: Armfield can provide a suitable portable air compressor, see below

Computer: A Windows PC (not supplied) running Windows 98 or later,
 with USB port is required if running the data logging software

Optional accessories

- Air compressor AC1 (If no compressed air supply is available)
- Maximum Pressure: 6 Bar
- Maximum Airflow: 100 l/min at 1 Bar
- Capacity: 6l
- Motor power: 820W
- Noise: 80 dBA typical at 1m

Ordering codes

UOP5-MkII:

- UOP5-MkII-A Supplied with European and UK mains leads
- UOP5-MkII-B Supplied with USA 115V mains lead
- UOP5-MkII-G Supplied with USA 230V mains lead

AC1:

- AC1-A 220-240V/1ph/50Hz
- AC1-B 120V/1ph/60Hz

Overall dimensions

	UOP5-MKII	AC1
Length	1.220m	0.452m
Width	0.760m	0.405m
Height	2.045m	0.293m
Packed and crated shipping specifications		
	UOP5-MKII	AC1
Volume	3.0m ³	0.3m ³
Gross weight	230Kg	8.2Kg

Use of Flammable Materials

The UOP5-MkII has been specifically designed for use with kerosene. Although this is flammable, it is actually difficult to ignite and is safe to use providing reasonable handling precautions are taken.

A number of design features have been incorporated into the equipment to ensure safe operation.

One restriction is that the ambient temperature should be below 35°C. Thus in hot climates the UOP5-MkII should be installed in a temperature controlled laboratory.

For use with other combustible or flammable materials please consult Armfield, but as a general guideline, materials with a flash point > 38°C (cat IIA) and an auto-ignition temperature > 135°C (T4) are likely to be suitable.

Ordering specification

- A laboratory liquid / liquid extraction column designed for use with Kerosene (Paraffin) and Acetic acid
- Column length 1.6m (1.2m working length), 50mm diameter, made from glass
- Column packed with 15mm glass Rashig rings
- Aqueous phase circulation system with a 25l feed tank, 25l return tank and variable speed pump. Pump is calibrated and gives flows of 50-250ml/min
- Organic phase circulation system with an 18l feed tank, 18l return tank and variable speed air operated pump. Pump is calibrated and gives flows of 50-250ml/min
- Includes valves for taking samples of both phases for analysis
- Touch panel for control / calibration of pumps and display of measurements
- A single valve sets either the organic phase or the aqueous phase as the continuous phase
- Fine adjustment of the lower phase interface to compensate for variation in specific gravity of the Kerosene
- Instrumentation measures the inlet and outlet concentrations in the aqueous phase when using the recommended acid
- Data logging as standard, software calculates acid concentration in the aqueous phase from which extraction efficiency can be determined (requires PC, not supplied)

Technical specifications

Solvent temperatures:	Ambient to 50°C, individually controllable
Pump rate:	0-13.5 l/hr
Feed rate:	0-3 l/hr
Rotation speed:	1 rev/15min (4 revs/hr)
Cell compartment:	0.16 l capacity

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.

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