armfield

SOLID/LIQUID EXTRACTION UNIT

UOP4MkII
issue 3

- ***CONTINUOUS SOLID/ LIQUID EXTRACTION***
- ***MULTIPLE STAGE***
- ***INDUSTRIAL ROTARY CELL CONFIGURATION***
- ***COMPUTER COMPATIBLE***

The UOP4MkII is a laboratory solid/liquid extractor system for teaching the fundamentals of this important Unit Operation to chemical engineering students. The equipment utilises a sophisticated, continuous feed, counter current flow, multiple stage, rotary extractor system of the type frequently seen in industrial applications. This gives the student an insight into the practical implementation of the operation, including process economics and control problems. The effects of temperature, multiple stages, and throughput rate can all be investigated. The extractor is computer compatible with optional educational software.

FEATURES

- *Self contained floor standing unit with integral control and instrumentation console*
- *3 stage extraction process, can also be configured as 1 or 2 stages*
- *Independent vessel for closed loop batch extraction*
- *Temperature control at each stage*
- *Individual control of solvent feed pumps at each stage, of cell rotation rate and of feed rate*
- *Probes at each stage allow full monitoring of the process*
- *With the data logger, the product concentrations can be directly displayed in real time (for the recommended material)*
- *Optional data logger accessory with USB interface and educational software*

Heat and Mass Transfer Unit Operations

UOP

DESCRIPTION

The heart of the solid/liquid extraction system is a continuously rotating extraction cell divided into compartments. The raw material is fed into these compartments from the input hopper using a screw feeder mechanism. The material is then passed under three solvent sprinkler bars, one for each stage of the process, and the dissolved product captured in three drainage compartments. Pumps are provided at each stage to pump the product from the drainage compartment of one stage to the sprinkler of the next stage. At the end of the process the spent carrier material is dropped into a collection vessel, assisted by water sprayed from above.

The system is configured as a three stage, counter current flow process, but may also be configured as a one or two stage process for teaching purposes.
Full temperature control is provided at each stage of the process using the three integrated PID controllers and related heating elements. Direct control is also provided over the product feed rate, the cell rotation speed and the inter-stage pump speeds.

In addition to the rotary cell, an independent vessel is provided which allows batch extractions to be performed.
The unit is fully instrumented with each stage of the process equipped with sensors, giving a temperature and a milli-volt conductivity probe output. When using the standard water/potassium bicarbonate system, the sensor readings can be related to the percentage weight of potassium bicarbonate in the solution using experimental data.

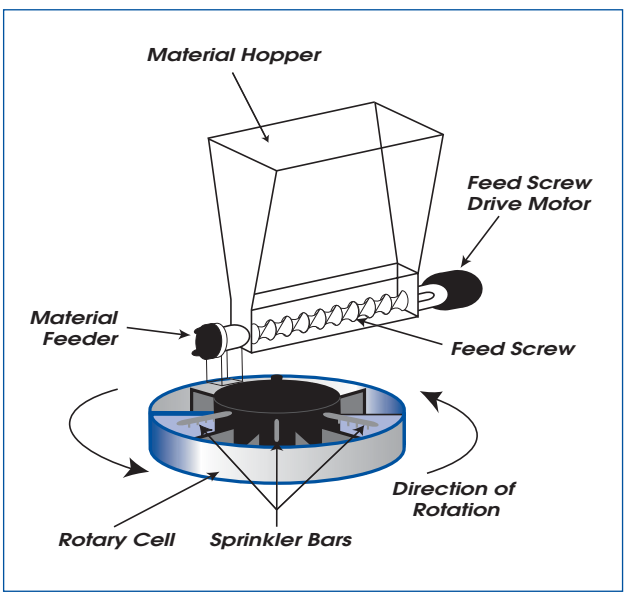
All temperatures and voltage outputs from the conductivity sensors, together with the feed, extractor cell and individual pump rates can also be displayed directly on a computer using the optional data logging package. Using this package it is also possible to display and log the product concentration (when using the recommended material).

The equipment is designed to teach all relevant aspects of solid/liquid extraction in a simple and safe manner. It does not require the use of toxic, volatile or flammable solvents, as it is designed to use water or water based solvents. This allows the process to be made fully visible to students, allowing them to observe and understand the details of the operation at every stage. There is no need for expensive solvent recovery equipment, such as a distillation column.

The solid carrier is a light porous material, a quantity of which is supplied with the equipment. It can be impregnated with a salt such as potassium bicarbonate or sodium bicarbonate, which is then extracted by the process. The use of a salt allows real time monitoring of the process using the sensors and instrumentation. The carrier material is reusable.

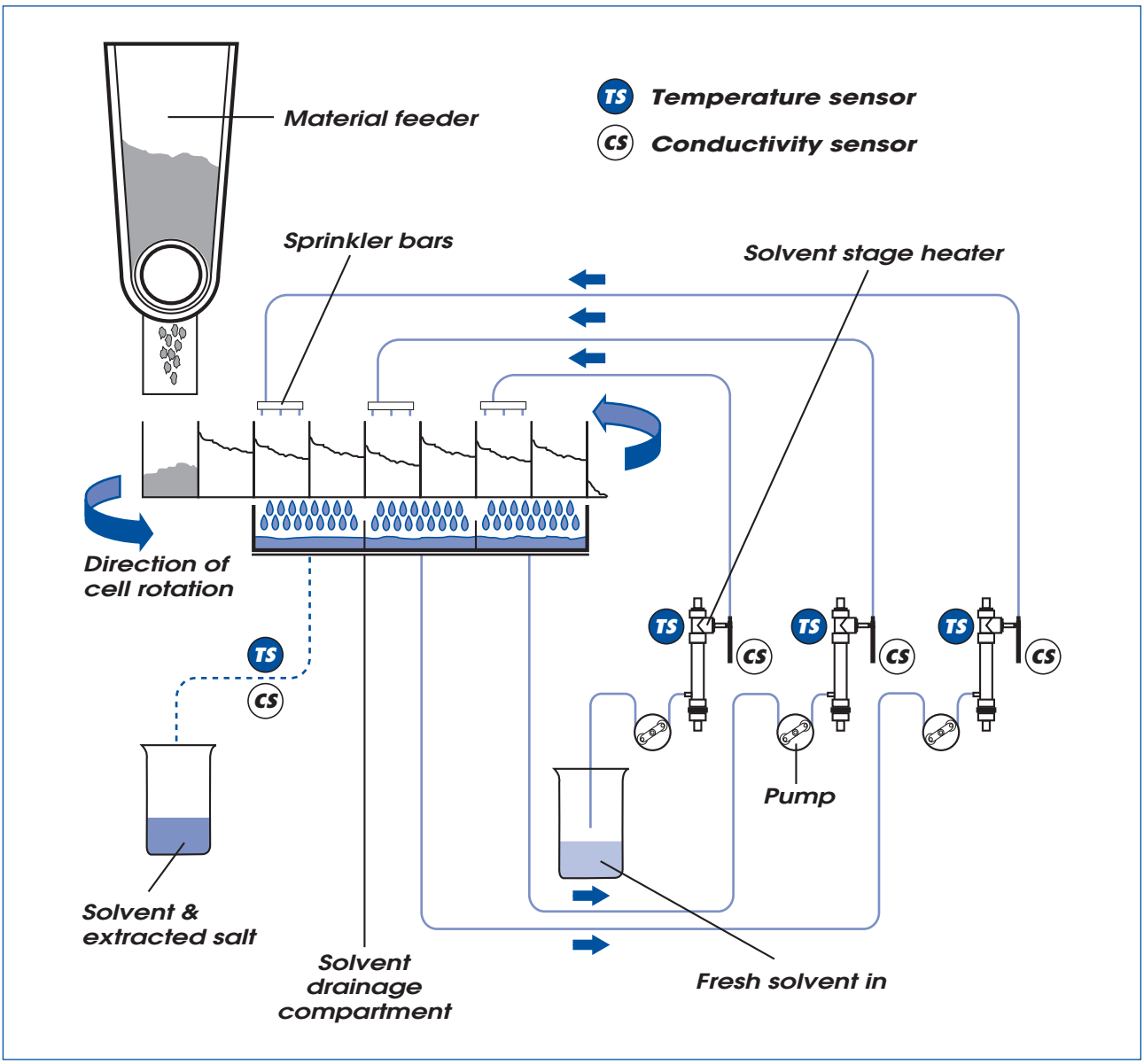
EXPERIMENTAL CAPABILITIES

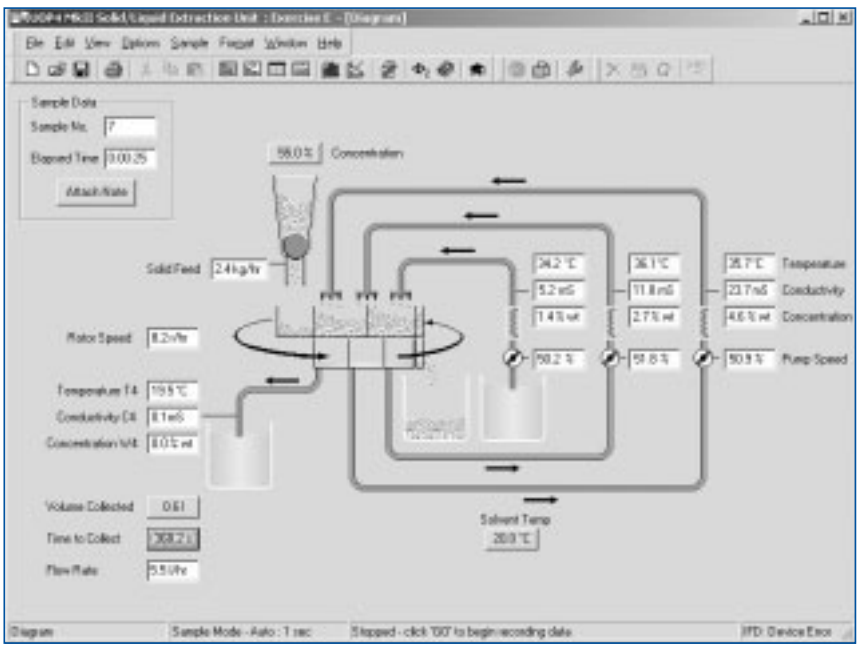
- *Demonstration of the operation of a continuous multiple stage process*
- *Closed circuit percolation extraction (batch extraction)*
- *Open loop percolation extraction (continuous operation)*
- *Investigation of one, two and three stage continuous processes*
- *Investigation into effect of solvent temperatures*
- *Investigation into effect of solvent flow rates*
- *Investigation into effect of processing time*
- *Process economics*
- *Mass balances*



Detail of UOP4MkII showing the rotary extractor cell, feed hopper, feed screw and solvent sprinkler bars

UOP4MkII Flow Chart





UOP4 MkII-304 Mimic diagram with the sensor values displayed

TECHNICAL DETAILS

Solvent Temperatures	*Ambient to 50°C, individually controllable*
Pump Rate	*0-13.5L/hr*
Feed Rate	*0-3L/hr*
Rotation Speed	*1 rev/15min (4revs/hr)*
Cell Compartment	*0.16L Capacity*

OPTIONAL ACCESSORIES

UOP4MkII-304IFD - Educational software and data logging accessory: *USB based data logging system, including an Armfield IFD5 data logger, software and all cables required to connect the USB MkII to a PC. The customer needs to provide a PC running Windows 98, 2000, ME or XP with a spare USB port.*

Carrier material: *The UOP4MkII is supplied with 2kg of carrier material. Before use this material needs to be impregnated with potassium bicarbonate and dried. If an oven is not available the drying process may take up to 3 days. Approximately 1kg of material is required for a typical laboratory investigation. The material is reuseable, but there is inevitably a slight loss of material during use. More material can be ordered, using order code* ***UOP4MkII-CM*** *(1kg bag).*

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ORDERING SPECIFICATION

- ***A continuous three stage solid/liquid extraction system using the rotary extraction cell design. The rotacell rotation speed is variable (0-4 revs/hour).***
- ***Delivery of feed material is automated and feed rate is variable (0-3 L/hr)***
- ***Operation modes are batch, or continuous with 1, 2 or 3 stages. Independant temperature control is provided at each stage. Flow of all three solvent stages is variable (0-13.5 L/hr).***
- ***Conductivity of the fluid stream is measured at the input, and at the output of each of the three stages.***
- ***UOP4MkII is computer compatible using the optional data logging accessory which includes a full educational software package giving details of theory and experimental exercises, operation of the equipment, automatic data logging and real-time graphical display of measured and calculated data.***
- ***Experimental capabilities include:***
  - ***Demonstration of batch and continuous multiple stage liquid/solid extraction processes.***
  - ***Investigation into the effect of solvent temperatures and flow rates of solvent and solids.***
  - ***Mass balancing.***
  - ***Process economics.***

SERVICES REQUIRED

Single phase mains electrical supply:

UOP4MkII-A:	*220-240/1ph/50Hz/13A*
UOP4MkII-B:	*120V/1ph/60Hz/20A*
UOP4MkII-G:	*220V/1ph/60Hz/13A*

Cold water: Typically 0.5L/min

OVERALL DIMENSIONS

Height:	*1.52m*
Width:	*0.77m*
Depth:	*0.56m*

SHIPPING SPECIFICATION

Volume:	*1m³*
Gross weight:	*100kg*

Specifications may change without notice.
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