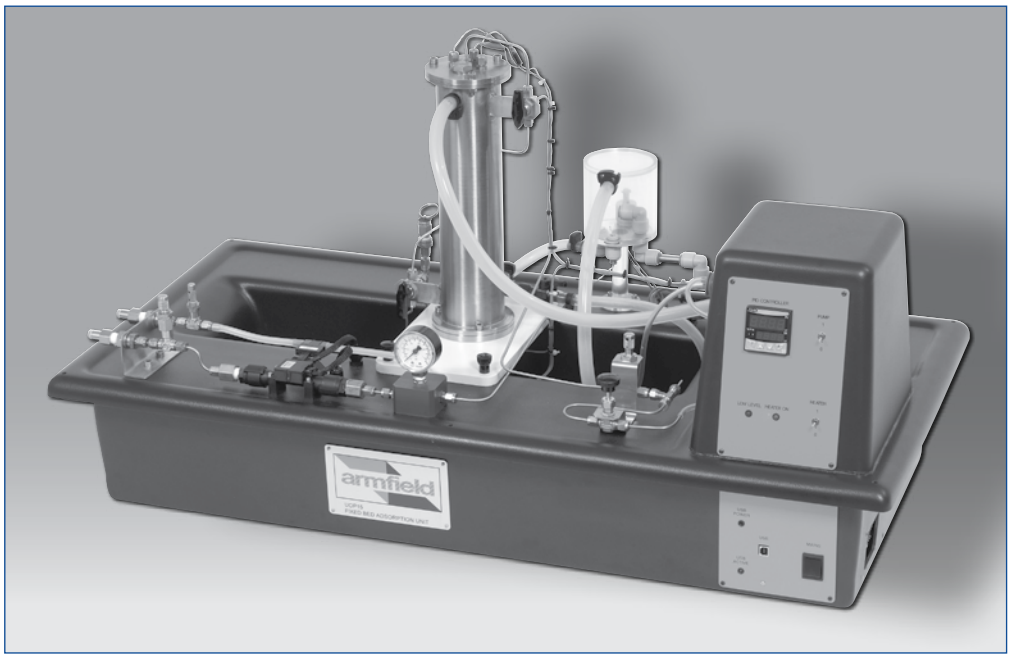
armfield

FIXED BED ADSORPTION UNIT

UOP15
issue 1



UOP15 demonstrates the adsorption of a solute, carbon dioxide, from a binary gas mixture onto the surface of a solid adsorbent, activated carbon. The process takes place in a fixed bed adsorption column. The adsorption and desorption/regeneration processes are monitored using temperature sensors sited at intervals along the column and also by carbon dioxide measurement of the exit gas using an infra red (IR) detector.

DETAILED CAPABILITIES

Teaching exercises are included to familiarise students with the following aspects of a relevant technology:

- *Study of the Adsorption/Desorption processes under different operational conditions: temperature, flow rates, molar fraction and pressure*
- *Study of the breakthrough curves of temperature profiles during the adsorption/desorption process*
- *Study of the quasi-isothermal regime at low concentrations and pressures and how these variables can affect it*
- *Study of the Solute Movement Theory model which describes the adsorption/desorption process*
- *Familiarization with the formation of the compressive and dispersive fronts in adsorption processes*
- *Analysis of the breakthrough curves of CO_2 during the adsorption and desorption/regeneration processes*
- *Obtain the adsorption equilibrium isotherm of CO_2 from the desorption curve (dispersive wave)*

Heat and Mass Transfer Unit Operations

UOP

DESCRIPTION

The UOP15 introduces students to the fundamentals of adsorption and desorption processes using a packed bed reactor. The unit is fitted with a stainless steel reactor column in which the adsorbent, activated carbon, is packed.

There are six thermocouples (T1 - T6) sited along the length of the column which allow the adsorption/desorption fronts to be followed (Adsorption/desorption of CO_2 leads to changes in temperature).

A hot water circulation system, also containing a thermocouple (T7), is connected to the jacket of the column to enable accurate temperature control via a PID temperature controller so that the desired processing temperature is accurately maintained.

The system is equipped with all the valves required for flow direction control, flow rate control and pressure relief for safety. Electronic flowmeters monitor the flow rate of both the carrier gas, helium and the absorbate, carbon dioxide. These combined with the column temperature sensors and the IR detector, for measuring CO_2 concentration; enable the processes to be followed closely and a wide range of operating variables to be examined.

There is a divert path around the column which is used for calibration of the IR detector and also setting up of process conditions prior to beginning an experiment.

The recommended operation variables are flowrates of 0-5 SLPM and pressures of 0 - 0.3 bars. Such operating pressures suit safe operation and provide ideal conditions for the adsorption/desorption processes.

The UOP15 column is easily loaded with the activated carbon supplied or the operator could use their own variety thus enabling performance comparison of different adsorbents.

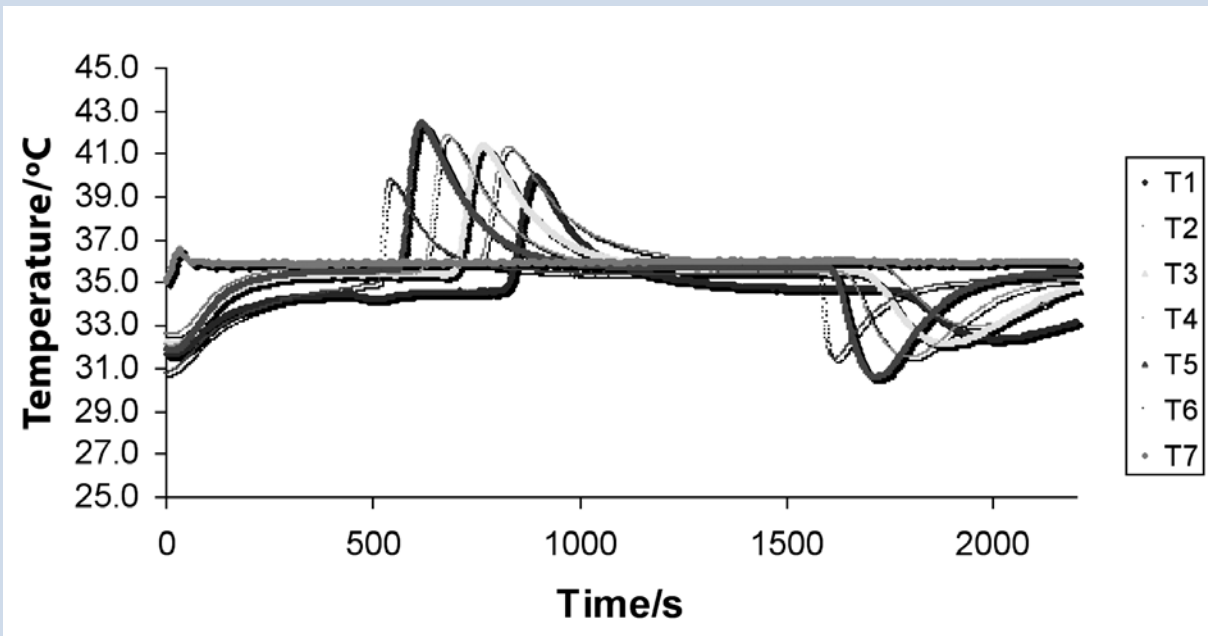
All important sensors used on the unit are electronic and provide outputs for data logging and analysis. The data logger, provided with the unit, interfaces between the UOP15 unit and the user's computer using a USB port.

The associated software allows graph plotting and provides full instructions on setting up the equipment and performing the experiments.

All related theory and full help texts are provided. The software requires a computer running Windows 98 or later with a USB port.

ARMSOFT Armfield software

For further details of the comprehensive capabilities of Armfield software please visit: www.armfield.co.uk/armsoft_datasheet.html

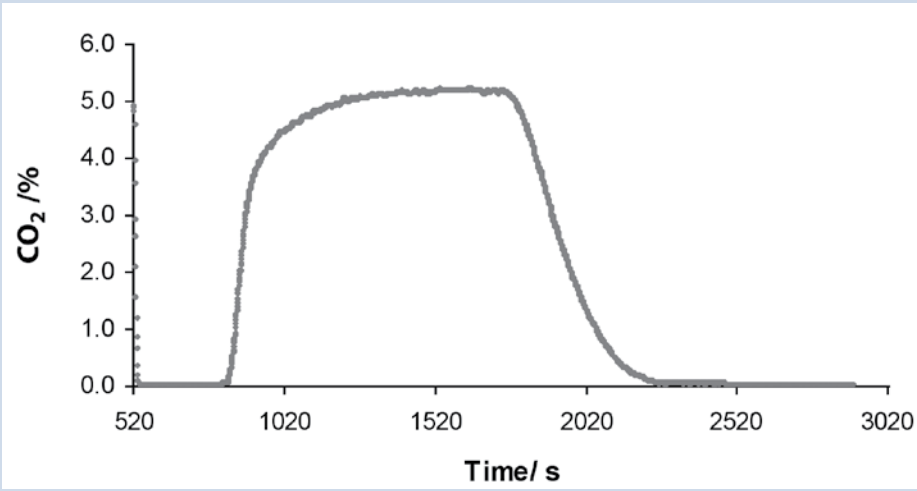


Temerature profiles in adsorption/desorption process

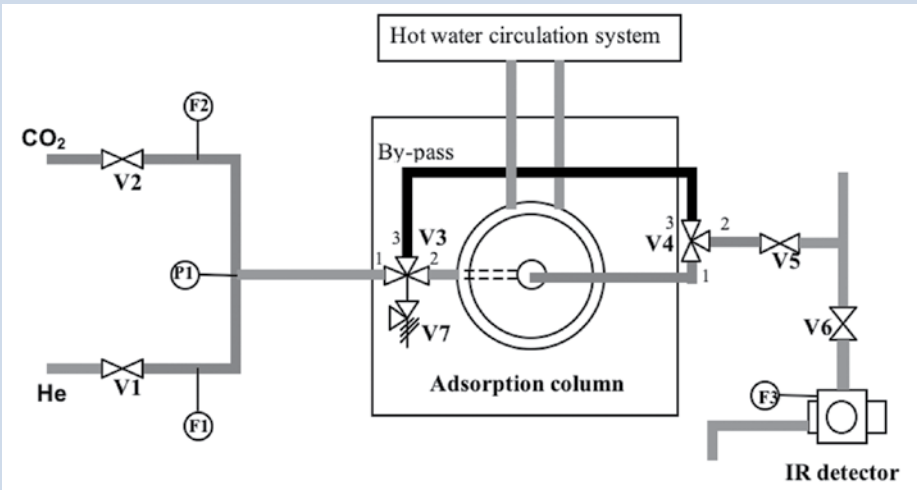
TECHNICAL DETAILS

Operation pressure	*0-0.5 bars*
Gas flow rates	*0 < 5 SLPM (He)*
	0 < 1 SLPM (CO_2)
Column capacity	*480 cm³*
Gases	*CO_2, He*
Relief valve pressure	*20 psi*
Column operating temperature	*25 - 45ºC*

Detail of the UOP15 adsorption column



Breakthrough curve of CO_2 in adsorption and desorption processes



UOP15 layout

ORDERING SPECIFICATION

- *A bench top unit comprising a vacuum formed ABS plastic plinth with integral electrical console onto which is mounted the stainless steel, packed fixed bed adsorption column, hot water circulation system and infrared detector.*
- *The hot water circulator system connected to the column jacket allows automatic control of temperature adsorption to a set point value.*
- *Gas feed flow rate can be controlled between 0 and 5 l/min.*
- *The Bed Adsorption column has the following specifications:*
  - *Height 325 mm, diameter 58 mm*
  - *Stainless steel jacket for temperature control*
  - *Gas distribution plate at entry to column*
  - *Bed of glass beads for good gas distribution and maintenance of steady-state temperature*
  - *Six thermocouples spaced evenly along the length of the column*
- *All electrical circuits are protected by appropriate safety devices.*
- *The control console incorporates an electronic display: PID controller display, including the set-point temperature.*
- *USB interface and sophisticated data logging software are included*

SERVICES REQUIRED

Single phase Electrical supply:

UOP15-A: 220/240V/1ph/50 Hz@10A
UOP15-B: 120V/1ph/60 Hz@15A
UOP15-G: 220V/1ph/60 Hz@10A

Gases:

CO_2	*5 SLPM,1 bar max*
Helium	*1 SLPM,1 bar max*

NOTE: The equipment should be run in a ventilated room.

OVERALL DIMENSIONS

Height:	*0.60m*
Width:	*0.50m*
Depth:	*1.00m*

SHIPPING SPECIFICATION

Volume:	*0.44m^3*
Gross Weight:	*45kg*

Armfield Limited
Bridge House, West Street, Ringwood,
Hampshire BH24 1DY, England

Tel: +44 (0)1425 478781 Fax: +44 (0)1425 470916
E mail: sales@armfield.co.uk
URL: http://www.armfield.co.uk

USA Office:
Armfield Inc.
436 West Commodore Blvd (#2)
Jackson NJ 08527

Tel: (732) 928-3332 Fax: (732) 928-3542
E mail: info@armfieldinc.com

ARMSOFT Armfield software

For further details of the comprehensive capabilities of Armfield software please visit: www.armfield.co.uk/armsoft_datasheet.html

Specifications may change without notice
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