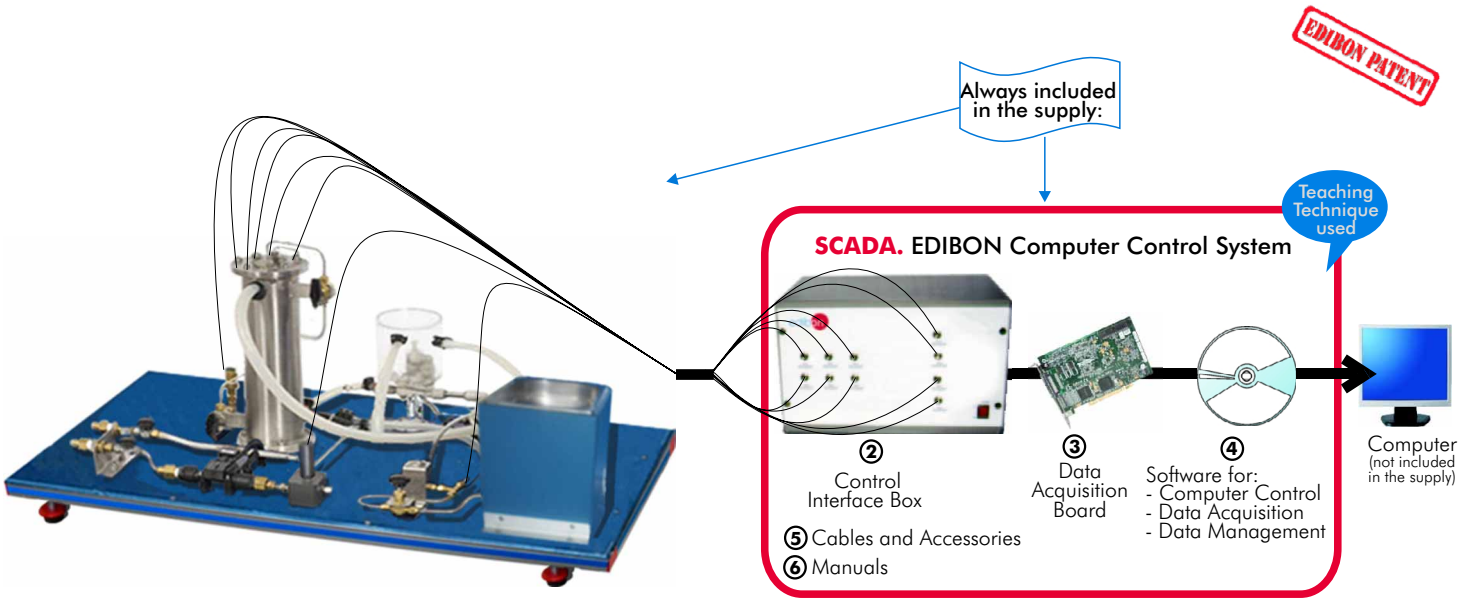
Computer Controlled **Fixed Bed Adsorption Unit**

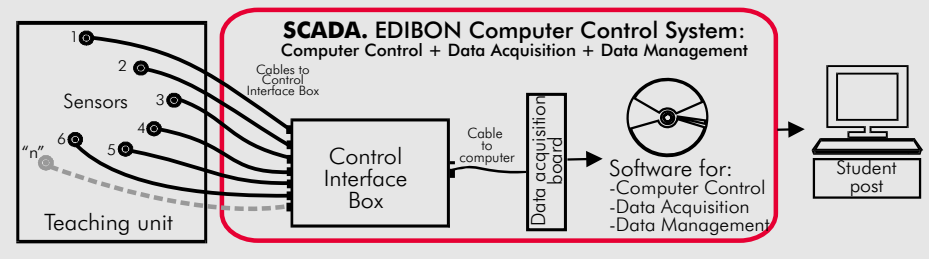
QALFC

Technical Teaching Equipment



① Unit: QALFC. Fixed Bed Adsorption Unit

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



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Products
Products range
Units
11.-Chemical Engineering

DESCRIPTION

QALFC Unit demonstrates the adsorption of a solute (carbon dioxide) from a binary gas mixture onto the surface of a solid adsorbent (activated carbon).

It introduces users to the fundamentals of adsorption and desorption processing using a packed fixed bed adsorption column.

QALFC Unit allows the study of adsorption-desorption processes under different operational conditions: temperature, flow rates, pressures, etc.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), including: Control Interface Box + Data Acquisition Board +Computer Control and Data Acquisition Software, for controlling the process and the parameters involved. The adsorption and desorption/regeneration processes are monitored using temperature sensors sited along the column and also by Co_2 measurement of the exit gas using an IR detector.

ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and **ECO-Management and Audit Scheme**
(environmental management)

Worlddidac Quality Charter Certificate
(Worlddidac Member)

Items supplied as standard

① QALFC. Unit:

QALFC. Unit

Bench-top unit.
Anodized aluminium structure and panels in painted steel (epoxy paint).
Main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Packed fixed bed adsorption column, in which the adsorbent, activated carbon, is packed:
- Stainless steel jacket for temperature control.
- Diameter: 60 mm approx. Height: 330 mm approx.
- Bed of glass balls for good gas distribution and steady-state temperature maintenance.
- Temperature sensors sited along the length of the column.
- Gas distribution plate at inlet to the column.

A hot water circulation system, including a temperature sensor, is connected to the column jacket to enable temperature control by a PID temperature control, form the computer (PC). It allows automatic control of temperature adsorption to a set point value.
Valves for flow direction and flow rate control.
Pressure relief valve for safety.
Flow sensors for measurement of flow rate of both the carrier gas, helium and the adsorbate, carbon dioxide.
IR detector for measuring CO_2 concentration.
Gas feed flow rate can be controlled.
All electrical circuits are protected by the appropriate safety elements.
The column is loaded with the activated carbon supplied, but the user could be use other variety, allowing the performance comparison of different adsorbents.

② QALFC/CIB. Control Interface Box :

QALFC/CIB

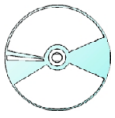
Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.
All sensors, with their respective signals, are properly manipulated from -10V. to +10V computer output.
Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.
Single cable between the control interface box and computer.
The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.
Simultaneously visualization in the computer of all parameters involved in the process.
Calibration of all sensors involved in the process.
Real time curves representation about system responses. Storage of all the process data and results in a file. Graphic representation, in real time, of all the process/system responses.
All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process. All the actuators and sensors values and their responses are placed in only one computer screen.
Shield and filtered signals to avoid external interferences.
Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Real time PID and on/off control for pumps, compressors, resistances, control valves, etc. **Real time PID control for parameters involved in the process simultaneously. Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time,** of the three control constants (proportional, integral and derivative constants).
Open control allowing modifications, at any time and in a real time , of parameters involved in the process simultaneously.
Possibility of automatization of the actuators involved in the process.
Three safety levels, one mechanical in the unit, other electronic in control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

DAB

PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
Analog input: Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.
Sampling rate up to: 250 KS/s (Kilo samples per second).
Input range (V)= ±10V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.
Analog output: Number of **channels=2**. **Resolution=16 bits**, 1 in 65536. Max. output rate up to: 833 KS/s.
Output range(V)= ±10V. Data transfers=DMA, interrupts, programmed I/0.
Digital Input/Output: Channels=24 inputs/outputs. D0 or DI Sample Clock frequency: 0 to 1 MHz.
Timing: **Counter/timers=2**. Resolution: Counter/timers: 32 bits.

④ QALFC/CCSOF. Computer Control+Data Acquisition+Data Management Software:



QALFC/CCSOF

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen.
Compatible with the industry standards.
Registration and visualization of all process variables in an automatic and simultaneously way.
Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
Analog and digital PID control. Menu for PID and set point selection required in the whole work range.
Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. Calibration system for the sensors involved in the process.
It allows the registration of the alarms state and the graphic representation in real time.
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access at different work levels.
This unit allows that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is **supplied with 8 manuals**: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

✱ References 1 to 6: QALFC + QALFC/CIB + DAB + QALFC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.

Continue ...

Additional and optional items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PLC-PI. PLC Module:

Circuit diagram in the front panel.

Front panel:

Digital inputs(X) and Digital outputs (Y) block:

16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).

14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

Analog inputs block:

16 Analog inputs (-10V. to + 10V.)(through SCSI connector).

Analog outputs block:

4 Analog outputs (-10V. to + 10V) (through SCSI connector).

Touch screen:

High visibility and multiple functions.
Display of a highly visible status.
Recipe function.
Bar graph function.
Flow display function.
Alarm list.
Multi language function.
True type fonts.

Back panel:

Power supply connector.
Fuse 2A.
RS-232 connector to PC.
USB 2.0 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

Panasonic PLC:

High-speed scan of 0.32 μsec. for a basic instruction.
Program capacity of 32 Ksteps, with a sufficient comment area.
Free input AC voltage(100 to 240 V AC).
DC input:16 (24 V DC).
Relay output: 14 (250 V A AC/2 A).
High-speed counter.
Multi-point PID control.
Digital inputs/outputs and analog inputs/outputs Panasonic modules.

Communication RS232 wire, to computer (PC).

PLC-PI

⑧ QALFC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

Items available on request

⑨ QALFC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

⑩ QALFC/FSS. Faults Simulation System.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Study of Adsorption/Desorption processes under different operational conditions such as: temperature, flow rates, pressure, molar fraction.

2.- Study of the Solute Movement Theory model which describes the adsorption-desorption process.

3.- Breakthrough curves of temperature profiles during the process.

4.- Analysis of the breakthrough curves of CO_2 during the adsorption and desorption/regeneration processes.

5.- Study of the quasi-isothermal regime at low concentrations and pressures. Study of effect of these variables.

6.- Study of the formation of the compressive and dispersive fronts in adsorption processes.

7.- Obtaining of the adsorption equilibrium isotherm of CO_2 from the desorption curve.

Other possible practices:

8.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

9.- Control of the QALFC unit process through the control interface box without the computer.

10.- Visualization of all the sensors values used in the QALFC unit process.

11.- Calibration of all sensors included in the QALFC unit process.

12.- Hand on of all the actuators involved in the QALFC unit process.

13.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

14.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).

15.- PLC hardware general use and manipulation.

16.- PLC process application for QALFC unit.

17.- PLC structure.

18.- PLC inputs and outputs configuration.

19.- PLC configuration possibilities.

20.- PLC program languages.

21.- PLC different programming standard languages.

22.- New configuration and development of new process.

23.- Hand on an established process.

24.- To visualize and see the results and to make comparisons with the QALFC unit process.

25.- Possibility of creating new process in relation with the QALFC unit.

26.- PLC Programming Exercises.

27.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS

Expansion 1:

⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System

Teaching Technique used

1 UNIT = 30 STUDENTS can work simultaneously

Fixed Bed Adsorption Unit (QALFC)

Control Interface Box

Computer Control Software: Computer Control + Data Acquisition + Data Management

Teacher's Central Computer

Mini Scada-Net Software

30 Student Post

LOCAL NET

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL + MULTI STUDENT POST

Note: The Mini ESN system can be used with any EDIBON computer controlled unit.

Expansion 2:

⑫ ESN. Multipost EDIBON Scada-Net System

Teaching Technique used

Continuous Distillation Unit (UDCC)

Gas Absorption Column (CAGC)

Liquid-Liquid Extraction Unit (UELLC)

Chemical Reactors Training System (QRQC)

Fixed Bed Adsorption Unit (QALFC)

"n" Any other additional computer controlled unit

"n" (1)Control Interface

"n" PLC

PLC

CENTRAL PLC

"REAL TIME MULTICONTROL SYSTEMS"

"SCADA" CENTRAL COMPUTER

Option

"ETDL" EDIBON TECHNICAL DISTANCE LEARNING SYSTEM

30 Student Post

LOCAL NET

30 students can work at the same time

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL + MULTI STUDENT POST

Note: The ESN system can use any EDIBON computer controlled unit.

ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

① **Unit: QALFC. Fixed Bed Adsorption Unit.**

② **QALFC/CIB.Control Interface Box.**

③ **DAB.Data Acquisition Board.**

④ **QALFC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**

⑤ **Cables and Accessories**, for normal operation.

⑥ **Manuals.**

* **IMPORTANT: Under QALFC we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.**

Additional and optional items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PCL-PI.PLC Module.

⑧ QALFC/PLC-SOF. PLC Control Software.

⑨ QALFC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).

⑩ QALFC/FSS. Faults Simulation System. (Available on request).

Expansions

⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System.

⑫ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

-Electrical supply: single-phase, 220V./50Hz or 110V./60Hz.
-Gases:
  CO_2.
  Helium.
-Computer (PC).

*Note: this unit should be run in a good ventilated room.

DIMENSIONS & WEIGHTS

QALFC Unit:	-Dimensions: 1000 x 600 x 700 mm. approx.
	-Weight: 50 Kg. approx.
Control Interface Box:	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 10 Kg. approx.
PLC Module (PLC-PI):	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 30 Kg. approx.

✱ Specifications subject to change without previous notice, due to the convenience of improvements of the product.

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REPRESENTATIVE: