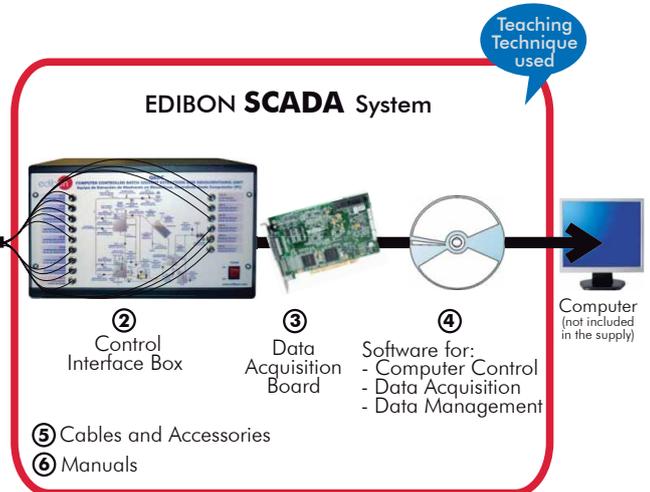


EDIBON PATENT



*Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6
(Computer not included in the supply)

① Unit: QEDC. Batch Solvent Extraction and Desolventising Unit

Key features:

- **Advanced Real-Time SCADA.**
- **Open Control + Multicontrol + Real-Time Control.**
- **Specialized EDIBON Control Software based on Labview.**
- **National Instruments Data Acquisition board (250 KS/s , kilo samples per second).**
- **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**
- **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**
- **Capable of doing applied research, real industrial simulation, training courses, etc.**
- **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**
- **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**
- **Designed and manufactured under several quality standards.**
- **Optional CAL software helps the user perform calculations and comprehend the results.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

**OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL**

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- ↳ Products
- ↳ Products range
- ↳ Units
- ↳ 11.- Chemical Engineering &
- ↳ 12.- Food & Water Technologies

For more information about Key Features, click here:



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 and
Worlddidac Member

INTRODUCTION

Solvent extraction, as the name itself suggests, is a process to extract oil from materials through solvents.

Oil has been obtained from different types of vegetables for centuries. There are several extraction methods: pressure extraction, solvent extraction and a combined system. The solvent extraction method is characterized by its great yield, its low workmanship requirements and the possibility to recover used solvents. Therefore, it is the most efficient method.

Oil solvent extraction from an oily seed is a process used in almost all plants working with these products.

There is a number of factors that influences the extraction process. They are directly related to the solvent:

- Extraction time.
- Solvent temperature.
- Amount of solvent.
- Type of solvent.

GENERAL DESCRIPTION

The Solvent Extraction and Desolventising Unit (QEDC) is a batch process unit able to perform different solid/liquid extractions. It is especially suitable for extracting oil from oily seeds and to remove the solvent both from the extracted solids and mixtures. Furthermore, several factors that influence the extraction process can be studied with this unit.

The cylindrical extractor/desolventiser tank with a hinged lid for charging the extraction material has a base slightly inclined towards a port to discharge the extracted and desolventised meal. Material is supported above the base by a perforated plate covered with a fine woven mesh, so solvent may drain through to the miscella tank whilst retaining the solids.

The tank base is equipped with an indirect steam chest for process heating. Direct steam is injected through a distribution pipe positioned above the mesh. A similar distribution pipe positioned near the top of the tank allows solvent to be sprayed uniformly onto the bed of material. This tank is equipped with a sight glass so that the processes can be observed and monitored.

The miscella tank, positioned directly below the extractor to collect the draining liquid, is also a cylindrical vessel incorporating a steam chest as its base and has a base slightly inclined towards a port for discharging the extracted and the dissolvent.

This tank also incorporates a direct steam distribution pipe through which steam can be sprayed uniformly onto the bed of material. This tank is equipped with a suitable level viewer.

The extractor/desolventiser tank and the miscella tank incorporate two safety valves to limit the working pressure to 0.9 bar in order to prevent the vapour condenser inlet pressure exceeding the working pressure in that condenser at the vapour side.

Vapour from the tanks, produced in the desolventising process, is directed by ducting to the solvent condenser and inclined cylindrical glass tube containing a double coil, through which cooling water is circulated. The covers of this condenser are made of stainless steel. The condenser water inlet is controlled by a pressure regulator so that the operating pressure range is not exceeded. Thus, the glass coil is prevented from breaking.

Condensate (usually a mixture of solvent and water) drains into the solvent water tank which allows thorough separation of the solvent and water by a gravity process. Note: Only hexane or solvents having a similar specific gravity can be effectively separated in this tank.

Solvent reclaimed from this tank can then be recirculated by the solvent pump at a regulated rate. Excess water overflows to a waste water tank from where it can be disposed of on completion of the process.

Operation at reduced system pressures are achieved by a PTFE double diaphragm type vacuum pump. The outlet of this pump is piped through a flame arrester to a suitable ventilation point.

Each tank is equipped with suitable level viewer or sight glasses so that the processes can be observed and monitored. Pressure and temperature sensors are supplied where necessary, as are adequate sampling and drain valves.

Hexane is the most widely used solvent in the extraction processes and due to the inflammable nature of this product electrical equipment has been kept to a minimum.

Modes of operation:

1. Extraction by washing with clean solvent:

This involves priming the solvent/water separator tank with solvent and pumping the solvent to the extractor where it percolates through the material bed and drains as miscella in the tank for recirculation.

2. Extraction by recirculating miscella:

As miscella is formed, steam admitted to the miscella tank causes solvent to evaporate. The vapour is condensed in the solvent condenser and returns to the separator tank from which it is pumped back to the extractor tank.

3. Desolventising extracted material:

When the extraction is complete, the solvent remaining in the material is removed using a combination of steam (direct and indirect) and vacuum. The solvent vapourises and is condensed in the solvent condensate. The mixture of solvent and water is separated in the solvent water separator tank by a gravity process. When the extracted material is free of solvent it is discharged through the door at the base of the extractor.

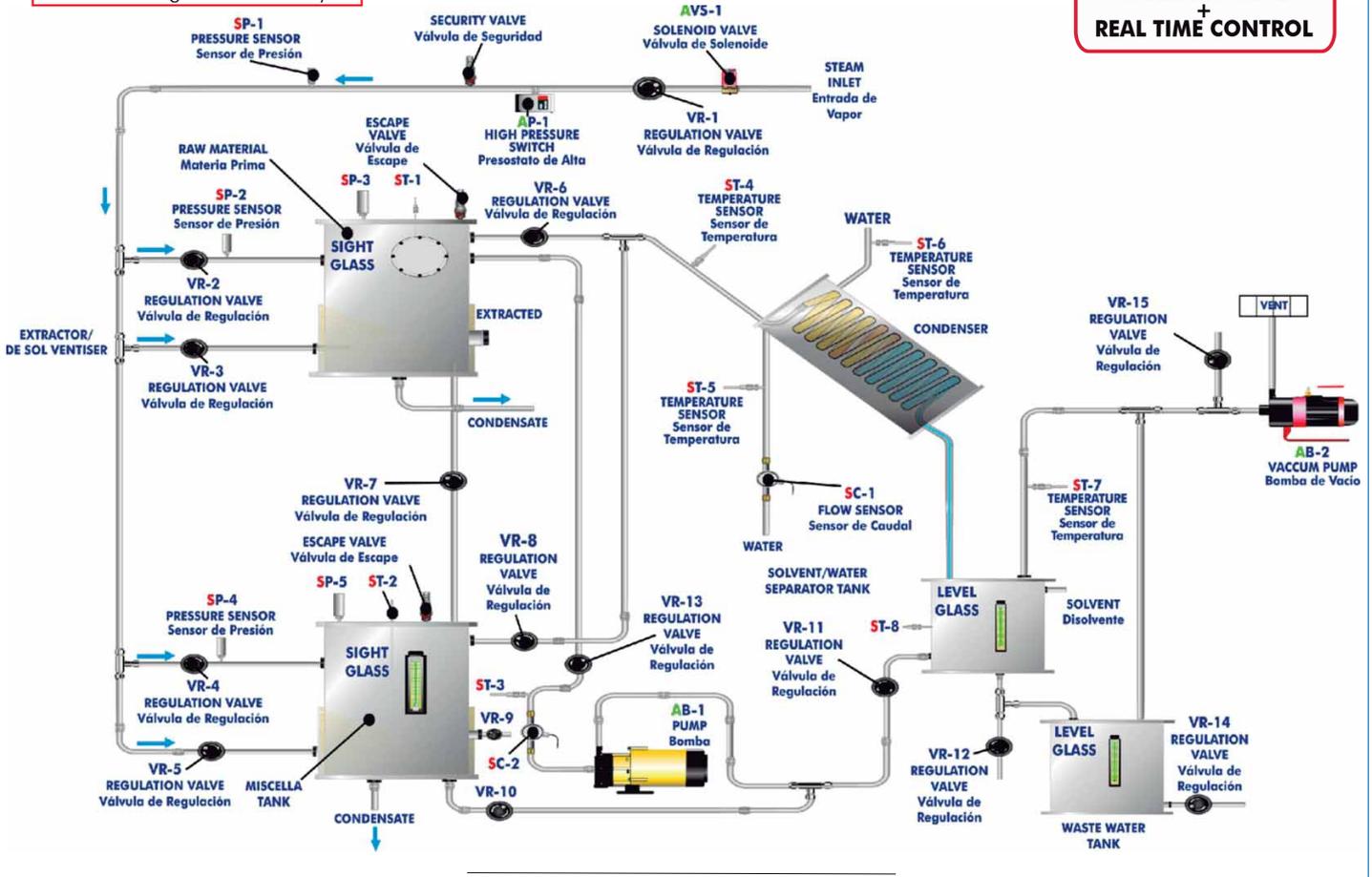
4. Desolventising miscella:

Miscella is a mixture of solvent and oil from the extraction material which accumulates in the miscella tank during the extraction process. The solvent and oil are separated using a combination of steam (direct and indirect) and vacuum.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

3 actuators and 15 sensors controlled from any computer, and working simultaneously

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



Extractor/desolventiser tank

Solvent condenser

Miscella tank

Solvent water separator tank

Waste water tank

Solvent pump

Vacuum pump

With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9, 10, 11 and 12.

Let us describe first the main items (1 to 6):

① QEDC. Unit:

Metallic structure and panels in painted steel.

Diagram in the front panel with similar distribution to the elements in the real unit.

All the vessels, valves and accessories in contact with the process materials are made of stainless steel, except the solvent condenser (made of borosilicate glass) and safety valves (made of brass). Viewers are made of PTFE and Neoceram.

Extractor tank:

Cylindrical vessel of stainless steel, with a hinged lid and equipped with an indirect steam chest for process heating and a sight glass of neoceram.

The vessel has a base inclined slightly towards a port for discharging the extracted and desolventised meal and a perforated plate covered with a fine woven mesh so solvent may drain through to the miscella tank whilst retaining the solids.

Direct steam and solvent are injected through two distribution pipe.

Volume: 100 l.

Direct steam: 0 - 0.9 bar. Indirect steam: 0-3.5 bar.

Miscella tank:

Cylindrical vessel of stainless steel, equipped with an indirect steam chest for process heating and a level viewer. The vessel has a base inclined slightly towards a port for discharging the extracted and solvent.

Direct steam is injected through a distribution pipe.

Volume: 30 l. Direct steam: 0 - 0.9 bar. Indirect steam: 0 - 3.5 bar.

Solvent condenser:

Condensing capacity: 2.5kW. Condensing area: 2.5m². Cooling medium: water. Cooling water flow range: 0 - 22 l./min. Maximum working pressure: 1.0 bar.

Solvent water separator tank:

Cylindrical vessel of stainless steel equipped with a level viewer. Volume of separator section: 16 l.

Volume of solvent store: 16 l.

Waste water tank:

Cylindrical vessel of stainless steel equipped with a level viewer. Volume: 15 l.

Solvent pump:

With bypass flow control. It includes an online Y filter made of stainless steel.

Vacuum pump: Type: double PTFE diaphragm. Operating pressure: 100 mbar (max).

8 Temperature sensors, "J" type. 5 Pressure sensors, range: 0-10 bar. 2 Flow sensors, range: 1.5 - 30 l./min.

The inlet of vapour incorporates a safety valve to limit the working pressure to 4.0 bar, and the extractor/desolventiser tank and the miscella tank incorporate two safety valves to limit the working pressure to 0.9 bar.

An electronic solenoid valve and a pressure switch (4 bar).

A flame arrester at the vacuum pump outlet to obtain a suitable ventilation. Any flashback will be extinguished, so that the unit is not damaged upstream.

Modes of operation:

Extraction by washing with clean solvent. Extraction by recirculating miscella.

Desolventising extracted material. Desolventising miscella.

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on Labview.

National Instruments Data Acquisition board (250 KS/s, kilo samples per second).

Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional CAL software helps the user perform calculations and comprehend the results.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.



QEDC. Unit

② **QEDC/CIB. Control Interface Box:**

The Control Interface Box is part of the SCADA system.

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.

Simultaneous 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 displayed on only one screen in the computer.

Shield and filtered signals to avoid external interferences.

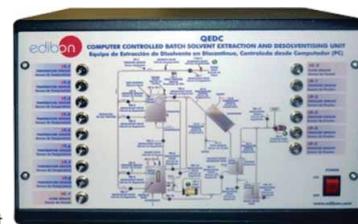
Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.

Real time computer control for pumps, compressors, resistances, control valves, etc.

Real time computer control for parameters involved in the process simultaneously.

Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.

Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.



QEDC/CIB

③ **DAB. Data Acquisition Board:**

The Data Acquisition board is part of the SCADA system.

PCI Express Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI Express.

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) = ±10 V. Data transfers=DMA, interrupts, programmed I/O. DMA channels=6.

Analog output:

Number of channels=2. Resolution= 16 bits, 1 in 65536. Maximum output rate up to: 900 KS/s.

Output range(V) = ±10 V. Data transfers=DMA, interrupts, programmed I/O.

Digital Input/Output:

Number of channels=24 inputs/outputs. D0 or DI Sample Clock frequency: 0 to 100 MHz.

Timing: Number of Counter/timers=4. Resolution: Counter/timers: 32 bits.



DAB

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

The three softwares are part of the SCADA system.

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 simultaneous way.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

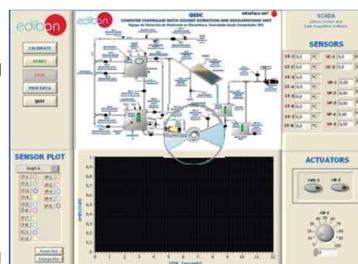
Calibration system for the sensors involved in the process.

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 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 to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.



QEDC/CCSOF

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 are the main items: QEDC + QEDC/CIB + DAB + QEDC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH MAIN ITEMS

- 1.- Operation of small scale version of industrial processes.
- 2.- Effect of degree of pretreatment of solid material on extraction efficiency.
- 3.-Effect of extraction time.
- 4.-Effect of drain time.
- 5.-Effect of solvent type.
- 6.-Effect of solvent percolation rate.
- 7.-Effect of process temperature.
- 8.-Effect of process pressure.
- 9.-Method of solvent recovery.
- 10.-Degree of solvent recovery.

Additional practical possibilities:

- 11.-Sensors calibration.

Other possibilities to be done with this Unit:

- 12.- Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

- 13.-Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gain; proportional, integral, derivate parameters; etc., in real time.

- 14.-The Computer Control System with SCADA allows a real industrial simulation.

- 15.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.

16.-This unit can be used for doing applied research.

17.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

18.-Control of the QEDC unit process through the control interface box without the computer.

19.-Visualization of all the sensors values used in the QEDC unit process.

- By using PLC-PI additional 19 more exercises can be done.

- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V./50Hz or 110V./60Hz.
- Steam supply (10 - 20 Kg/h, 6 - 8 bar max. pressure).
- Water supply (25 l./min., 3.0 (minimum) - 5.0 (maximum) bar pressure.
- Computer (PC).

DIMENSIONS & WEIGHTS

QEDC:

Unit: -Dimensions: 1750 x 1000 x 2000 mm. approx.
(68.89 x 39.37 x 78.74 inches approx.).

-Weight : 850 Kg. approx.
(1873.92 pounds approx.).

Control Interface Box:-Dimensions: 490 x 330 x 310 mm. approx.
(19.29 x 12.99 x 12.20 inches approx.).

-Weight: 10 Kg. approx.
(22 pounds approx.).

RECOMMENDED ACCESSORIES

TGV-6KWA. Steam Generator (6KW) (for high pressures and high temperatures)

SCADA
Main screen

The main screen displays the following components:

- Top Left:** edibon logo and a vertical menu with buttons: CALIBRATE, START, STOP, VIEW DATA, QUIT.
- Top Center:** QEDC interface on? and a detailed process flow diagram of a solvent extraction system with various valves (VB-1 to VB-14), sensors (ST-1 to ST-8, SP-1 to SP-5, SC-1 to SC-2), and tanks.
- Top Right:** SCADA edibon Control and Data Acquisition Software. A **SENSORS** panel showing real-time values for ST-1 to ST-8 (Temperature) and SP-1 to SP-5 (Pressure).
- Bottom Left:** **SENSOR PLOT** panel with a legend for ST-1 to ST-8, SP-1 to SP-5, and SC-1 to SC-2. Includes 'Reset Plot' and 'Enlarge Plot' buttons.
- Bottom Center:** A plot area showing **AMPLITUDE** vs **TIME (seconds)**.
- Bottom Right:** **ACTUATORS** panel with controls for AVS-1, AVS-2, AB-1, and AB-2.

- Ⓘ Main software operation possibilities.
- Ⓜ Sensors displays, real time values, and extra output parameters. Sensors: ST= Temperature sensor. SP= Pressure sensor. SC= Flow sensor.
- Ⓝ Actuators controls. Actuators: AB=Pump. AVS= Solenoid valve.
- Ⓥ Channel selection and other plot parameters.
- Ⓦ Real time graphics displays.

Software for Sensors Calibration

Examples of screens

The calibration software includes the following screens:

- CALIBRATION:** Shows settings for 'Analog Input Channel' (ST-1), 'Sensor Name' (ST-1), 'Calibration units' (°C), 'Full Scale' (700), 'Gain' (102,491), and 'Offset' (-0,832089). Includes 'Least Squares Fit', 'PTA' (10), 'Volts' (0,1763), 'Calibrated' (17,24), and 'ENTER/EXIT' buttons.
- MULTICALIBRATE:** Shows a table of sensor calibration data. Reference Value is 23,2113. Includes 'Signed Technical Support', 'AT Full Scale Tolerance (%)' (100, 1), and a table with columns: Reference Select, Sensors, Volts, Calibrated, Err (%).
- ACTUATORS:** Shows physical actuator controls for AVS-1, AVS-2, AB-1, and AB-2.
- Gain/Offset/PTA Table:**

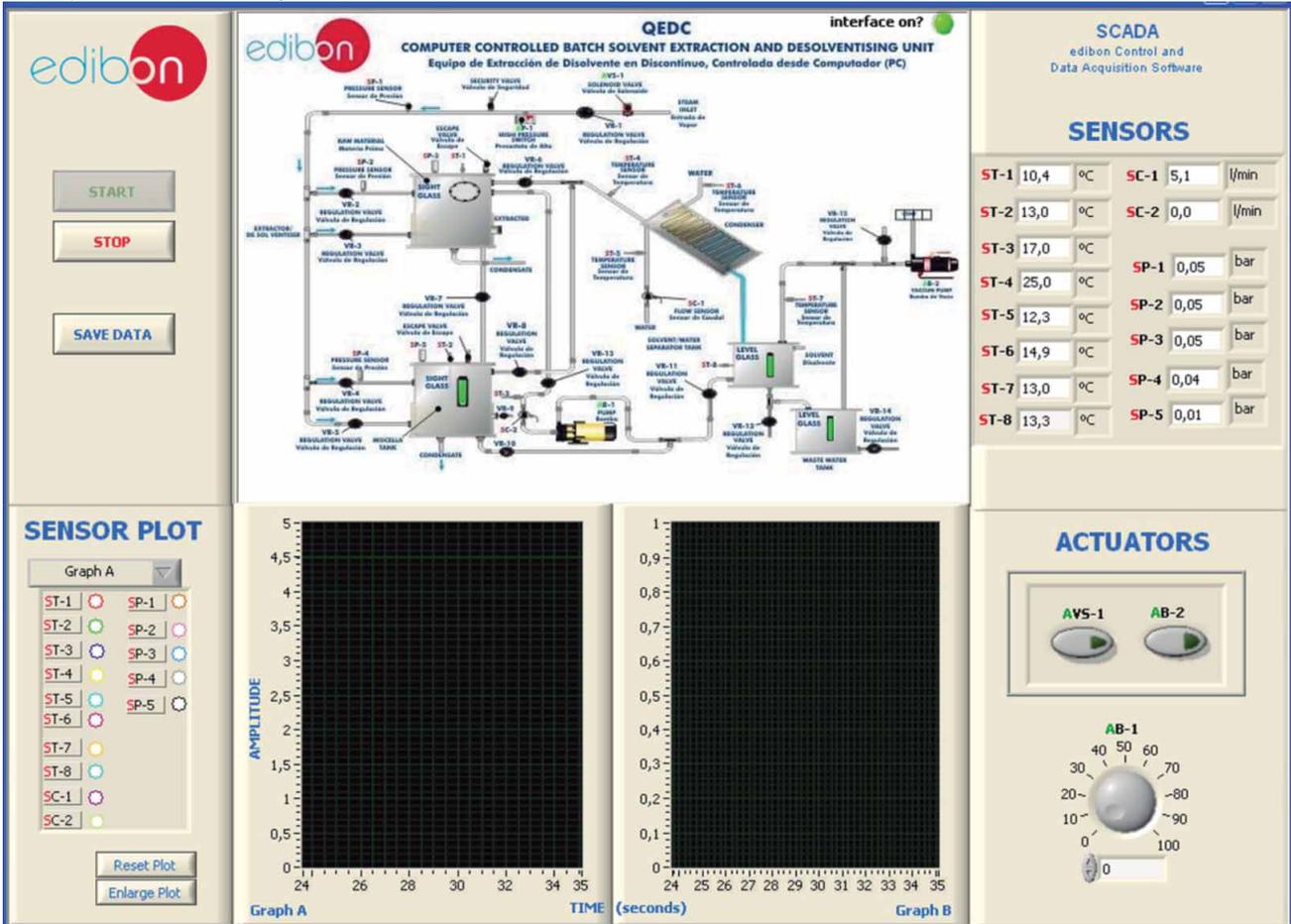
Sensor	GAIN	OFFSET	p
ST-1	97,7605	2,3804	0
ST-2	97,7997	1,0627	0
ST-3	95,8345	0,6041	0
ST-4	96,8188	0,9623	0
ST-5	93,9573	-1,1855	0
ST-6	162,04	1027,9537	0
ST-7	97,4967	0,3676	0
ST-8	0,679363	0,1525	0
SC-1	41,2123	-49,4113	0
SC-2	0,27089	0,4817	0
SC-3	1	0	0
SC-4	0,417958	-0,0315	0
SC-5	878,1	0	0
SC-6	1	0	0
SC-7	1	0	0
SC-8	1	0	0

By using a free of charge code, the teacher and the students can calibrate the unit.

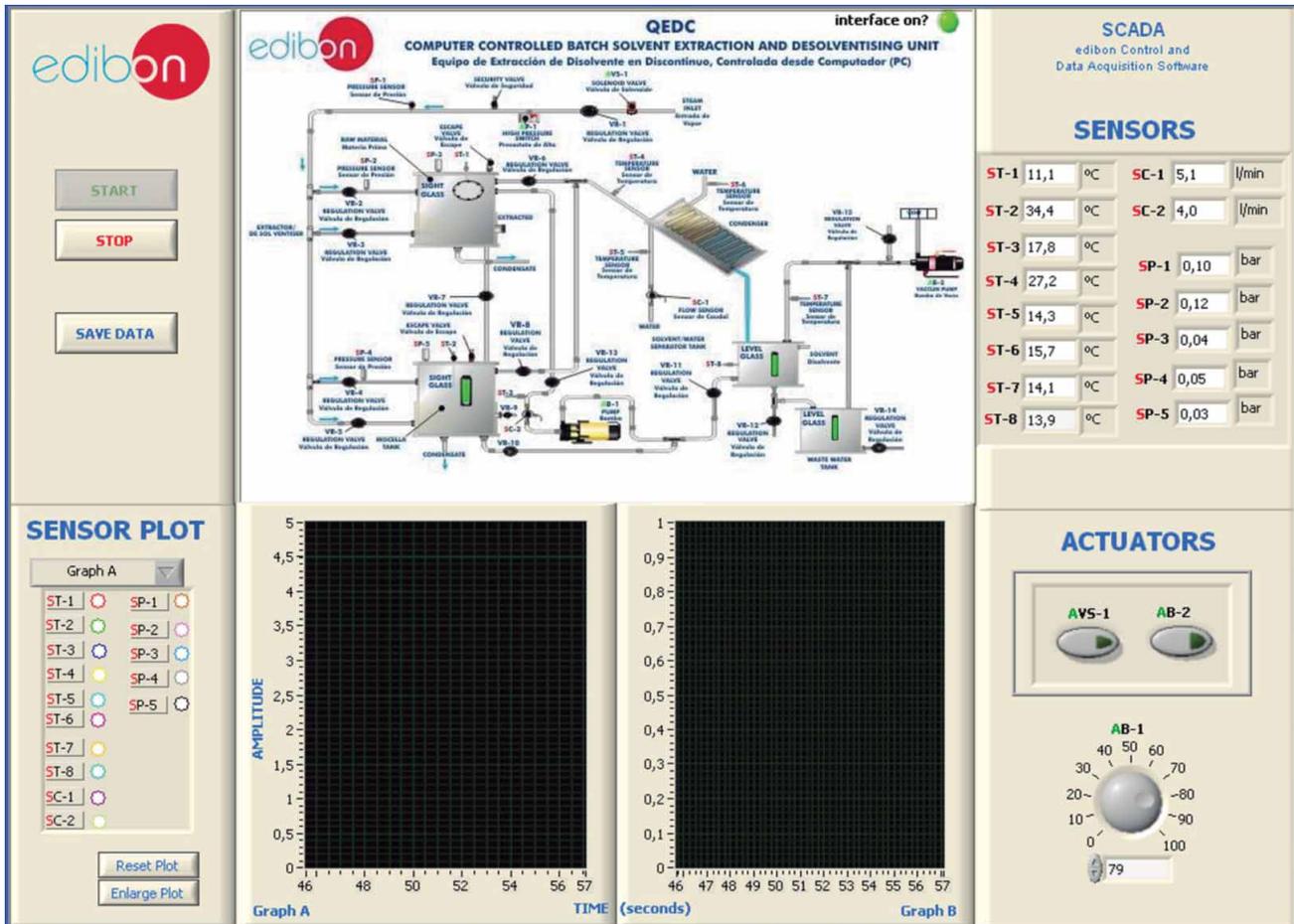
The teacher can recover his/her own calibration by using the EDIBON code that we give free of charge.

SOME TYPICAL RESULTS

When starting an experiment, cooling water begins to flow through the solvent condenser's coil. Its flow is regulated with a manual valve and it is measured with the SC-1 flow sensor. The condenser water inlet is controlled by a pressure regulator so that the operating pressure range is not exceeded. Thus, the glass coil is prevented from breaking.

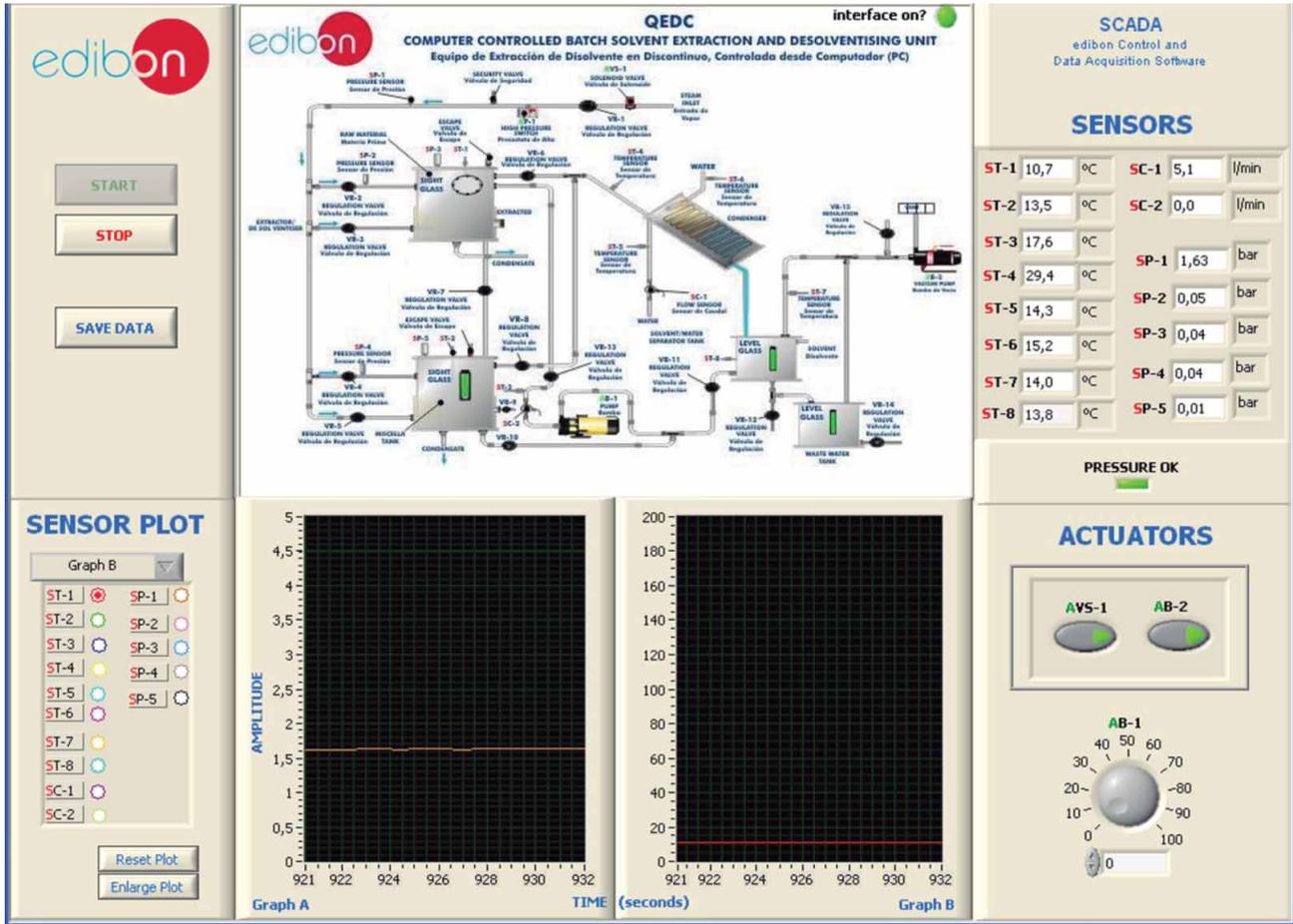


When the extraction material has been loaded in the extraction tank, the solvent is pumped with the AB-1 pump from the separator tank to the extraction tank. This pump can be controlled through the AB-1 pump actuator to vary the flow. The flow of solvent is measured with the SC-2 flow sensor.

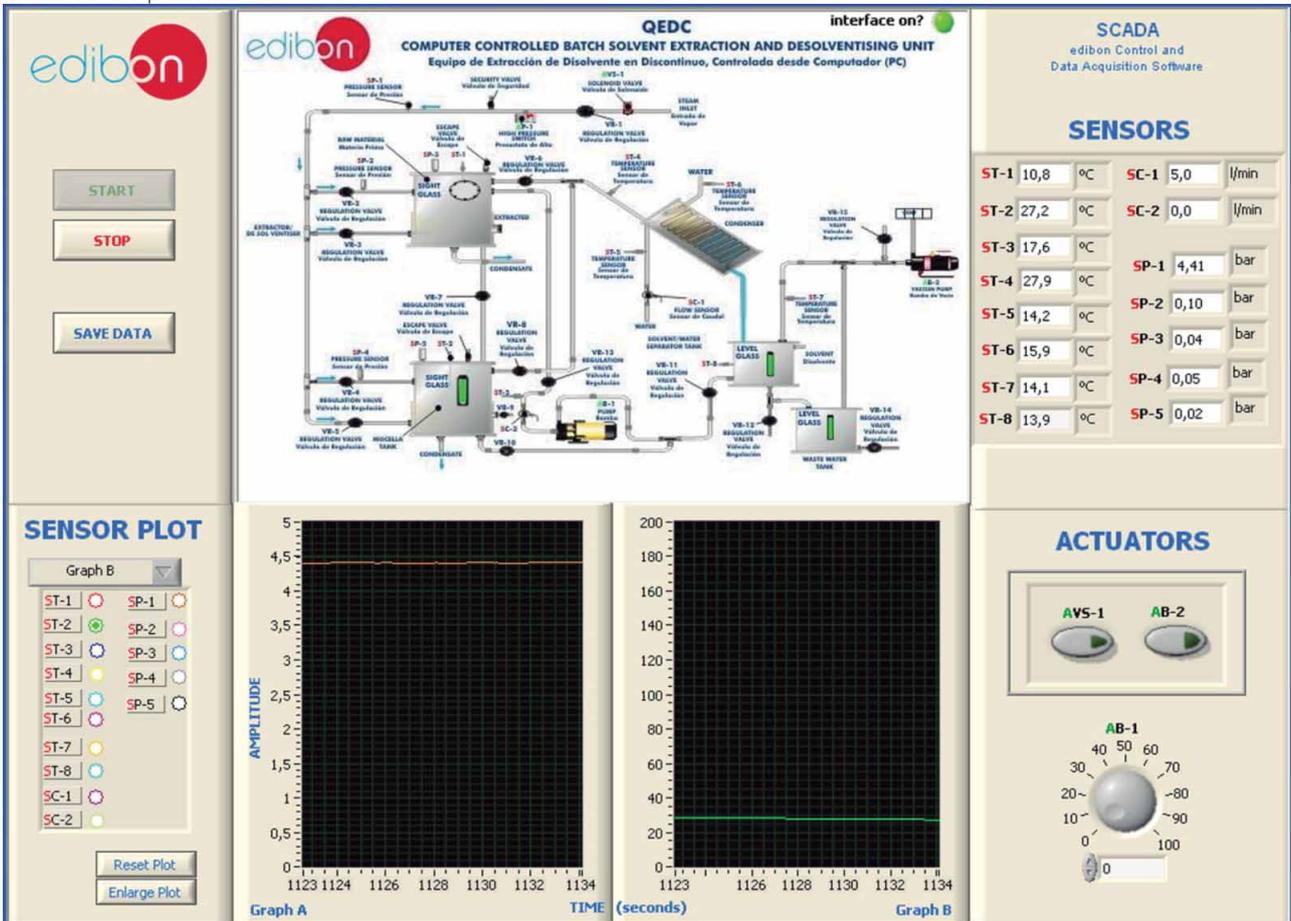


Some typical results

After completing the extraction, the solvent remaining in the material is removed using a combination of steam (direct and indirect) and vacuum. The unit works with a vapour generator. The vapour evaporates the solvent in the extraction and miscella tanks, and heats both tanks bases. A solenoid valve is used to allow the vapour ingress to the QEDC unit. It can be opened through the AVS-1 actuator and can work with up to 4 bars.

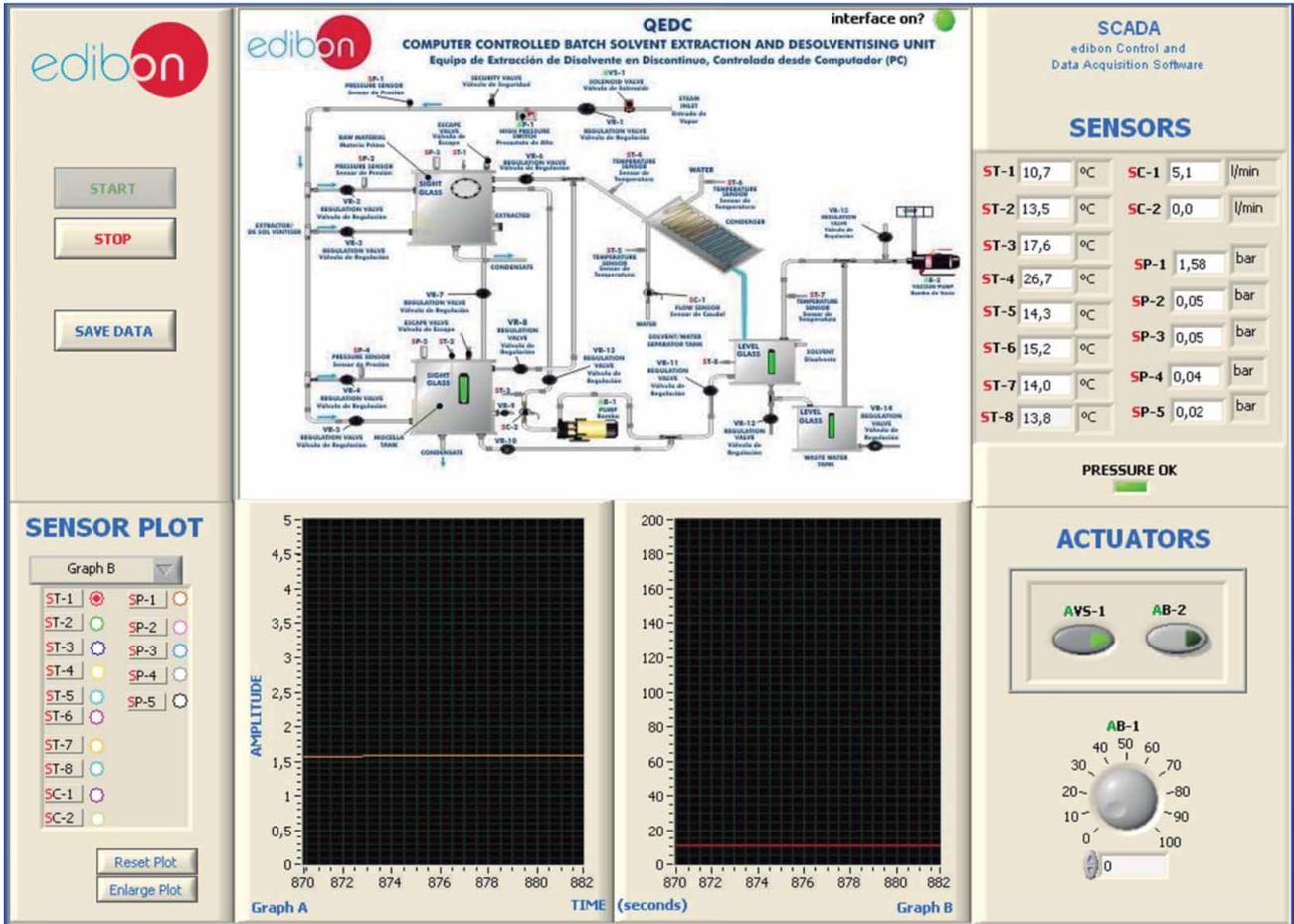


If the vapour inlet exceeds 4 bars, the solenoid valve closes automatically. Besides, the vapour inlet includes a safety valve that releases pressure to 4 bars and a pressure switch.

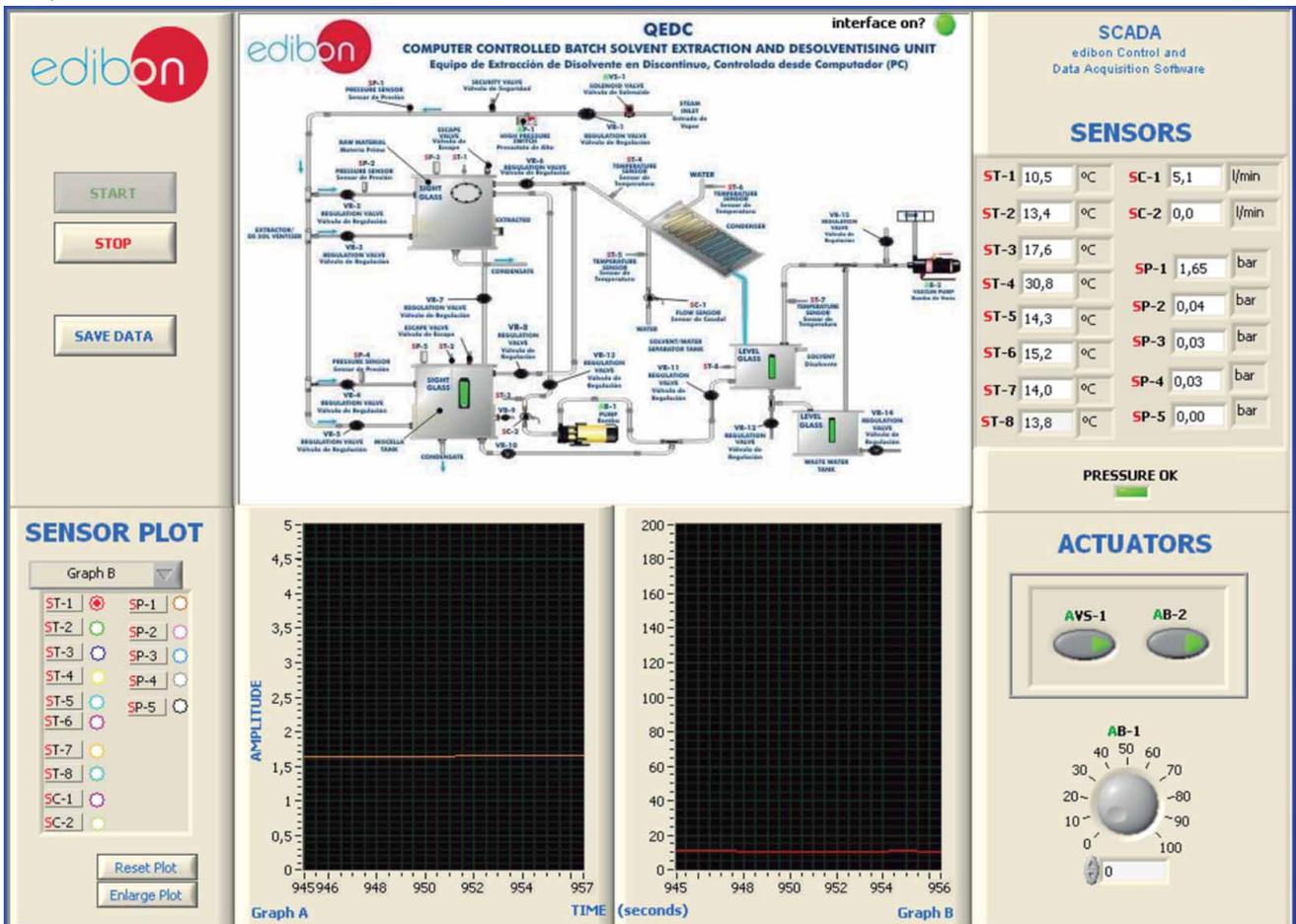


Some typical results

Miscella is a mixture of solvent and oil from the extraction material which accumulates in the miscella tank during the extraction process. The solvent and oil are separated using a combination of steam (direct and indirect) and vacuum.



The vacuum pump can be switched on through the AB-2 pump actuator. The pressure drop due to the vacuum pump starting is detected through the SP-4 and SP-5 pressure sensors.



COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 12.

All these items try to give more possibilities for:

- a) Industrial configuration. (PLC)
- b) Technical and Vocational Education configuration. (CAL and FSS)
- c) Higher Education and/or Technical and Vocational Education configuration. (CAL)
- d) Multipost Expansions options. (Mini ESN and ESN)

a) Industrial configuration

⑦ **PLC. Industrial Control using PLC** (it includes PLC-PI Module plus PLC-SOF Control Software):

-PLC-PI. PLC Module:

Metallic box.

Circuit diagram in the module 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 (-10 V. to + 10 V.) (through SCSI connector).

Analog outputs block:

4 Analog outputs (-10 V. to + 10 V.) (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.

Power supply input (100 to 240 V AC).

DC input: 16 (24 VDC).

Relay output: 14.

High-speed counter.

Multi-point PID control.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

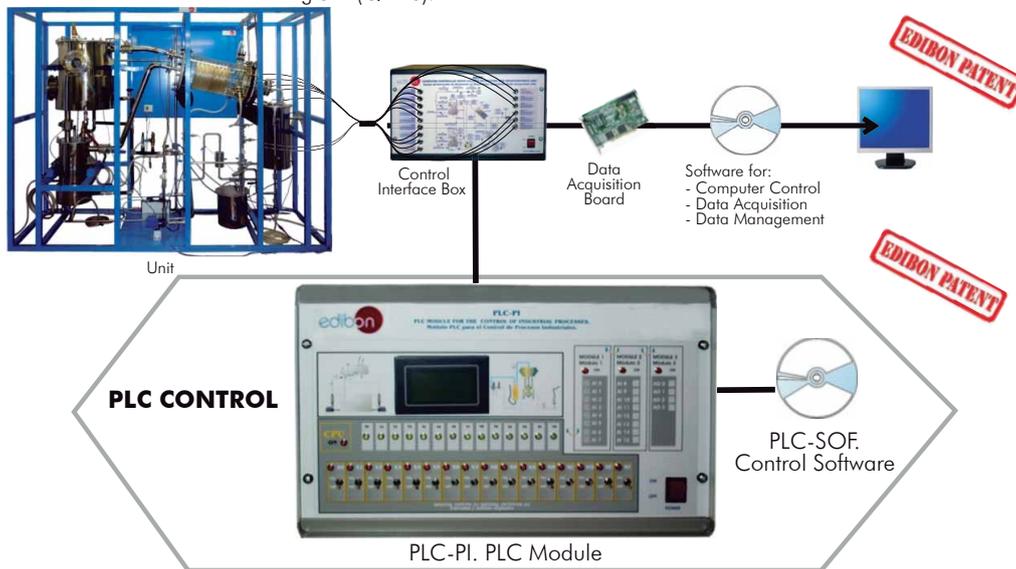
Communication RS232 wire to computer (PC).

Dimensions: 490 x 330 x 310 mm. approx. (19.3 x 13 x 12.2 inches approx.). Weight: 30 Kg. approx. (66 pounds approx.).

-QEDC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

The software has been designed using Labview and it follows the unit operation procedure and linked with the Control Interface Box used in the Computer Controlled Batch Solvent Extraction and Desolventising Unit (QEDC).



Practices to be done with PLC-PI:

- 1.- Control of the QEDC unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the QEDC unit process.
- 3.- Calibration of all sensors included in the QEDC unit process.
- 4.- Hand on of all the actuators involved in the QEDC unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 6.- Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 7.- PLC hardware general use and manipulation.
- 8.- PLC process application for QEDC unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC programming languages.
- 13.- PLC different programming standard languages.
- 14.- New configuration and development of new process.
- 15.- Hand on an established process.
- 16.- To visualize and see the results and to make comparisons with the QEDC unit process.
- 17.- Possibility of creating new process in relation with the QEDC unit.
- 18.- PLC Programming exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ **QEDC/CAI. Computer Aided Instruction Software System.**

This complete software package includes two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the QEDC/SOF. Computer Aided Instruction Software (Student Software).

This software is optional and can be used additionally to items (1 to 6).

This complete software package consists on an Instructor Software (INS/SOF) totally integrated with the Student Software (QEDC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- INS/SOF. Classroom Management Software (Instructor Software):

The Instructor can:

- Organize Students by Classes and Groups.
- Create easily new entries or delete them.
- Create data bases with student information.
- Analyze results and make statistical comparisons.
- Generate and print reports.
- Detect student's progress and difficulties.
- ...and many other facilities.

Instructor Software



- QEDC/SOF. Computer Aided Instruction Software (Student Software):

It explains how to use the unit, run the experiments and what to do at any moment.

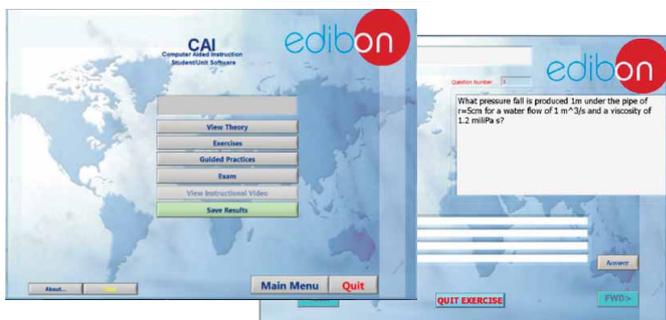
This Software contains:

- Theory.
- Exercises.
- Guided Practices.
- Exams.

For more information see CAI catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/CAI.pdf

Student Software



⑨ **QEDC/FSS. Faults Simulation System.**

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.

The "FAULTS" mode consists on causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.
- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.
- Response reduction of an actuator.

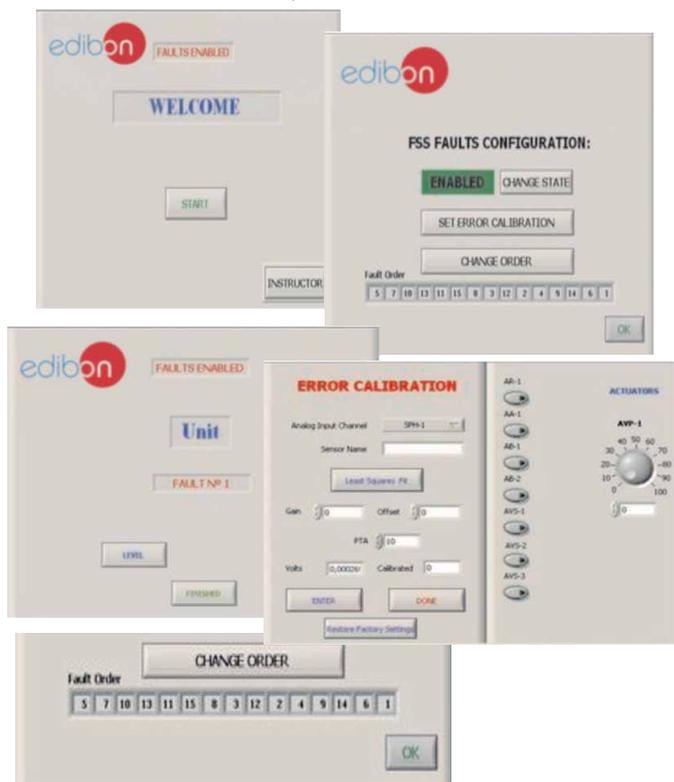
Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

Example of some screens



For more information see FSS catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/FSS.pdf

c) Higher Education and/or Technical and Vocational Education configuration

10 **QEDC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).**

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use, specifically developed by EDIBON. It is very useful for Higher Education level.

CAL is a class assistant that helps in doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL computes the value of all the variables involved and performs the calculations.

It allows to plot and print the results. Within the plotting options, any variable can be represented against any other.

Different plotting displays.

It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

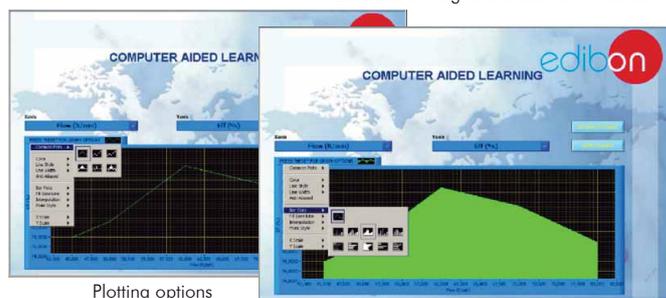
For more information see CAL catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/CAL.pdf



Calculations

Information of constant values, unit conversion factors and integral and derivative tables



Plotting options

d) Multipost Expansions options

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

Mini ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The Mini ESN system consists on the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

Main characteristics:

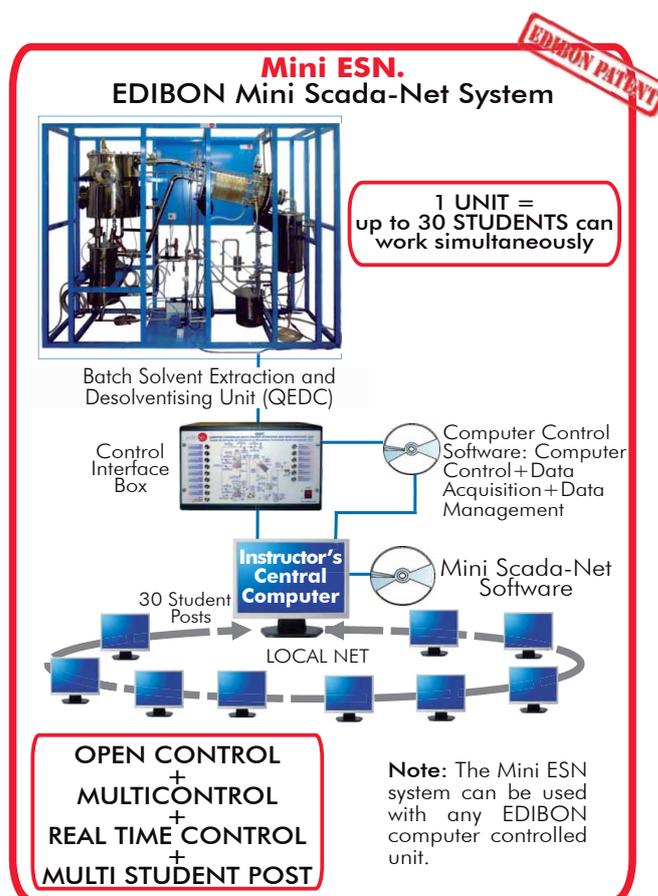
- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student can work doing "real time" control/multicontrol and visualisation.
- Instructor can see in the computer what any user/student is doing in the unit.
- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

For more information see Mini ESN catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/Mini-ESN.pdf



12 **ESN. EDIBON Scada-Net System.**

This unit can be integrated, in future, in a Complete Laboratory with many Units and many Students.

For more information see ESN catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/units/chemicalengineering/esn-chemicalengineering/ESN-CHEMICAL_ENGINEERING.pdf

Main items (always included in the supply)

Minimum supply always includes:

- ① **Unit: QEDC. Batch Solvent Extraction and Desolventising Unit.**
- ② **QEDC/CIB. Control Interface Box.**
- ③ **DAB. Data Acquisition Board.**
- ④ **QEDC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ⑤ **Cables and Accessories**, for normal operation.
- ⑥ **Manuals.**

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

Optional items (supplied under specific order)

a) Industrial configuration

- ⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):
 - PCL-PI. PLC Module.
 - QEDC/PLC-SOF. PLC Control Software.

b) Technical and Vocational configuration

- ⑧ QEDC/CAL. Computer Aided Instruction Software System.
- ⑨ QEDC/FSS. Faults Simulation System.

c) Higher Education and/or Technical and Vocational Education configuration

- ⑩ QEDC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

d) Multipost Expansions options

- ⑪ Mini ESN. EDIBON Mini Scada-Net System.
- ⑫ ESN. EDIBON Scada-Net System.

① QEDC. Unit:

Metallic structure and panels in painted steel.

Diagram in the front panel with similar distribution to the elements in the real unit.

All the vessels, valves and accessories in contact with the process materials are made of stainless steel, except the solvent condenser (made of borosilicate glass) and safety valves (made of brass). Viewers are made of PTFE and Neoceram.

Extractor tank:

Cylindrical vessel of stainless steel, with a hinged lid and equipped with an indirect steam chest for process heating and a sight glass of neoceram.

The vessel has a base inclined slightly towards a port for discharging the extracted and desolventised meal and a perforated plate covered with a fine woven mesh so solvent may drain through to the miscella tank whilst retaining the solids.

Direct steam and solvent are injected through two distribution pipe.

Volume: 100 l. Direct steam: 0 - 0.9 bar. Indirect steam: 0-3.5 bar.

Miscella tank:

Cylindrical vessel of stainless steel, equipped with an indirect steam chest for process heating and a level viewer. The vessel has a base inclined slightly towards a port for discharging the extracted and solvent. Direct steam is injected through a distribution pipe.

Volume: 30 l. Direct steam: 0 - 0.9 bar. Indirect steam: 0 -3.5 bar.

Solvent condenser:

Condensing capacity: 2.5kW. Condensing area: 2.5m². Cooling medium: water. Cooling water flow range: 0 - 22 l./min. Maximum working pressure: 1.0 bar.

Solvent water separator tank:

Cylindrical vessel of stainless steel equipped with a level viewer. Volume of separator section: 16 l. Volume of solvent store: 16 l.

Waste water tank:

Cylindrical vessel of stainless steel equipped with a level viewer. Volume: 15 l.

Solvent pump:

With bypass flow control. It includes an online Y filter made of stainless steel.

Vacuum pump:

Type: double PTFE diaphragm. Operating pressure: 100 mbar (max).

8 Temperature sensors, "J" type. 5 Pressure sensors, range: 0-10 bar. 2 Flow sensors, range: 1.5 - 30 l./min.

The inlet of vapour incorporates a safety valve to limit the working pressure to 4.0 bar, and the extractor/desolventiser tank and the miscella tank incorporate two safety valves to limit the working pressure to 0.9 bar.

An electronic solenoid valve and a pressure switch (4 bar).

A flame arrester at the vacuum pump outlet to obtain a suitable ventilation. Any flashback will be extinguished, so that the unit is not damaged upstream.

Modes of operation:

Extraction by washing with clean solvent. Extraction by recirculating miscella. Desolventising extracted material. Desolventising miscella.

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on Labview.

National Instruments Data Acquisition board (250 KS/s, kilo samples per second).

Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional CAL software helps the user perform calculations and comprehend the results.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

② QEDC/CIB. Control Interface Box:

The Control Interface Box is part of the SCADA system.

Control interface box with process diagram in the front panel.

The unit control elements are permanently computer controlled.

Simultaneous 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.

All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.

Shield and filtered signals to avoid external interferences.

Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.

Real time computer control for parameters involved in the process simultaneously.

Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.

Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.

PCI Express Data acquisition board (National Instruments) to be placed in a computer slot.

Analog input: Channels= 16 single-ended or 8 differential. Resolution= 16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (kilo samples per second).

Analog output: Channels=2. Resolution=16 bits, 1 in 65536.

Digital Input/Output: Channels=24 inputs/outputs.

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

The three softwares are part of the SCADA system. Compatible with the industry standards.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.

Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second).

Calibration system for the sensors involved in the process.

It allows the registration of the alarms state and the graphic representation in real time.

Open software, allowing 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 to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

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.

Exercises and Practical Possibilities to be done with Main Items

- 1.- Operation of small scale version of industrial processes.
 - 2.- Effect of degree of pretreatment of solid material on extraction efficiency.
 - 3.- Effect of extraction time.
 - 4.- Effect of drain time.
 - 5.- Effect of solvent type.
 - 6.- Effect of solvent percolation rate.
 - 7.- Effect of process temperature.
 - 8.- Effect of process pressure.
 - 9.- Method of solvent recovery.
 - 10.- Degree of solvent recovery.
- Additional practical possibilities:
- 11.- Sensors calibration.
- Other possibilities to be done with this Unit:
- 12.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 13.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gain; proportional, integral, derivate parameters; etc in real time.
 - 14.- The Computer Control System with SCADA allows a real industrial simulation.
 - 15.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 16.- This unit can be used for doing applied research.
 - 17.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
 - 18.- Control of the QEDC unit process through the control interface box without the computer.
 - 19.- Visualization of all the sensors values used in the QEDC unit process.
- By using PLC-PI additional 19 more exercises can be done.
 - Several other exercises can be done and designed by the user.

a) Industrial configuration

⑦ **PLC. Industrial Control using PLC** (it includes PLC-PI Module plus PLC-SOF Control Software):

-PLC-PI. PLC Module:

Metallic box.
 Circuit diagram in the module front panel.
 Digital inputs(X) and Digital outputs (Y) block: 16 Digital inputs. 14 Digital outputs.
 Analog inputs block: 16 Analog inputs.
 Analog outputs block: 4 Analog outputs.
 Touch screen.
 Panasonic PLC:

High-speed scan of 0.32 μsec. Program capacity of 32 Ksteps. High-speed counter. Multi-point PID control.
 Digital inputs/outputs and analog inputs/outputs Panasonic modules.

-QEDC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

Practices to be done with PLC-PI:

- 1.- Control of the QEDC unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the QEDC unit process.
- 3.- Calibration of all the sensors included in the QEDC unit process.
- 4.- Hand on of all the actuators involved in the QEDC unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 6.- Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 7.- PLC hardware general use and manipulation.
- 8.- PLC process application for QEDC unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC programming languages.
- 13.- PLC different programming standard languages.
- 14.- New configuration and development of new process.
- 15.- Hand on an established process.
- 16.- To visualize and see the results and to make comparisons with the QEDC unit process.
- 17.- Possibility of creating new process in relation with the QEDC unit.
- 18.- PLC Programming exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ **QEDC/CAI. Computer Aided Instruction Software System.**

This complete software package consists on an Instructor Software (INS/ SOF) totally integrated with the Student Software (QEDC/SOF).

-INS/SOF. Classroom Management Software (Instructor Software):

The Instructor can:

- Organize Students by Classes and Groups.
- Create easily new entries or delete them.
- Create data bases with student information.
- Analyze results and make statistical comparisons.
- Generate and print reports.
- Detect student's progress and difficulties.

-QEDC/SOF. Computer Aided Instruction Software (Student Software):

It explains how to use the unit, run the experiments and what to do at any moment.

This Software contains:

- Theory.
- Exercises.
- Guided Practices.
- Exams.

⑨ **QEDC/FSS. Faults Simulation System.**

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.

The "FAULTS" mode consists on causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.
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Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

c) Higher Education and/or Technical and Vocational Education configuration

⑩ **QEDC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).**

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use.

CAL is a class assistant that helps in doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

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It allows to plot and print the results. Within the plotting options, any variable can be represented against any other.

Different plotting displays.

It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

d) Multipost Expansions options

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

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The Mini ESN system consists on the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student can work doing "real time" control/multicontrol and visualisation.
- Instructor can see in the computer what any user/student is doing in the unit.
- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

The system basically will consist of:

This system is used with a Computer Controlled Unit.

- Instructor's computer.
- Students' computers.
- Local Network.
- Unit- Control Interface adaptation.
- Unit Software adaptation.
- Webcam.
- Mini ESN Software to control the whole system.
- Cables and accessories required for a normal operation.

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



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Issue: ED01/14
Date: May/2014

REPRESENTATIVE: