Computer Controlled **Liquid-Liquid Extraction Unit**

UELLC

Technical Teaching Equipment

Always included in the supply:

EDIBON PATENT

Teaching Technique used

SCADA. EDIBON Computer Control System

② Control Interface Box

③ Data Acquisition Board

④ Software for:
- Computer Control
- Data Acquisition
- Data Management

⑤ Cables and Accessories

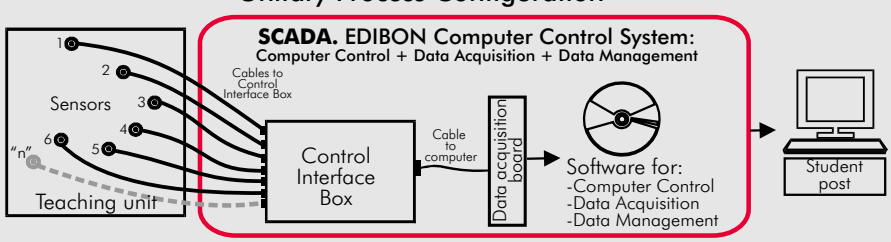
⑥ Manuals

Computer (not included in the supply)

① Unit: UELLC. Liquid-Liquid Extraction Unit

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

Unitary Process Configuration



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Products
Products range
Units
11.-Chemical Engineering

ISO 9001:2000 Certificate of Approval

European Union Certificate

Certificates ISO 14001: 2004 and ECO-Management and Audit Scheme (environmental management)

Worlddidac Quality Charter Certificate
Worlddidac Member

DESCRIPTION

The UELLC is an unit, at laboratory scale, designed for studying the separation of liquid mixtures by contact with a solvent.

This unit allows to study the extraction of one or several components in a continuous way with a solvent in a theoretical stage. The contact takes place inside a packed column, in which the two phases circulate in countercurrent. The circulation velocity of both phases can be controlled in an independent way. The unit allows the recovery of the solvent, by a rectification process.

The Unit consists of the following main parts:

The extraction unit, composed of a jacketed glass packed column (packed with 9 mm glass Raschig rings), with two enlargement pieces at the ends.

The rectification unit consist in a glass packed column (packed with 3 mm glass Raschig rings). It has a boiler, heated by an adjustable electric heating mantle (computer controlled), and two temperature sensors, one in the boiler and another one in the distillation column head.

Supply circuits and collection of products to connect the different units with the storage tanks.

There are sample takings to control the process in all the lines of fluid.

Dosing pumps are alternative pumps of positive displacement and regulating flow, computer controlled.

5 Pyrex tanks (feeding, solvent, refined, extract and solute).

The elements (actuators and sensors) are the following:

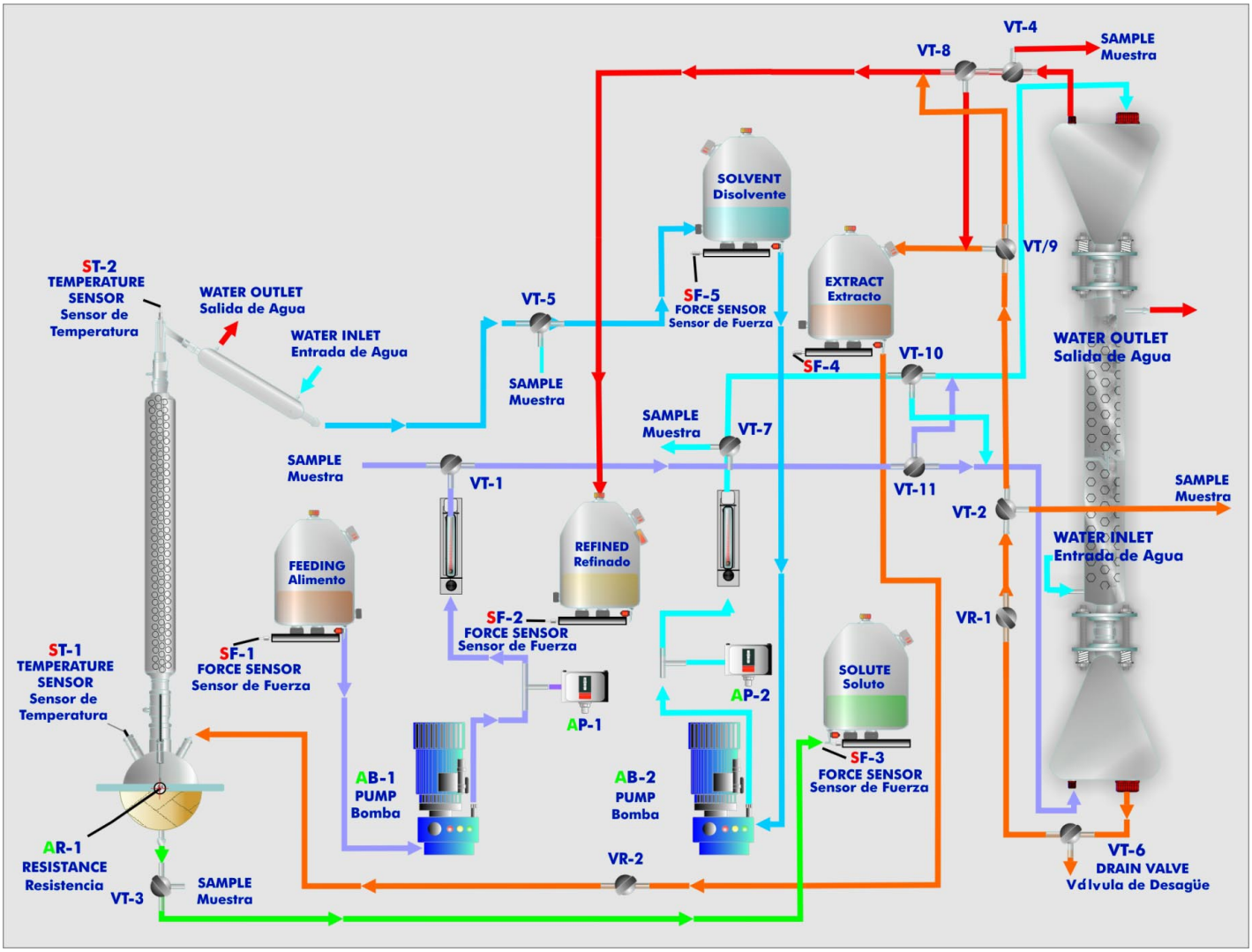
- Regulating valve of the height of the interphase.
- Temperature controller for the boiler.
- Temperature sensor for the distillation head.
- Electrical heating mantle power regulator.
- Two dosing pumps.
- Force sensors in the 5 tanks to measure the mass. On this way the level can be calculated.
- Flow meters.

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.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

3 actuators and 7 sensors controlled from any computer, and working simultaneously

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL



Note: ST=Temperature sensor. SF=Force sensor. AP=High Pressure switch. AB=Pump. AR=Heating resistance (electric heating mantle).

Items supplied as standard

① UELLC. Unit:

The UELLC is an unit, at laboratory scale, designed for studying the separation of liquid mixtures by contact with a solvent.
Anodized aluminium structure and panels in painted steel (epoxi paint).
Main metallic elements in stainless steel.
Transparent elements for a better observation of the process.
Diagram in the front panel with similar distribution to the elements in the real unit.
Jacketed glass packed column of 1200 mm of longitude and 50 mm of internal diameter, with two enlargement pieces with 2 l. of capacity at the ends, packed with 9 mm glass Raschig rings. In this column the extraction process is carried out.
Jacketed glass packed column of 500 mm of longitude and 25 mm of internal diameter, packed with 3 mm glass Raschig rings. This column is used to the distillation process. Coolant column and elbow.
Boiler with 5 l of capacity for the distillation, heated by an adjustable electric heating mantle, with control of the temperature.
5 Pyrex tanks with 10 l. of capacity for the feeding, the refined, the solvent, the extract and the solute. They have independent casting valves.
Dosing pump with stainless steel head (computer controlled), provides a maximum flow of 50 l/h. and a maximum pressure of 10 bar.
Dosing pump with stainless steel head (computer controlled), provides a maximum flow of 17 l/h and a maximum pressure of 12.5 bar.
Security devices in the pumps, to avoid shortcomings by overpressure, pressure switches that switch off the pumps when the pressure is high.
Flow meters to measure of feeding and solvent. For example: flow meter for acetic acid 4%, range: 0-50 l/h, and flow meter for trichloromethane, range: 0-17 l/h.
5 Force sensors to measure the mass in the five tanks (feeding, refined, solvent, extract and solute). Range: 0-15 Kg. On this way the level can be calculated.
2 Temperature sensors (type "J", range: -40 to 750°C) to measure the temperature in the column head and control of boiler temperature.
2 Pressure switches.
7 Sample takings, distributed between all the circuits of the unit.
Regulating valves.
This unit incorporates wheels for its mobility.

UELLC. Unit

OPTIONAL Distillation Column (not included in the standard supply):
- UELL-CP. Distillation column, 5 plates type.

② UELLC/CIB. Control Interface Box:

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. Real time curves representation about system responses. Graphic representation, in real time, of all the process/system responses. **Calibration of all sensors involved in the process.** Storage of all the process data and results in a file.
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.

UELLC/CIB

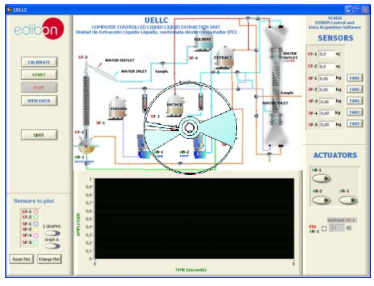
③ DAB. Data Acquisition Board:

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. Number of 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: Number of **channels=24 inputs/outputs**. D0 or DI Sample Clock frequency: 0 to 1 MHz. Timing: **Counter/timers=2**. Resolution: Counter/timers: 32 bits.

DAB

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

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.



UELLC/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: UELLC + UELLC/CIB + DAB + UELLC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.

Continue...

Complementary 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.

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 UELLC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

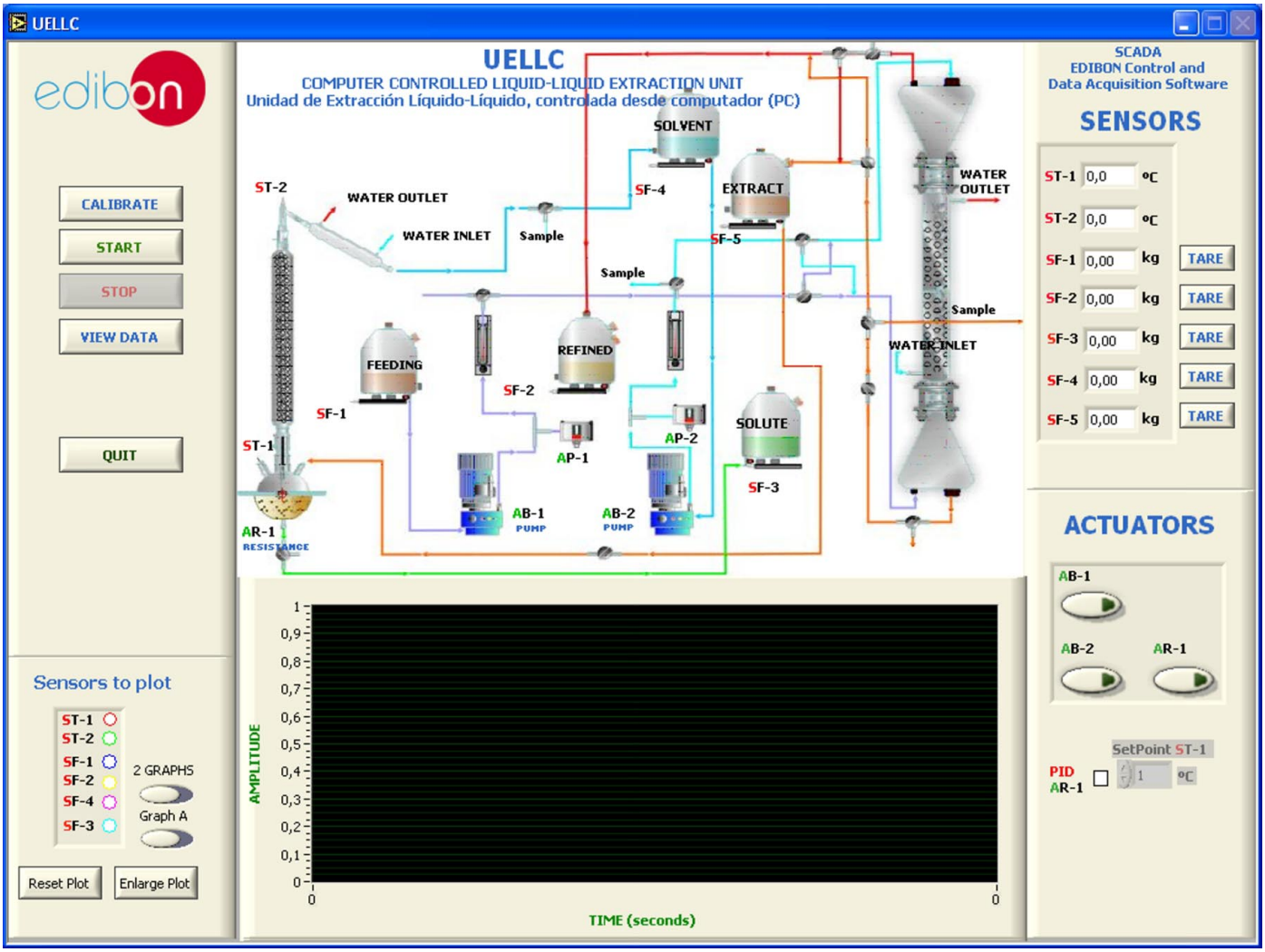
Items available on request

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

⑩ UELLC/FSS. Faults Simulation System.

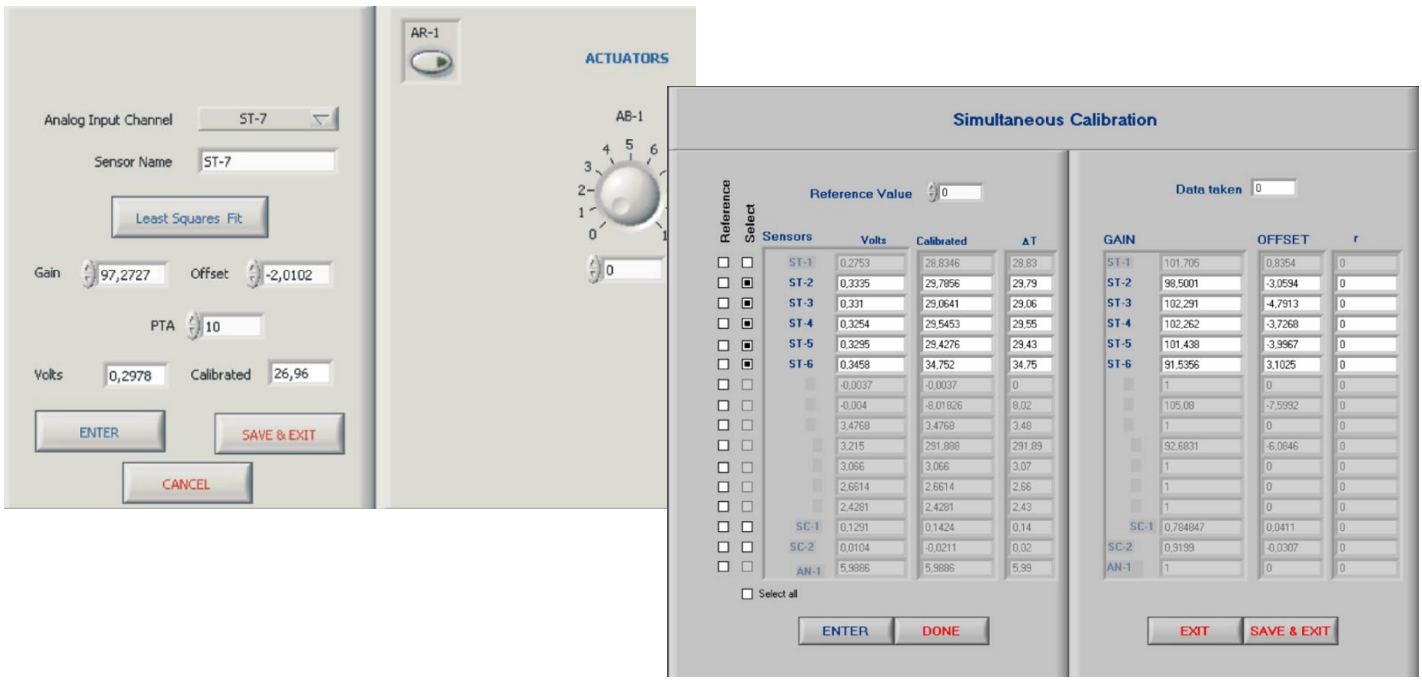
Software Main Screens

Main screen



Note: ST=Temperature sensor. SF=Force sensor. AB=Pump. AR=Heating resistance (electric heating mantle). AP=High pressure switch.

Examples of Sensors Calibration screens



EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Performance in continuous or discontinuous.
2.- Acid-bases valuation.
3.- Obtaining of the binodal curve.
4.- Material balances.
5.- Flooding velocity calculation of the column.
6.- Height interphase regulation.
7.- Determination of the critical point existence.
8.- Volumetric coefficient of material transfer.
9.- Work in discontinuous regarding the solvent.
10.- Work in discontinuous regarding the supply.
11.- Study of the extraction process for industrial processes.
12.- Analysis of the hydrodynamic liquid-liquid system.
13.- Effect of the temperature in the liquid-liquid extraction process.
14.- Studies of efficiency of the extraction.
15- Solvent recovery effectiveness calculation.
16.- Distillation process control study.
17.- Use of other combinations.

Other possible practices:

18.- Calibration of the pumps.
19.- Sensors calibration.

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

20.- Control of the UELLC unit process through the control interface box without the computer.
21.- Visualization of all the sensors values used in the UELLC unit process.
22.- Calibration of all sensors included in the UELLC unit process.
23.- Hand on of all the actuators involved in the UELLC unit process.
24.- Realization of different experiments, in automatic way, without having in Front the unit. (This experiment can be decided previously).
25.- 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).
26.- PLC hardware general use and manipulation.
27.- PLC process application for UELLC unit.
28.- PLC structure.
29.- PLC inputs and outputs configuration.
30.- PLC configuration possibilities.
31.- PLC program languages.
32.- PLC different programming standard languages (literal structured, graphic, etc.).
33.- New configuration and development of new process.
34.- Hand on an established process.
35.- To visualize and see the results and to make comparisons with the UELLC unit process.
36.- Possibility of creating new process in relation with the UELLC unit.
37.- PLC Programming Exercises.
38.- Own PLC applications in accordance with teacher and student requirements.

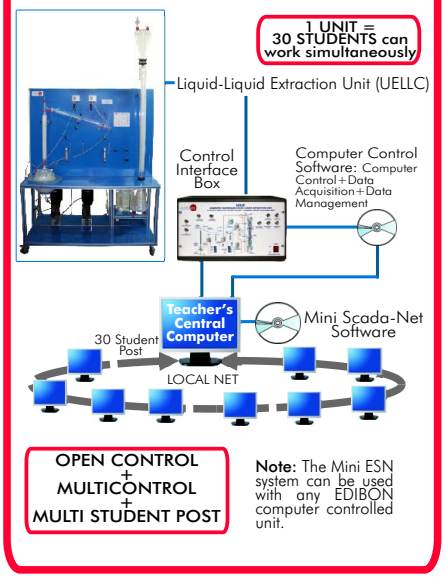
POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS

Expansion 1:

EDIBON PATENT

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

Teaching Technique used

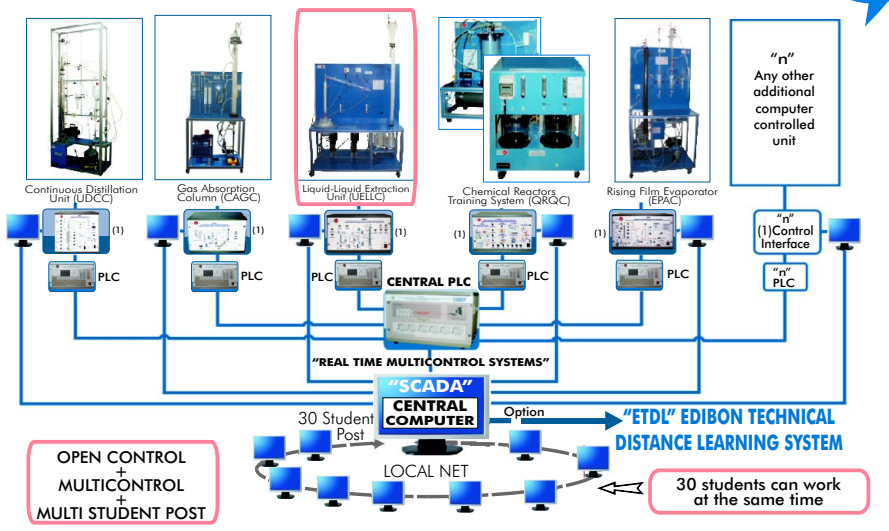


Expansion 2:

EDIBON PATENT

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

Teaching Technique used



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

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

Complementary items to the standard supply

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

⑦ PCL-PI.PLC Module.
⑧ UELLC/PLC-SOF. PLC Control Software.
⑨ UELLC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
⑩ UELLC/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.
- Water supply and drainage.
- Air extraction system.
- Computer (PC).

DIMENSIONS & WEIGHTS

UELLC Unit: -Dimensions: 1400 x 700 x 1800 mm. approx.
-Weight: 90 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.

RECOMMENDED REAGENTS

- Trichloromethane / acetic acid / water.
- Trichloromethane / ethanol / water.
  Where the trichloromethane is the solvent and the water plus acetic acid is the feeding.
- Leksol / Propionic acid / water.

* The unit is ready for working with a wide range of different chemical products, please consult us the most proper.

RECOMMENDED ACCESSORIES

-Refractometer.
-Pycnometer.
-Stopwatch.

OPTIONAL COLUMN

- UELL-CP. Distillation column, 5 plates type.

AVAILABLE VERSIONS

Offered in this catalogue:

- UELLC.Computer Controlled **Liquid- Liquid Extraction Unit.**

Offered in other catalogue:

- UELL. **Liquid- Liquid Extraction Unit.**

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

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