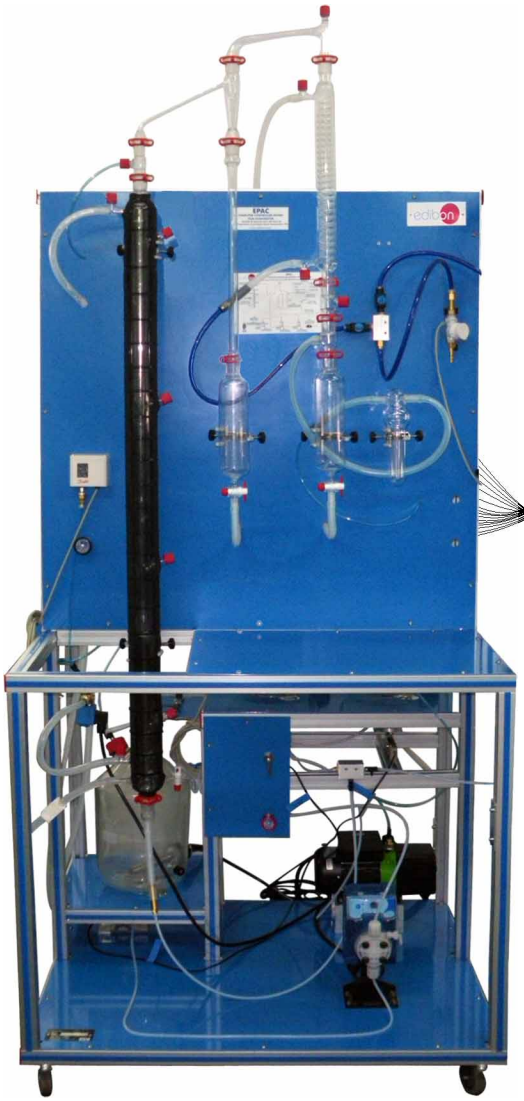
Computer Controlled **Rising Film Evaporator**

EPAC

Technical Teaching Equipment



EDIBON PATENT

Always included in the supply:

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

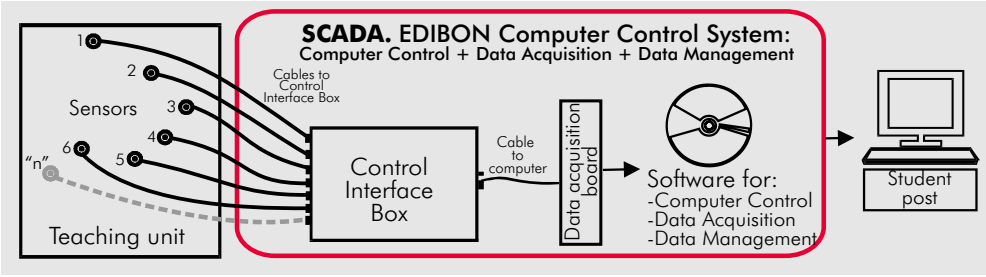
⑤ Cables and Accessories

⑥ Manuals

Computer (not included in the supply)

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

① Unit: EPAC. Rising Film Evaporator



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Products
Products range
Units
11.-Chemical Engineering

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
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DESCRIPTION

The objective of evaporation consists on concentrating a non-volatile solute, carrying out the elimination of a volatile compound. Water is the volatile compound used in most evaporation.

The rising or falling film evaporators are very useful if high temperatures can degrade the product that we want to concentrate, so these evaporators work at less temperature. They can be used, for example, for concentration of fruit juices, milk and milk products, effluents, etc.

Basically, the unit consists of the following circuits:

The feed circuit that consists on a feed pump that introduces the product in a double jacket column, which has temperature sensors. The product leaves the tank through a cyclone placed at the output of the column and it is collected in a 500 ml graduated vessel. The vessel is also connected to a 10 l. tank for the storage of the concentrated product. This last tank is connected to the feed tank for its recirculation.

The distillation circuit starts at the top of the column, where a joint with a pressure sensor has been assembled. It is also connected to the cyclone to separate the concentrated product and the distilled one that goes through a spiral condenser. The distilled product is stored in a graduated vessel that is connected to a 10 l. collection tank. This last one is connected to the feed tank for its recirculation in a continuous process.

The steam circuit, introduced in the external jacket of the column, contains a pressure sensor for the control of the temperature of steam. This sensor is connected to a high-pressure cutout control that opens or closes a control electrovalve for the steam supply.

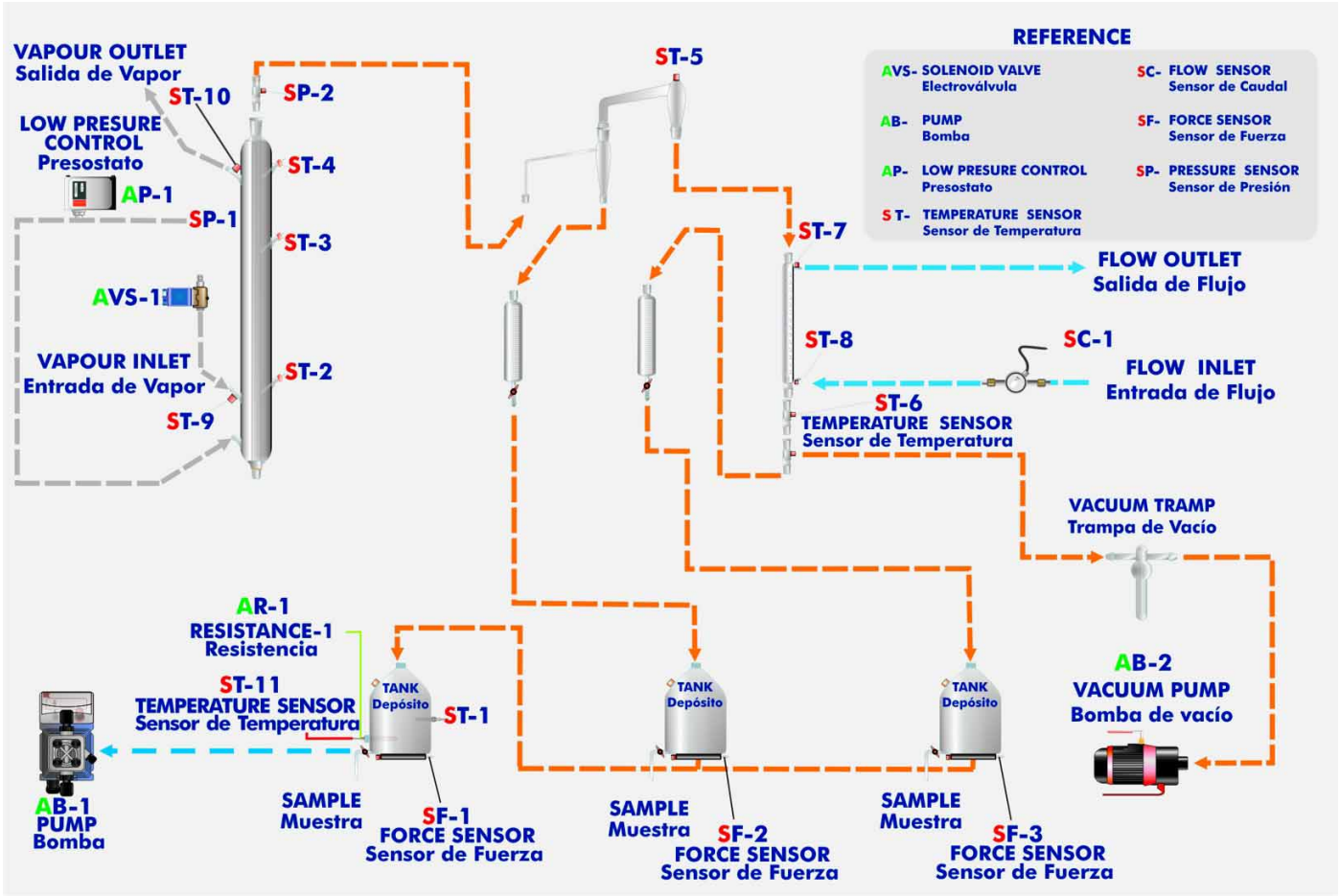
The casting circuit consists on a vacuum pump; one trap placed at the output of the condenser and other trap placed at the output of the condenser and other trap placed at the output of the cyclone.

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

5 actuators and 17 sensors controlled from any computer, and working simultaneously

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL



Items supplied as standard

① EPAC. 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.
Evaporation double jacket column, with a heating surface of 0.122m^3, 30mm of internal diameter, 60 mm of external diameter and 1300 mm of length.
Membrane dosing pump, computer controlled, maximum flow 15l/h, with flow control.
Single effect vacuum pump, computer controlled, maximum flow 3m^3/h and max. vacuum of 150 microns.
Three 10l. tanks (for feeding, concentrated and evaporated).
Two 500 ml graduated vessels for the storage of concentrated and evaporated product.
Coil coolant with length of 400 mm.
Heating resistance, computer controlled, range: 300W. Included a safety temperature sensor with internal temperature controller.
Automatic temperature control.
High safety pressure cut out for pressure control in the column.
10 Temperature sensors, type "J".
1 Flow sensor, range: 0.2 to 5 l./min.
3 Force sensors, one in each of the three tanks (for feeding, concentrated and evaporated), for measuring the amount of substance.
2 Absolute pressure sensors, range: 0 - 2 bar.
Solenoid valve, computer controlled.
The unit incorporates wheels for mobility.

EPAC. Unit

OPTIONAL Accessory: (not included in the standard supply)
EPDC. Computer Controlled **Falling Film Evaporator** (for adding to EPAC).

② EPAC/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.
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.

EPAC/CIB

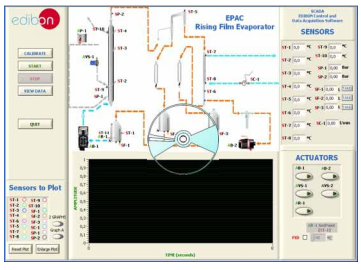
③ DAB. Data Acquisition Board:

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. 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.

DAB

④ EPAC/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.



EPAC/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: EPAC + EPAC/CIB + DAB + EPAC/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.
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 EPAC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

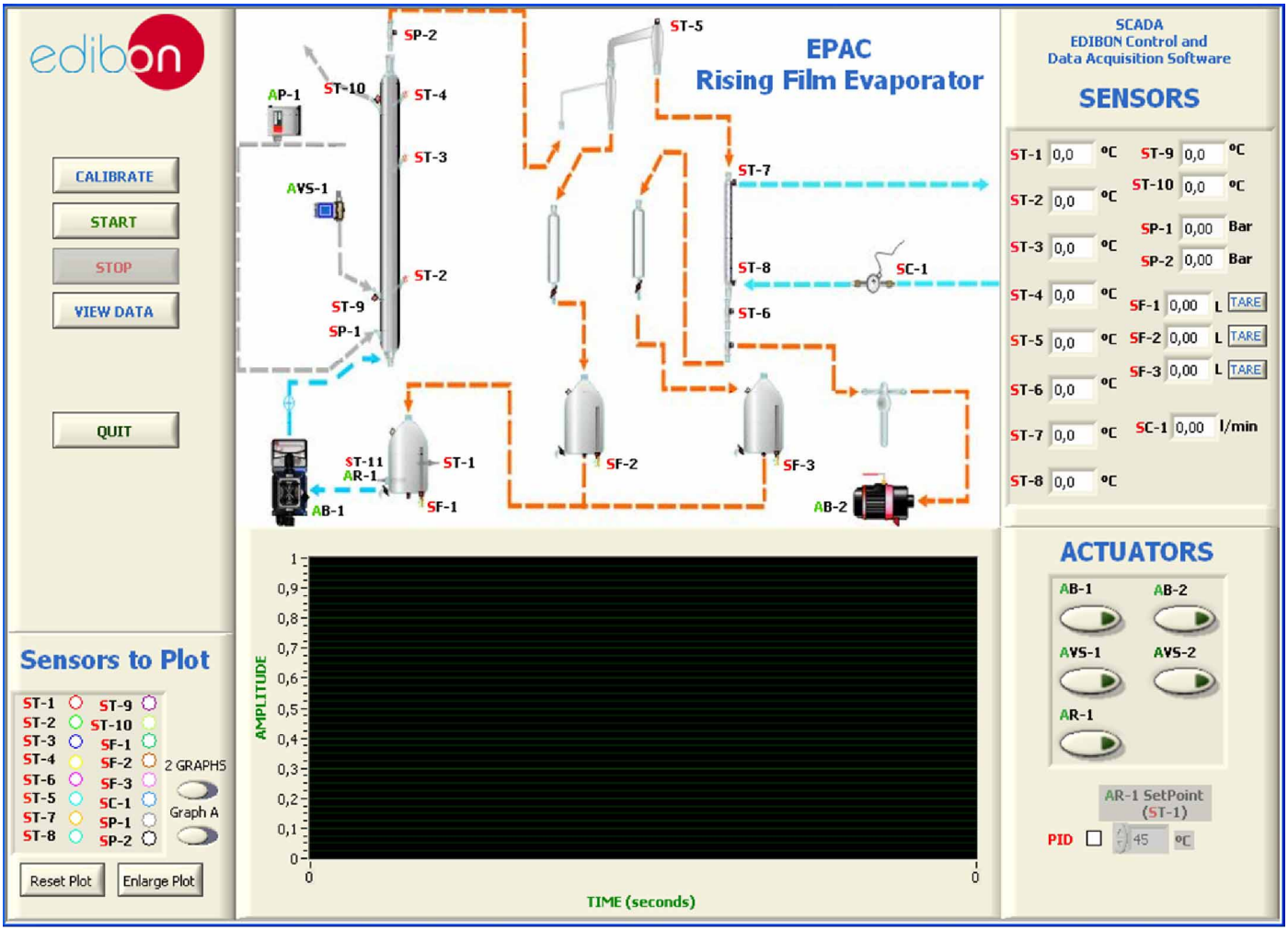
Items available on request

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

⑩ EPAC/FSS. Faults Simulation System.

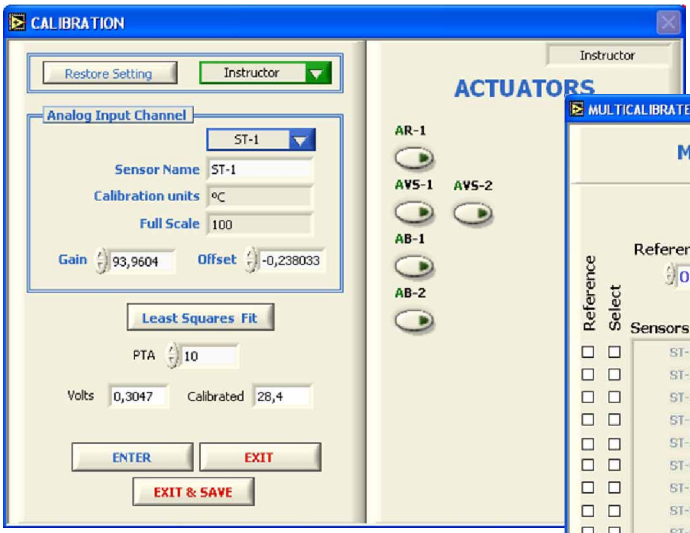
Software Main Screens

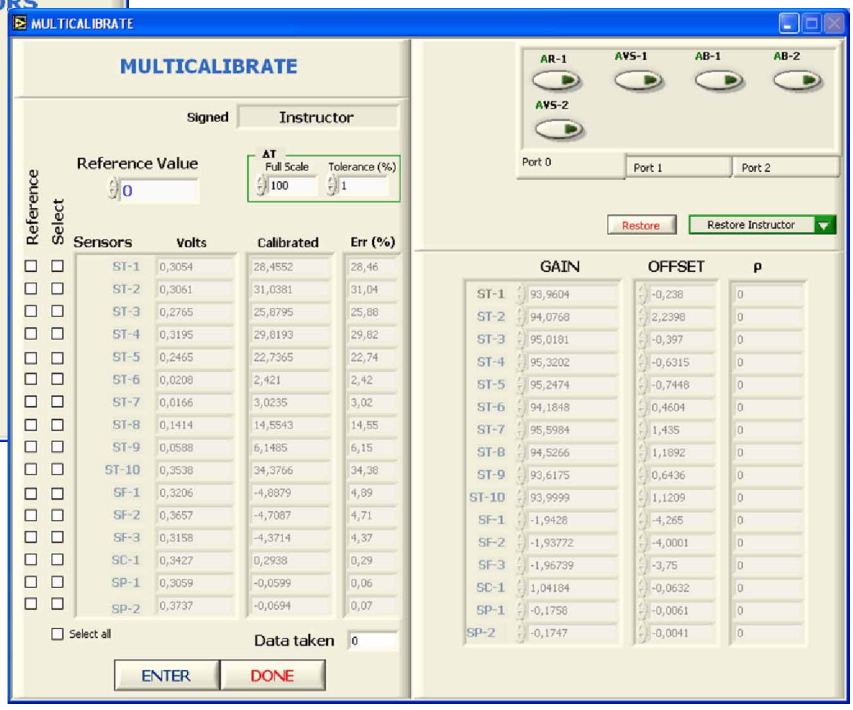
Main screen



Note: ST= Temperature sensor. SF= Force sensor. SC= Flow sensor. SP= Pressure sensor. AR= Heating resistance. AB= Pump. AVS= Solenoid valve.

Examples of Sensors Calibration screens





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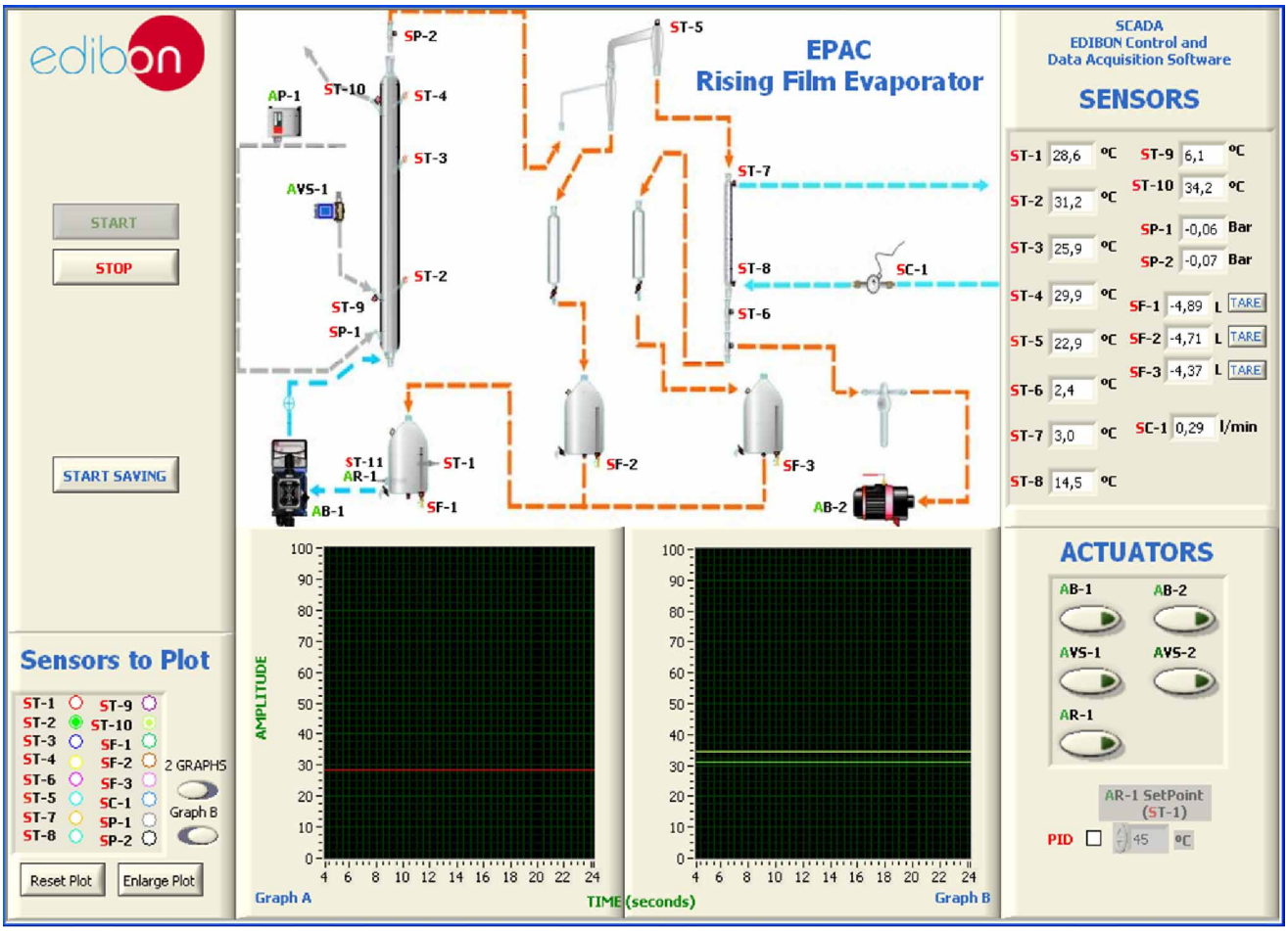
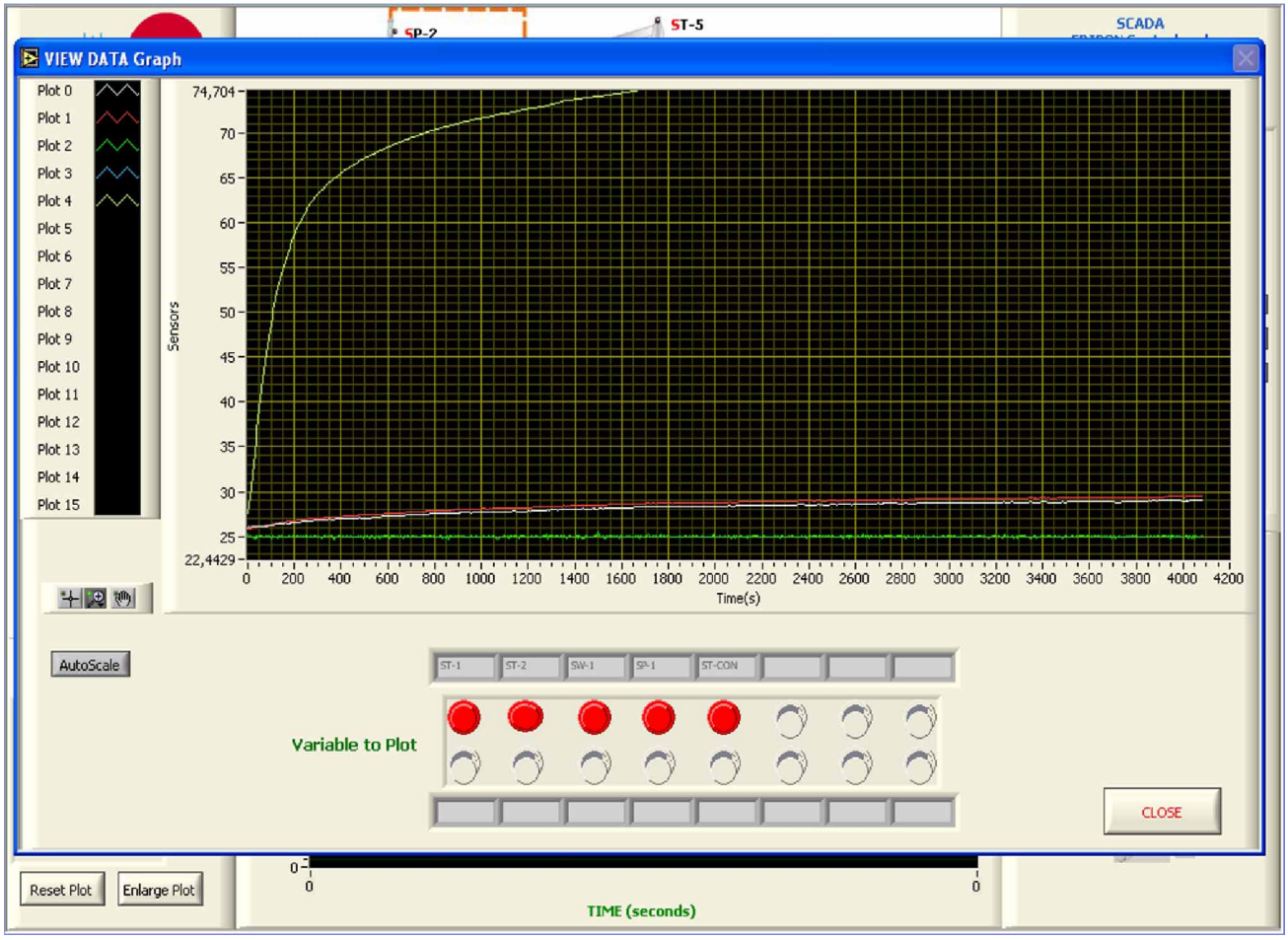
Some typical exercises results





EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Evaporation velocity calculation.
2.- Study of evaporation velocity in function of the working conditions.
3.- Study of the relation between the condensed product and the evaporated product.
4.- Study of the mass balance for the solute.
5.- Study of the mass balance for the water.
6.- Energy balance in the evaporation unit.
7.- Energy balance in the tubular refrigerator.
8.- Determination of the global heat transfer coefficient.
9.- Determination of the C_i coefficient for a tubular refrigerator.
10.- Investigation of effect of varying process parameters such as: vacuum, flow rate, temperature, recycle rate.
11.- Heat transfer measurements and calculation.
12.- Heating efficiency determination.
13.- Efficiency determination of the steam used in the process.
14.- Steam generator efficiency determination.

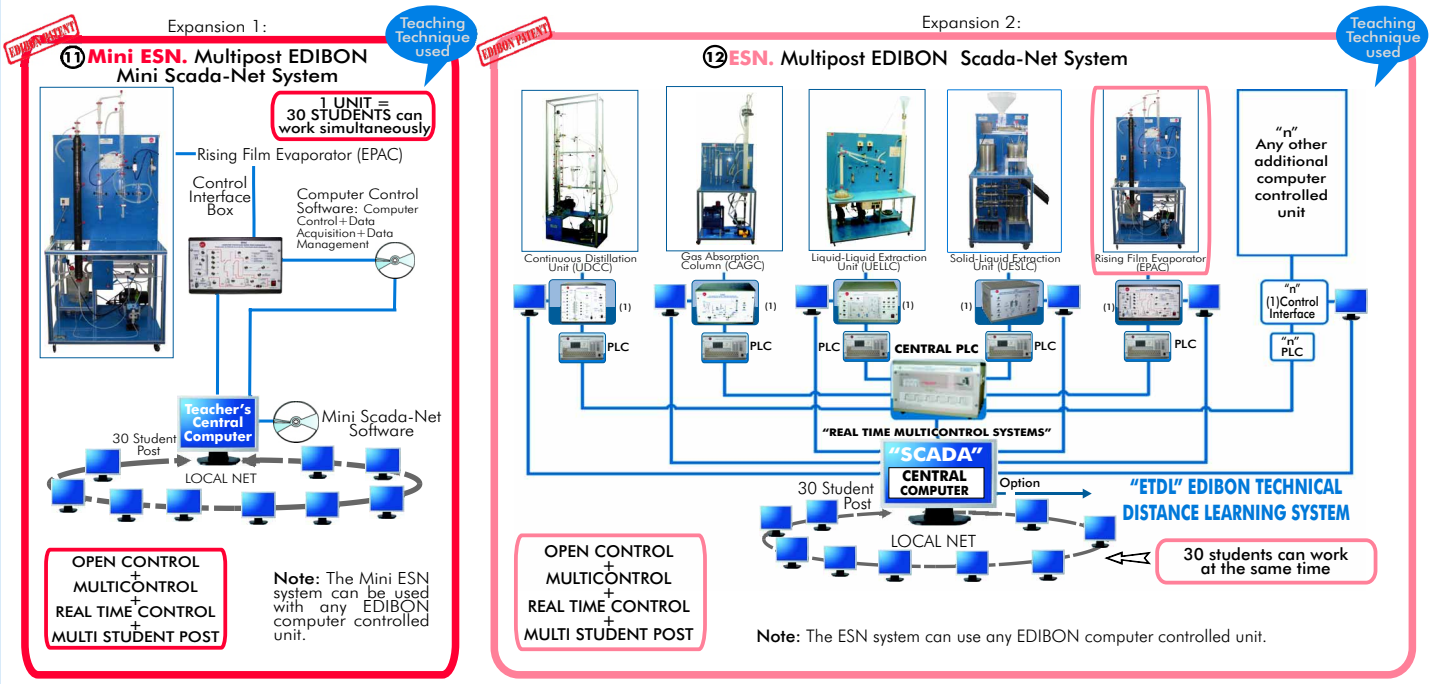
Other possible practices:

15.- Temperature sensors calibration.
16.- Force sensors calibration.
17.- Pressure sensors calibration.
18.- Feed pump calibration.

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

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

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

① **Unit: EPAC. Rising Film Evaporator.**
② **EPAC/CIB. Control Interface Box.**
③ **DAB. Data Acquisition Board.**
④ **EPAC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
⑤ **Cables and Accessories**, for normal operation.
⑥ **Manuals.**

* **IMPORTANT: Under EPAC 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 EPAC/PLC-SOF. PLC Control Software.
⑨ EPAC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
⑩ EPAC/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.
-Computer (PC).

DIMENSIONS & WEIGHTS

EPAC Unit:	-Dimensions: 1000 x 805 x 2300 mm. approx. -Weight: 115 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.

REQUIRED ACCESSORIES

-EDIBON Steam Generator (TGV), or similar steam generator.

-Stopwatch.

AVAILABLE VERSIONS

Offered in this catalogue:

- EPAC. **Computer Controlled Rising Film Evaporator.**

Offered in other catalogues:

- EPAB. **Rising Film Evaporator.**
- EDPAC. **Computer Controlled Double Effect Rising Film Evaporator.**
- EDPAB. **Double Effect Rising Film Evaporator.**

OPTIONAL ACCESSORY

EPDC. **Computer Controlled Falling Film Evaporator**
(for adding to EPAC)

Basically, it consists of the following elements:

- Falling film evaporation column with jacket for the steam and temperature takings.
- Cyclone to favor the separation of the most volatile component from the least volatile component.
- Vessel of 500 ml to collect the concentrated product, located under the cyclone.
- Liebig-Wet refrigerant to condense the distilled product (useful length of 400 mm).
- Vessel to collect the evaporated.

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

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