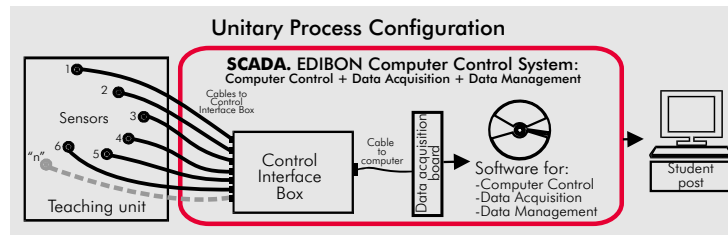
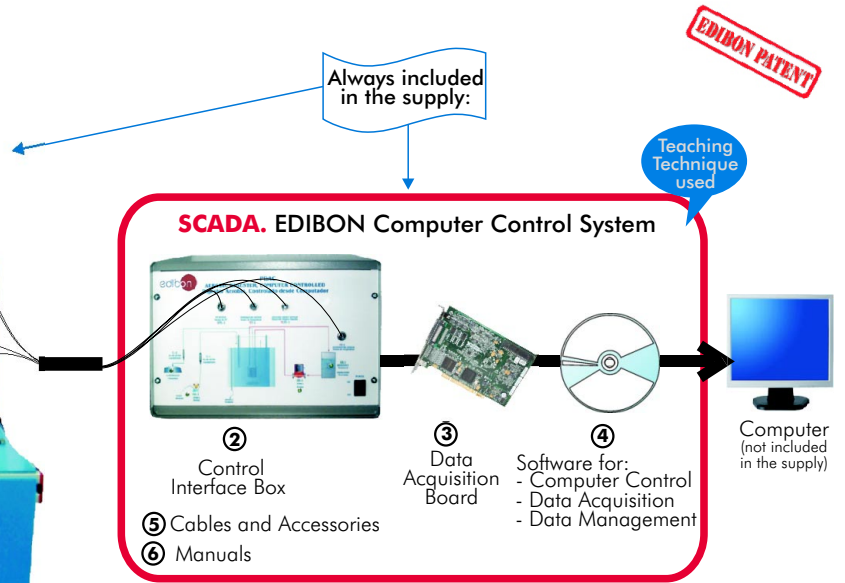




① Unit: PDAC. Aerobic Digester

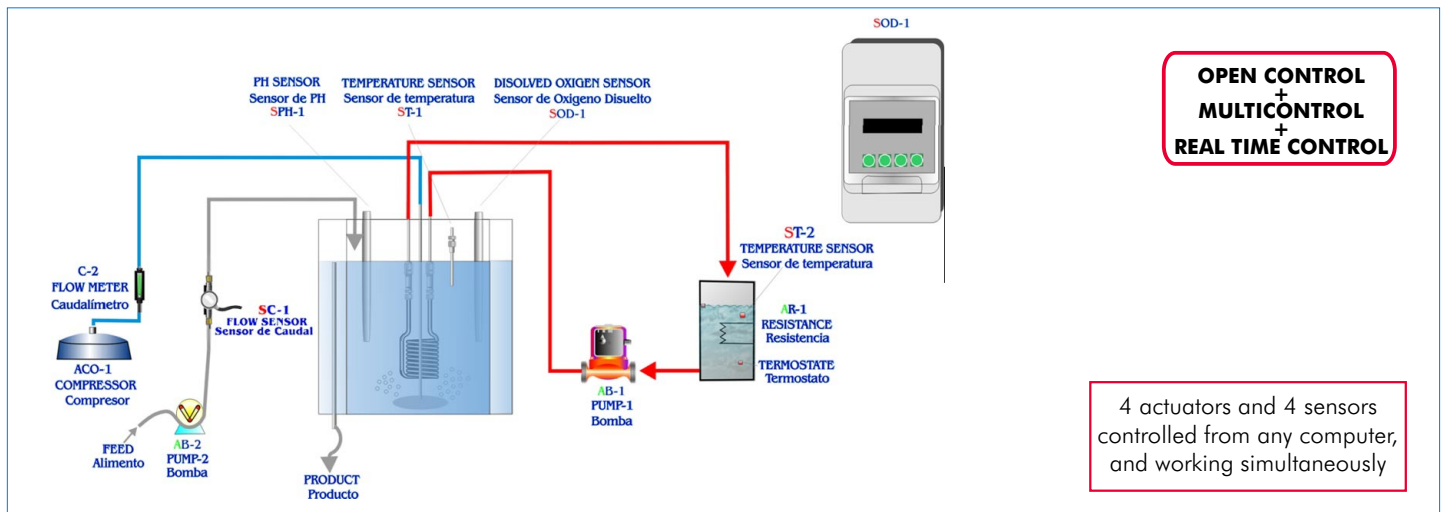


DESCRIPTION

The aim of this unit is to allow the study and the comprehension of the aerobic digestion processes. Such digestion is a biological process in which the parcial oxidation of primary mud, active muds or a mixing of different types of mud take place, through the constant aeration.

This computer controlled unit , the EDIBON Computer Control System (SCADA) is supplied, 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



Items supplied as standard

① PDAC. Unit:

- Bench-top unit.
- Anodized aluminium structure and panels in painted steel.
- Main metallic elements in stainless steel.
- Diagram in the front panel with similar distribution to the elements in the real unit.
- 20 litres reactor vessel with a tubular membrane inside.
- Lid for the reactor with a manual valve and the respective holes.
- Sensors:
 - 2 temperature sensors.
 - pH sensor.
 - Dissolved oxygen sensor.
- Thermostatic bath (until 60°C).
- Pump for water circulation of the thermostatic bath, computer controlled.
- Heating or cooling coil (temperature regulation coil), computer controlled.
- Peristaltic pump (4-50 cc/min), computer controlled.
- Water flow meter (4-50 cc/min).
- Air compressor (0.4-5 l./min), computer controlled.
- Diffusing sheet for the air inlet.
- Air flow meter (0.4-5 l./min).
- Membrane, muds separation.
- Overflow for the outlet of filtered water.
- Valve on the bottom for mud extraction.



PDAC Unit

② PDAC/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.



PDAC/CIB

③ DAB. Data Acquisition Board:

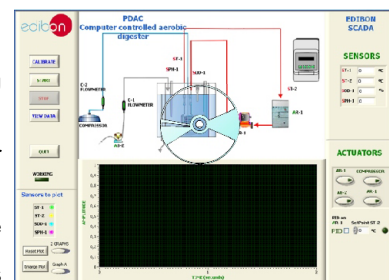
- PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
- Analog input: Channels= 16 single-ended or 8 differential. Resolution= 16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (Kilo samples per second). Input range (V)= ±10V. Data transfers=DMA, interrupts, programmed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



DAB

④ PDAC/CSOF. 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.



PDAC/CSOF

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

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 VA 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).

⑧ PDAC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.



PLC-PI

Items available on request

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

⑩ PDAC/FSS. Faults Simulation System.

Software Main Screens

Main screen

The main screen displays a schematic of a PDAC Computer controlled aerobic digester. The system includes a compressor (C-2 FLOWMETER), a digester tank (C-1 FLOWMETER), and a heating resistance (AR-1). Sensors include ST-1, SPH-1, and SOD-1. Actuators include AB-1 and AB-2. The interface features control buttons (CALIBRATE, START, STOP, VIEW DATA, QUIT), a 'WORKING' indicator, and a 'Sensors to plot' section with checkboxes for ST-1, ST-2, SOD-1, and SPH-1. A graph shows Amplitude vs. Time (seconds). The right panel shows 'EDIBON SCADA' with 'SENSORS' (ST-1, ST-2, SOD-1, SPH-1) and 'ACTUATORS' (AB-1 COMPRESSOR, AB-2, AR-1) with their respective control buttons. A PID control section is also present for AR-1.

Note: ST= Temperature sensor. SOD=Dissolved oxygen sensor. SPH=pH sensor. AB=Pump. AR=Heating resistance.

Examples of Sensors Calibration screens

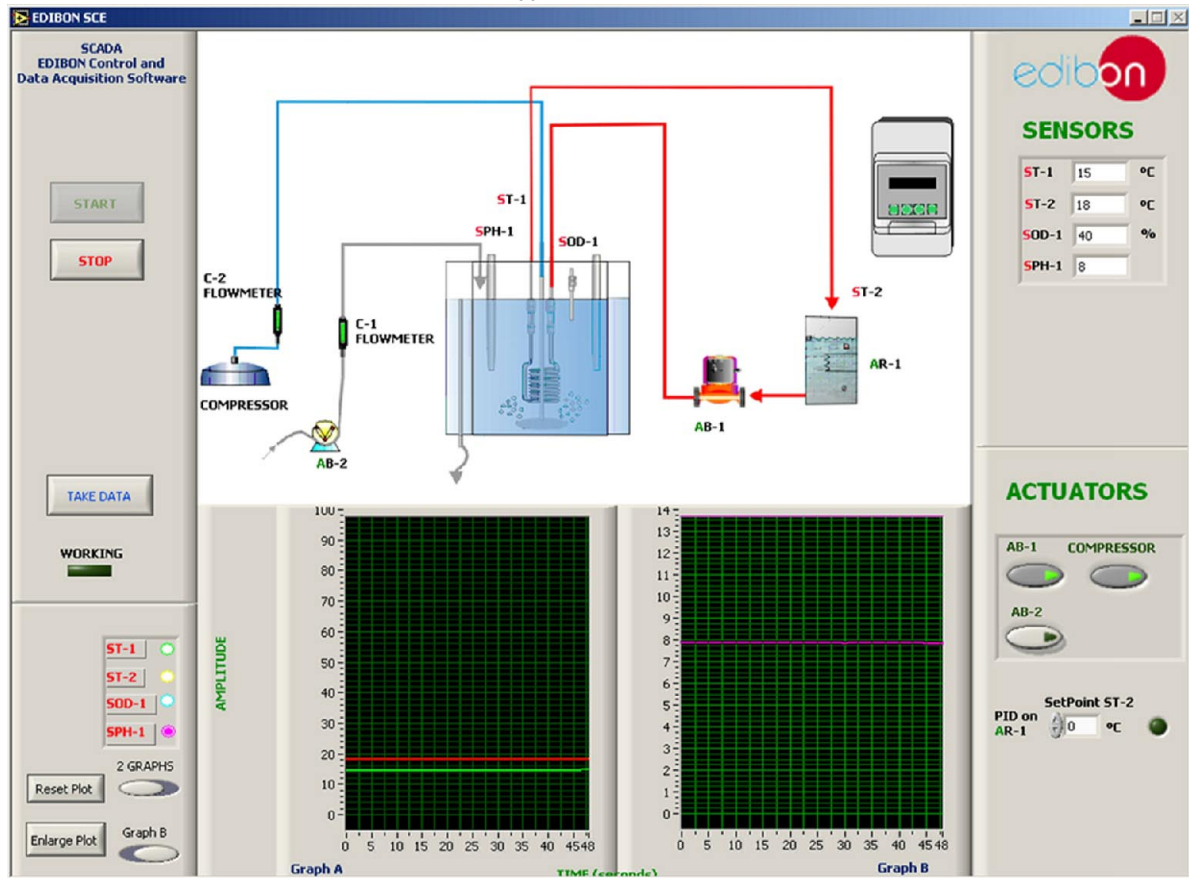
The calibration screens show the NIWriteCal.vi interface. The main window includes a 'Restore Factory Settings' button, 'Analog Input Channel' (ST-1), 'Sensor Name' (ST-1), and a 'Least Squares Fit' button. It displays 'Gain' (88.2321), 'Offset' (1.97998), 'PTA' (10), 'Volts' (0.1487), and 'Calibrated' (15.1) values. A 'Simultaneous Calibration' window shows a table of sensor data:

Reference Select	Sensors	Volts	Calibrated	ΔT
<input type="checkbox"/>	ST-1	0.2753	28.8346	28.83
<input checked="" type="checkbox"/>	ST-2	0.3335	29.7856	29.79
<input checked="" type="checkbox"/>	ST-3	0.331	29.0641	29.06
<input checked="" type="checkbox"/>	ST-4	0.3254	29.5453	29.55
<input checked="" type="checkbox"/>	ST-5	0.3295	29.4276	29.43
<input checked="" type="checkbox"/>	ST-6	0.3458	34.752	34.75
<input type="checkbox"/>		-0.0037	-0.0037	0
<input type="checkbox"/>		-0.004	-8.01926	8.02
<input type="checkbox"/>		3.4769	3.4769	3.48
<input type="checkbox"/>		3.215	291.888	291.89
<input type="checkbox"/>		3.066	3.066	3.07
<input type="checkbox"/>		2.6614	2.6614	2.66
<input type="checkbox"/>		2.4281	2.4281	2.43
<input type="checkbox"/>	SC-1	0.1291	0.1424	0.14
<input type="checkbox"/>	SC-2	0.0104	-0.0211	0.02
<input type="checkbox"/>	AN-1	5.9886	5.9886	5.99

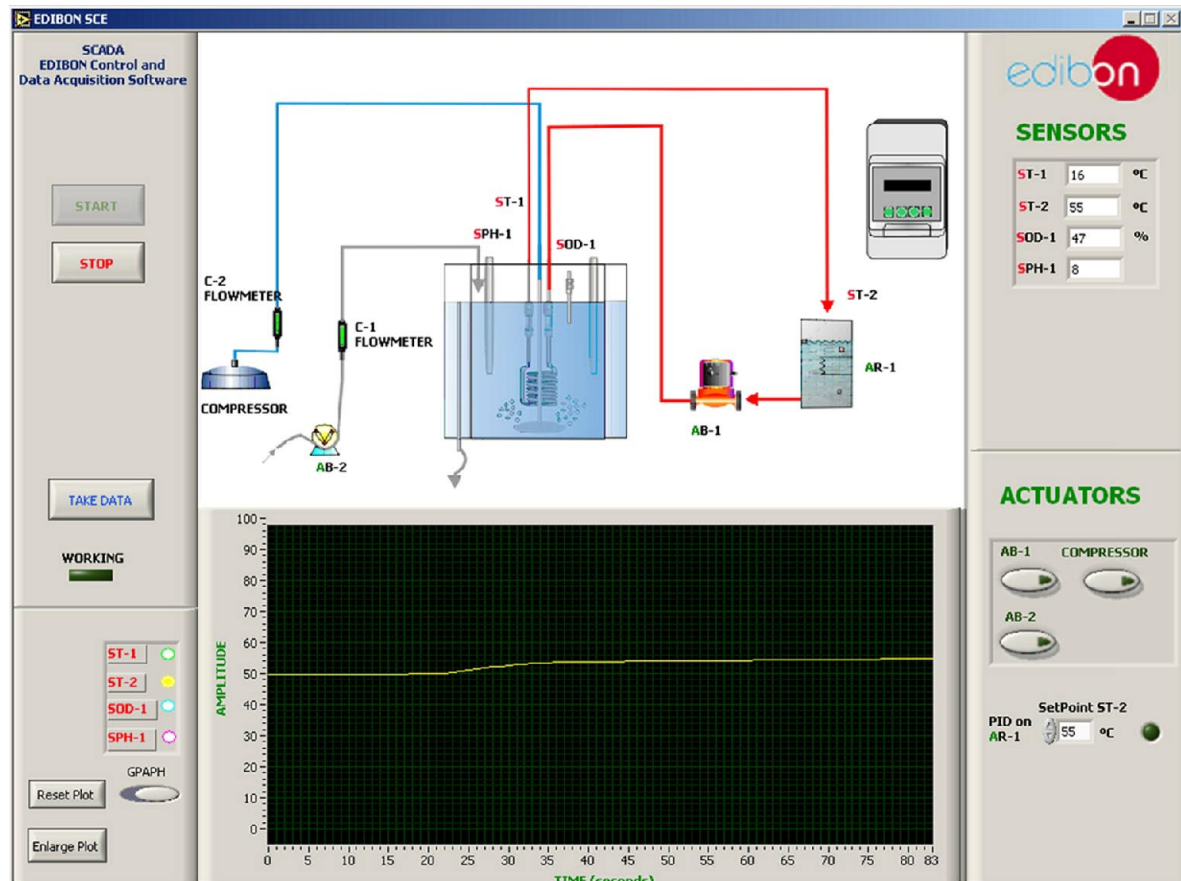
The 'Simultaneous Calibration' window also shows 'Data taken' (0) and a table for GAIN, OFFSET, and r values for each sensor.

Continue...

Some typical exercises results



In this screen we can see the system running. We see the values read by the sensors, some of which are plotted in the graphs (in this case, in graph A the temperature sensors (ST-1 and ST-2) are plotted; and in graph B we see the pH sensor (SPH-1)). Both compressor and pump (AB-1) are on, in order to make flow the water. Just when we click on "TAKE DATA" button, the measured values are saved in a file. These values can be plotted after running the program by selecting "VIEW RESULTS" button.



This screen shows how the temperature sensor (ST-2) is controlled through a PID control. This control consists on the activation/deactivation of the resistance (AR-1). In this case, we only can change the setpoint value, but not the constants of the PID process: it is a "hidden" PID. The maximum value we can introduce as a setpoint value is 55°C, by security reasons. As we see in the screen, when the temperature is near the setpoint value, the PID action is null, turning off the resistance (led turn off).

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

- 1.- Gas/liquid mass transfer.
- 2.- Measurement of MLSS and COD changes as criteria of performance.
- 3.- Residence time distributions.
- 4.- Acclimation of biological samples.
- 5.- Study of the temperature effect on the effluent quality.
- 6.- Study of the detention time effect on the effluent quality.
- 7.- Study of the aeration effect on the effluent quality.
- 8.- Study of the pH effect on the effluent quality.
- 9.- Study of the mass load effect on the effluent quality.
- 10.- Study of the nutrients effect on the effluent quality.
- 11.- Study of the recirculation effect on the effluent quality.
- 12.- Establishing the stoichiometry of aerobic processes.
- 13.- Establishing the kinetics of aerobic processes.

Other possible practices:

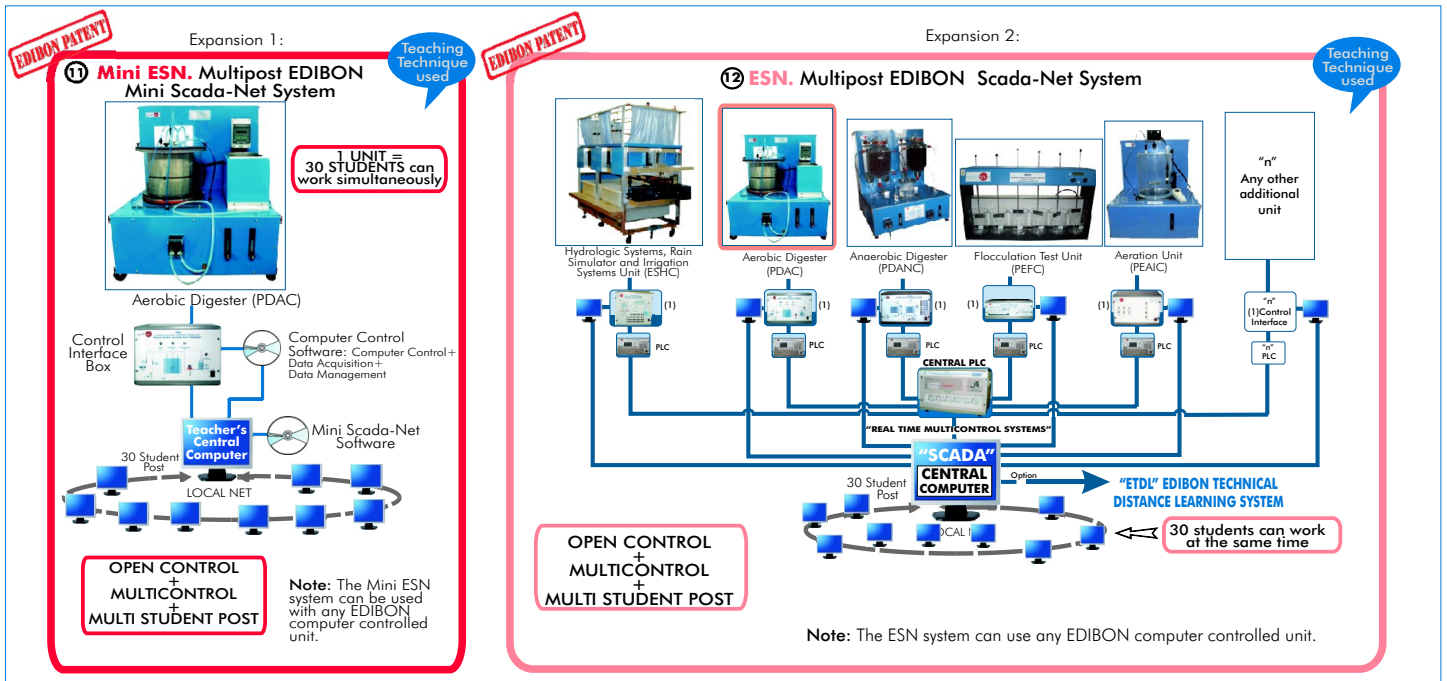
- 14.- Sensors calibration.

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

- 15.- Control of the PDAC unit process through the control interface box without the computer.
- 16.- Visualization of all the sensors values used in the PDAC unit process.
- 17.- Calibration of all sensors included in the PDAC unit process.
- 18.- Hand on of all the actuators involved in the PDAC unit process.
- 19.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

- 20.- 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).
- 21.- PLC hardware general use and manipulation.
- 22.- PLC process application for PDAC unit.
- 23.- PLC structure.
- 24.- PLC inputs and outputs configuration.
- 25.- PLC configuration possibilities.
- 26.- PLC program languages.
- 27.- PLC different programming standard languages (ladder structured, graphic, etc.).
- 28.- New configuration and development of new process.
- 29.- Hand on an established process.
- 30.- To visualize and see the results and to make comparisons with the PDAC unit process.
- 31.- Possibility of creating new process in relation with the PDAC unit.
- 32.- PLC Programming Exercises.
- 33.- 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: PDAC. Aerobic Digester.
- ② PDAC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ PDAC/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

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

DIMENSIONS & WEIGHTS

- | | |
|------------------------|---|
| PDAC Unit: | -Dimensions: 800 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. |

REQUIRED ACCESSORIES

- Feed and product tanks (approx. 40 litres). (Not included with the unit).

AVAILABLE VERSIONS

- | | |
|--|------------------------------------|
| - PDAC. Computer Controlled Aerobic Digester. | <u>Offered in this catalogue:</u> |
| - PDA. Aerobic Digester. | <u>Offered in other catalogue:</u> |

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



C/ Del Agua, 14. Polígono Industrial San José de Valderas.
28918 LEGANÉS. (Madrid). SPAIN.
Phone: 34-91-6199363 FAX: 34-91-6198647
E-mail: edibon@edibon.com WEB site: www.edibon.com

Issue: ED01/10
Date: March/2010

REPRESENTATIVE: