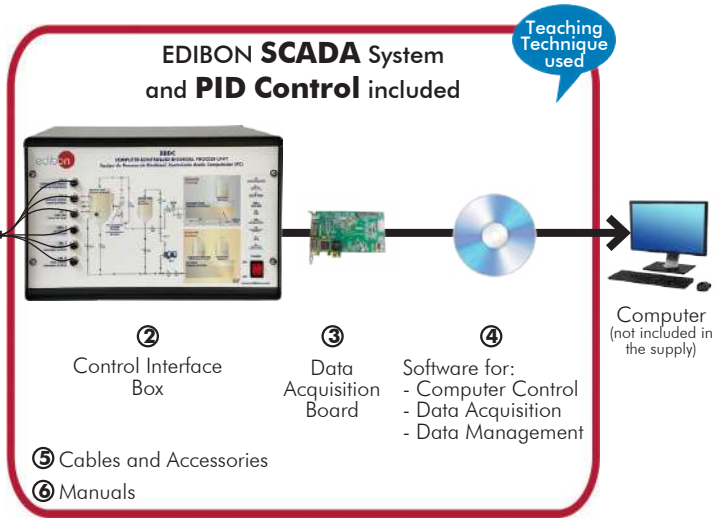
Engineering and Technical Teaching Equipment

Computer Controlled **Biodiesel Process Unit,** with SCADA and PID Control

EBDC

① Unit: EBDC. Computer Controlled Biodiesel Process Unit



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

Key features:

- **Advanced Real-Time SCADA and PID Control.**
- **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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**
- **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

POWERED BY NATIONAL INSTRUMENTS LabVIEW

www.edibon.com
PRODUCTS
5.- ENERGY

For more information about Key Features, click here

ISO 9001: **Quality Management** (for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate (total safety)

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

"Worlddidac Quality Charter" and Platinum Member of Worlddidac

INTRODUCTION

The Computer Controlled Biodiesel Process Unit, "EBDC", has been designed by EDIBON, is a unit that allows students to learn and manage the different stages of the biodiesel production cycle, as well as to study the different parameters that affect the whole process itself and the quality of the biodiesel obtained.

Biodiesel is a fuel of biological and renewable origin, obtained from used or unused vegetable oils or animal fats. It is intended for use in automotive engines as a substitute or additive to conventional diesel of fossil origin.

Its main advantages are energy and environmental. Among the former, biodiesel is a source of energy diversification and activation of the agricultural sector. On the other hand, one of the most significant objectives in the production of biodiesel is the production of high quality fuel from used vegetable oil, thus achieving the revaluation of a highly polluting waste. Currently, another trend is to achieve atmospheric carbon fixation by means of energy crops that are not usable in the food sector, so that biofuels obtained from these crops would have neutral CO_2 emissions.

However, despite these benefits and administrative support, biofuels still have a long way to go to strengthen their position in the market compared to petroleum derivatives, which have been perfectly integrated into the system for more than a century. The production process must be optimized, large volumes of by-products must be valorized, higher productivity crops must be grown without competition in the food sector, compliance with standard specifications must be monitored, information and promotion campaigns must be carried out, and the support of vehicle and component manufacturers must be obtained.

The Computer Controlled Biodiesel Process Unit, "EBDC", allows the production of biodiesel from vegetable oil by studying the main parameters that influence the performance of the process and the final quality of the product. Among these parameters are the operating temperature, the amount of catalyst used and the operating time.

GENERAL DESCRIPTION

The process carried out by the Computer Controlled Biodiesel Process Unit, "EBDC", consists of the transformation of the fatty acids from vegetable oils into a biofuel of high energetic power.

The process basically consists of two well-defined stages:

Stage I: Mixing and reaction under agitation. This first stage begins with the addition of vegetable oil to the main tank (reactor), and the preparation of the catalyst in a smaller secondary reactor. Next, reagent and catalyst are combined by subjecting the mixture to intense agitation and homogeneous heating, this is achieved by recirculating the medium through a centrifugal pump and providing heat by means of an electrical resistance, both actuators are computer controlled. This stage is carried out in a stainless steel reactor with temperature sensor and level switches that allow a controlled and safe operation.

EBDC detail

Stage II: Separation and washing of the obtained products. A second fundamental stage after the reaction is the separation of the main product from the rest of the by-products found in the medium. This is done by means of a first biphasic decantation. Decanting is a suitable operation when the compounds to be separated are not miscible with each other, which is the case between biodiesel and glycerin. Glycerin has a higher density than the fuel, so it is easily removed through the conical bottom of the reactor. On the other hand, the biodiesel undergoes a washing stage in which it is recirculated through a small ion exchange column that allows the elimination of impurities and water that may remain after the reaction. Finally, the fuel is passed through a diesel filter before final storage.

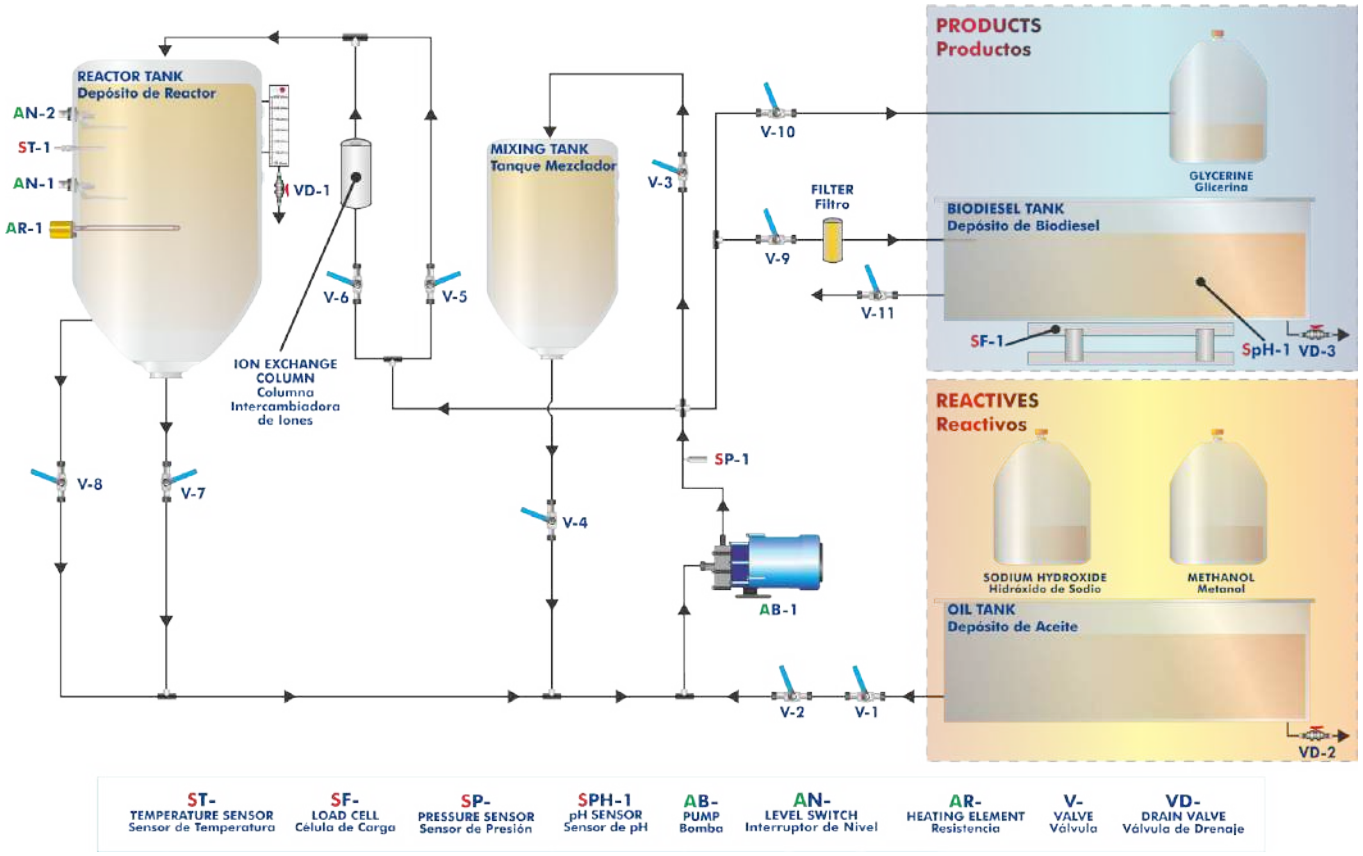
Additionally, the performance of the unit and the quality of the biodiesel can be evaluated thanks to a load cell installed in the product tank and a titration kit (pipette, drippers, etc.).

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.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

4 actuators and 4 sensors controlled from any computer, and working simultaneously

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL



ST-	SF-	SP-	SPH-1	AB-	AN-	AR-	V-	VD-
TEMPERATURE SENSOR Sensor de Temperatura	LOAD CELL Célula de Carga	PRESSURE SENSOR Sensor de Presión	pH SENSOR Sensor de pH	PUMP Bomba	LEVEL SWITCH Interruptor de Nivel	HEATING ELEMENT Resistencia	VALVE Válvula	DRAIN VALVE Válvula de Drenaje

With this unit there are several options and possibilities:

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

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

① EBDC. Unit:

Stainless steel frame and painted steel panels.
The unit includes wheels for easy mobility.
Main metallic elements made of stainless steel.
Diagram on the front panel with similar distribution to that of the elements in the real unit.
Circulation hose in specific polymer for fuels.
Cellulose filter with ten micron pore size.
Purification compartment with ion exchange resin.
Computer controlled single-phase pump specific for diesel fuels:
- Stainless steel interior.
- Seals in polymer resistant to chemicals and fuels.
- Max. flow rate: 80 l/min.
- Max. discharge height: 25 m.

Unit: EBDC

Reactor tank:
- Truncated cone-shaped vessel made of AISI 304 stainless steel.
- Lower outlet for decanting.
- Intermediate outlet to obtain biodiesel without previous decantation.
- Capacity: 120 l.
- Incorporates:
  - 3 kW electric heating resistance, computer controlled.
  - Two level switches made of stainless steel.
  - "J" type temperature sensor.
  - Level sight glass made of stainless steel and glass, incorporates sampling valve.

Mixing tank:
- Truncated cone-shaped vessel made of AISI 304 stainless steel.
- Lower outlet for decanting.
- Capacity: 40 l.

Oil tank:
- Fuel resistant high density polyethylene container.
- Capacity: 250 l.
- Incorporates:
  - Lid to prevent the deposition of dust and other impurities.
  - Removable mesh filter for solid particles.
  - Manual shut-off valve.
  - Drain valve.
  - Graduated volumetric scale up to 250 l.

Methylate tank:
- Chemical resistant high density polyethylene container.
- Capacity: 25 l.
- Incorporates:
  - Lower tap for sampling.
  - Graduated volumetric scale up to 25 l.

Glycerin tank:
- Container made of high density polyethylene resistant to fuels.
- Capacity: 60 l.
- Incorporates:
  - Lower tap for sampling.
  - Graduated volumetric scale up to 60 l.

Biodiesel tank:
- Container made of high density polyethylene resistant to fuels.
- Capacity: 250 l.
- Incorporates:
  - Lid to prevent the deposition of dust and other impurities.
  - Removable mesh filter for solid particles.
  - Manual shut-off valve.
  - Drain valve.
  - Graduated volumetric scale up to 250 l.

Instrumentation:

Load cell for measuring the mass of glycerin and biodiesel obtained; range: 0 - 300 kg.
pH sensor for the study of the quality of the biodiesel obtained; range: 0 - 14 pH.
Pressure sensor; range: 0 - 6 bar.

Titration kit:

Bottle suitable for methanol.
Titrant bottle.
Four 7 ml droppers.
Three 250 ml glass beakers.
Pipette with hand pump 10 ml.
Plastic wash bottle 500 ml.

The complete unit includes as well:

Advanced Real-Time SCADA and PID Control.

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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.

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 EBDC/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.

EBDC/CIB

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 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, heating elements, 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 moment and in 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, 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. 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/0. 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/0.

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.

The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.

DAB

④ EBDC/CCSOF. PID 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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

Management, processing, comparison and storage of data.

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

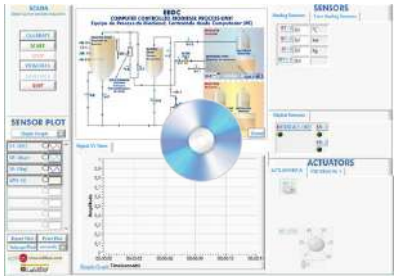
Calibration system for the sensors involved in the process.

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.



EBDC/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: EBDC + EBDC/CIB + DAB + EBDC/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 THE MAIN ITEMS

1.- Study and performance of tests to determine the appropriate amount of catalyst to be used in the biodiesel generation process (titration).

2.- Familiarization with the operation of a biodiesel production unit during the products reaction, extraction and washing process.

3.- Study of the agitation and mixing level influence on the final quality of the obtained biodiesel.

4.- Study of the washing and purifying stage influence on the final quality of the obtained biodiesel.

5.- Study of the influence of temperature during the vegetable oils preheating and reaction stage on the final quality of the obtained biodiesel.

6.- Analysis and tests to determine the biodiesel quality.

Additional practical possibilities:

7.- Study of vegetable oils transesterification with an alcohol to produce biodiesel.

8.- Sensors calibration.

Other possibilities to be done with this unit:

9.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

10.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

11.- The Computer Control System with SCADA and PID Control allow a real industrial simulation.

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

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

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

15.- Control of the EBDC unit process through the control interface box without the computer.

16.- Visualization of all the sensors values used in the EBDC unit process.

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

REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.
- Computer.

RECOMMENDED CONSUMABLES (Not included)

- For the production of 60 l of high quality biodiesel (every 24 hours):
  - 60 l of raw or used oil.
  - 10 l of methanol.
  - Catalyst (liquid methylate NaOH or KOH are recommended).
  - Titration indicator.

DIMENSIONS AND WEIGHTS

EBDC:

Unit:

- Dimensions: 2500 x 2500 x 1600 mm approx.
  (98,42 x 98,42 x 62,99 inches approx.)
- Weight: 200 Kg approx.
  (440 pounds approx.)

Control Interface Box:

- Dimensions: 490 x 330 x 310 mm approx.
  (19.29 x 13 x 12.20 inches approx.)
- Weight: 10 Kg approx.
  (22 pounds approx.)

SIMILAR UNITS AVAILABLE

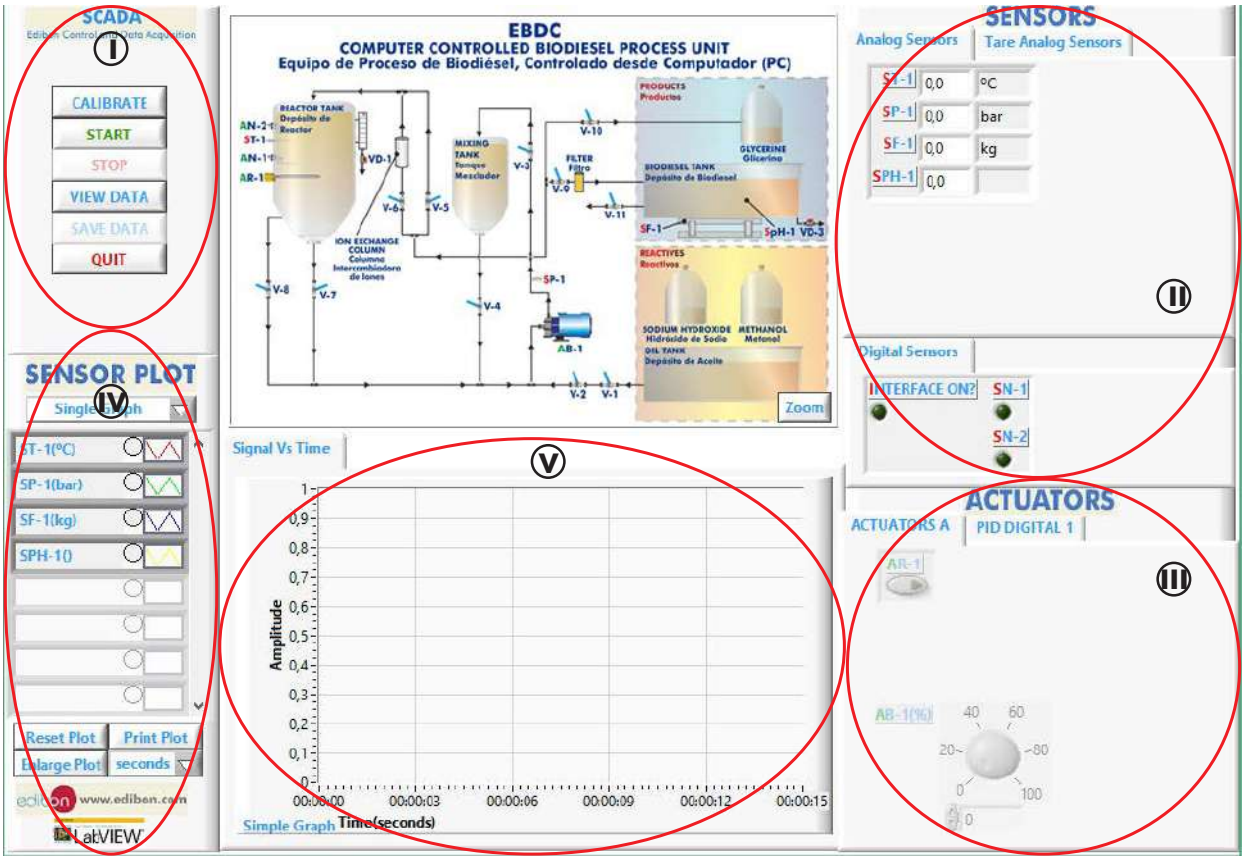
Offered in this catalogue:

- EBDC. Computer Controlled Biodiesel Process Unit.

Offered in other catalogue:

- EBDB. Biodiesel Process Unit.

SCADA and PID Control
Main screen



Ⓘ Main software operation possibilities.

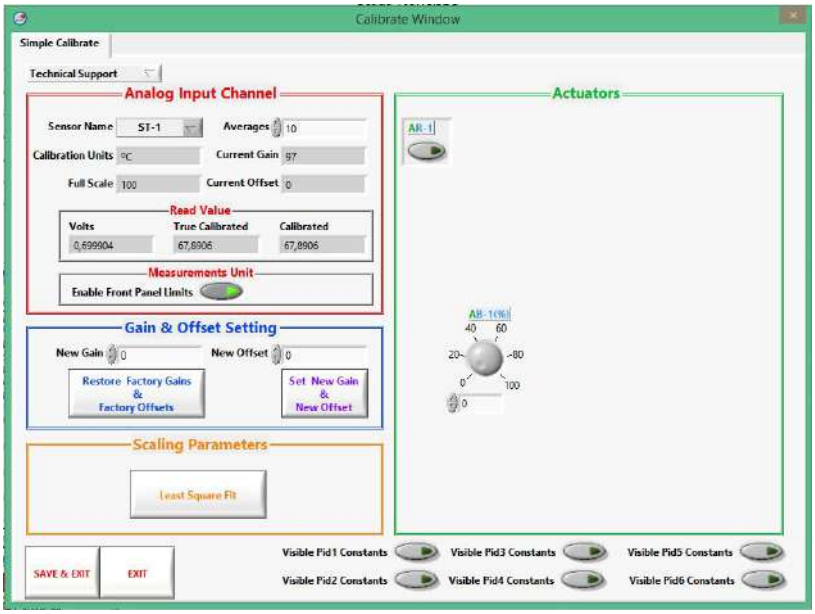
Ⓘ **Sensors displays, real time values, and extra output parameters. Sensors:** ST=Temperature sensor. SP=Pressure sensor. SF= Load cell. SpH=pH sensor.

Ⓘ **Actuators controls. Actuators:** AR=Heating resistance. AB=Pump. AN=Level switch.

Ⓘ Channel selection and other plot parameters.

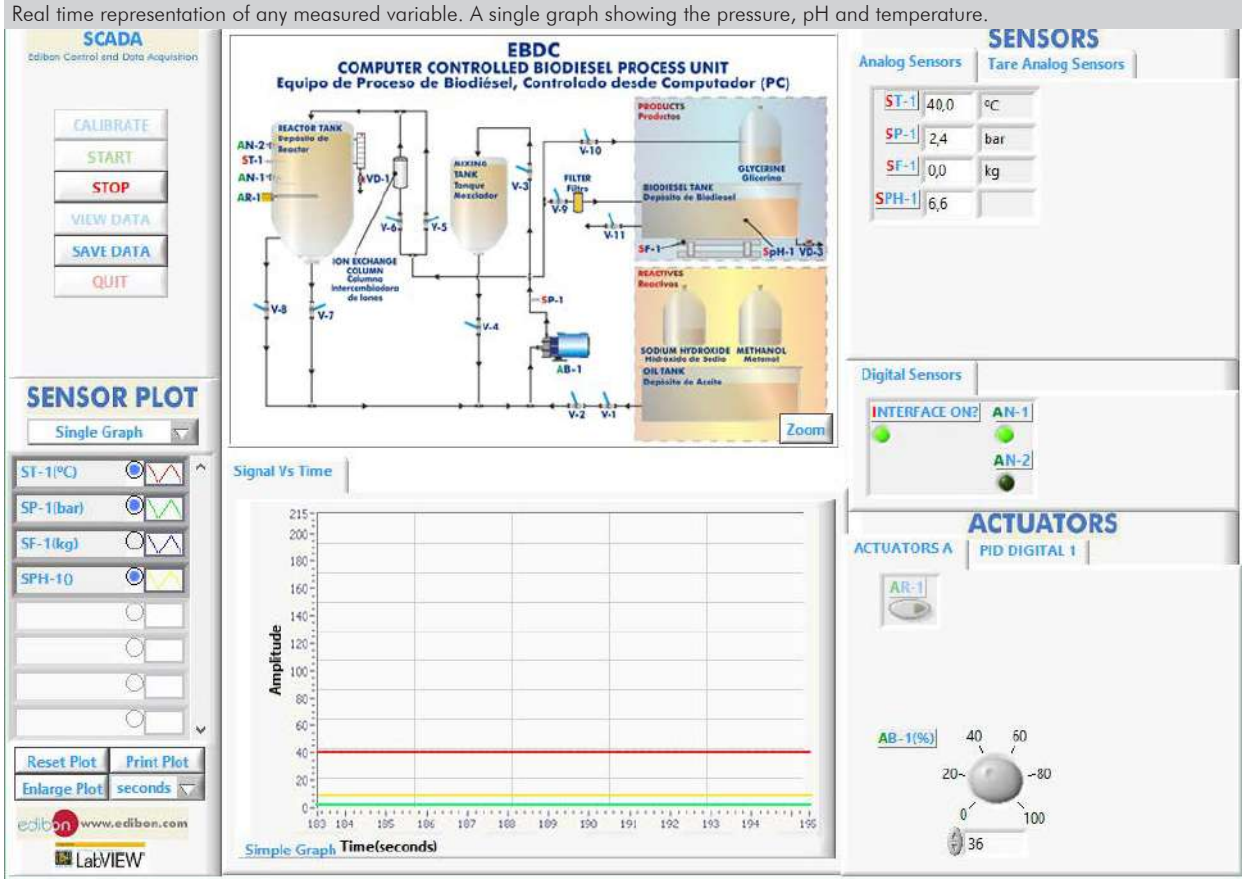
Ⓘ Real time graphics displays.

Software for Sensors Calibration
Example of screen

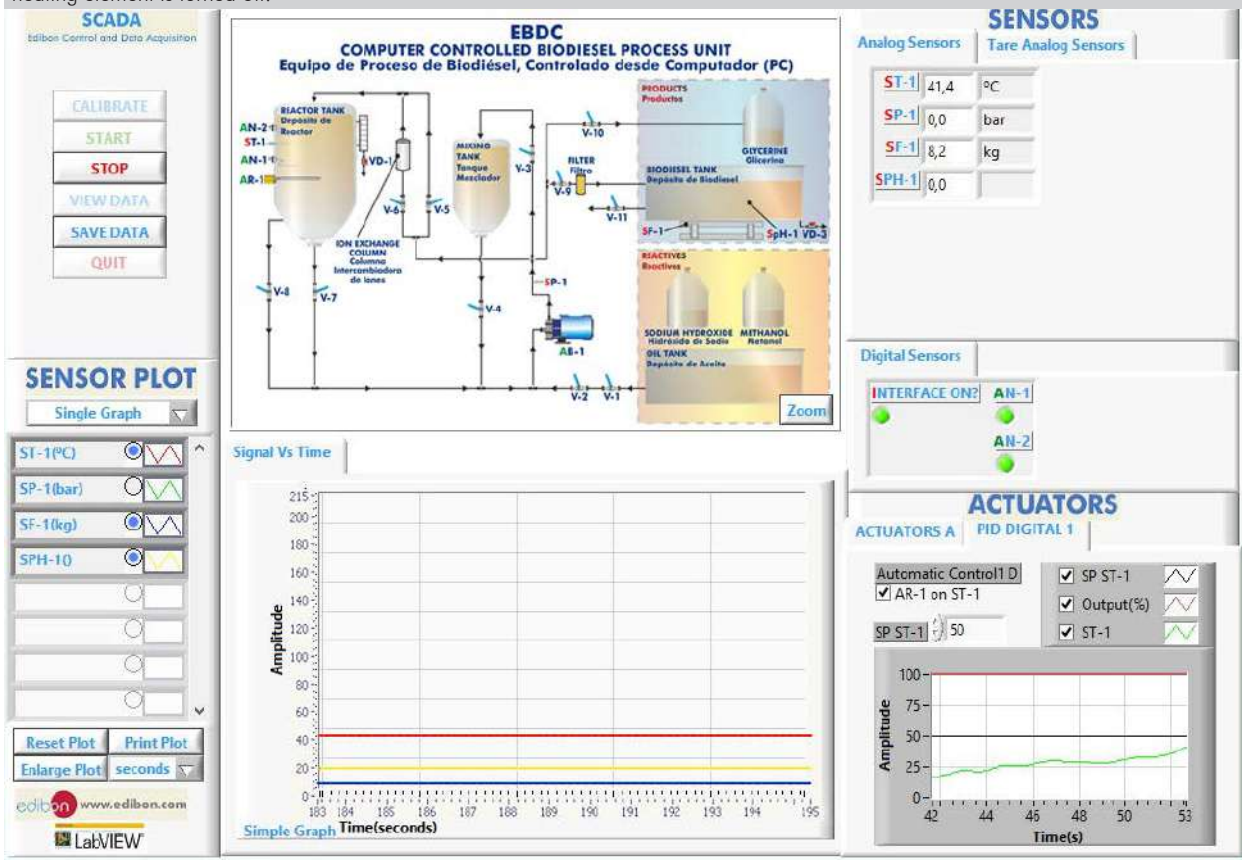


The teacher and the students can calibrate the unit with a password provided by EDIBON.
The teacher can restore the factory calibration any time.

Real time representation of any measured variable. A single graph showing the pressure, pH and temperature.

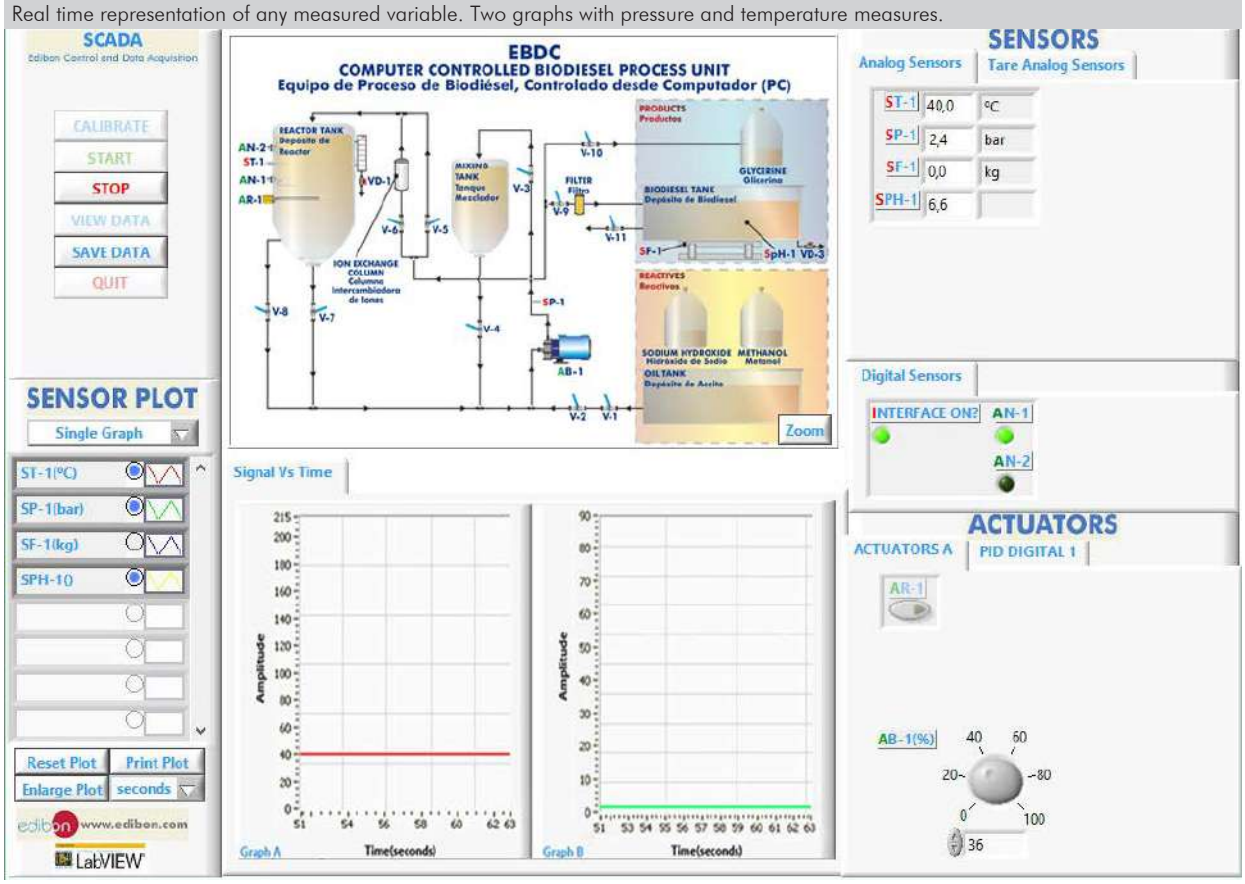


Heating temperature control is done through a PID control. When the target temperature is reached at the temperature sensor (ST-1), the heating element is turned off.

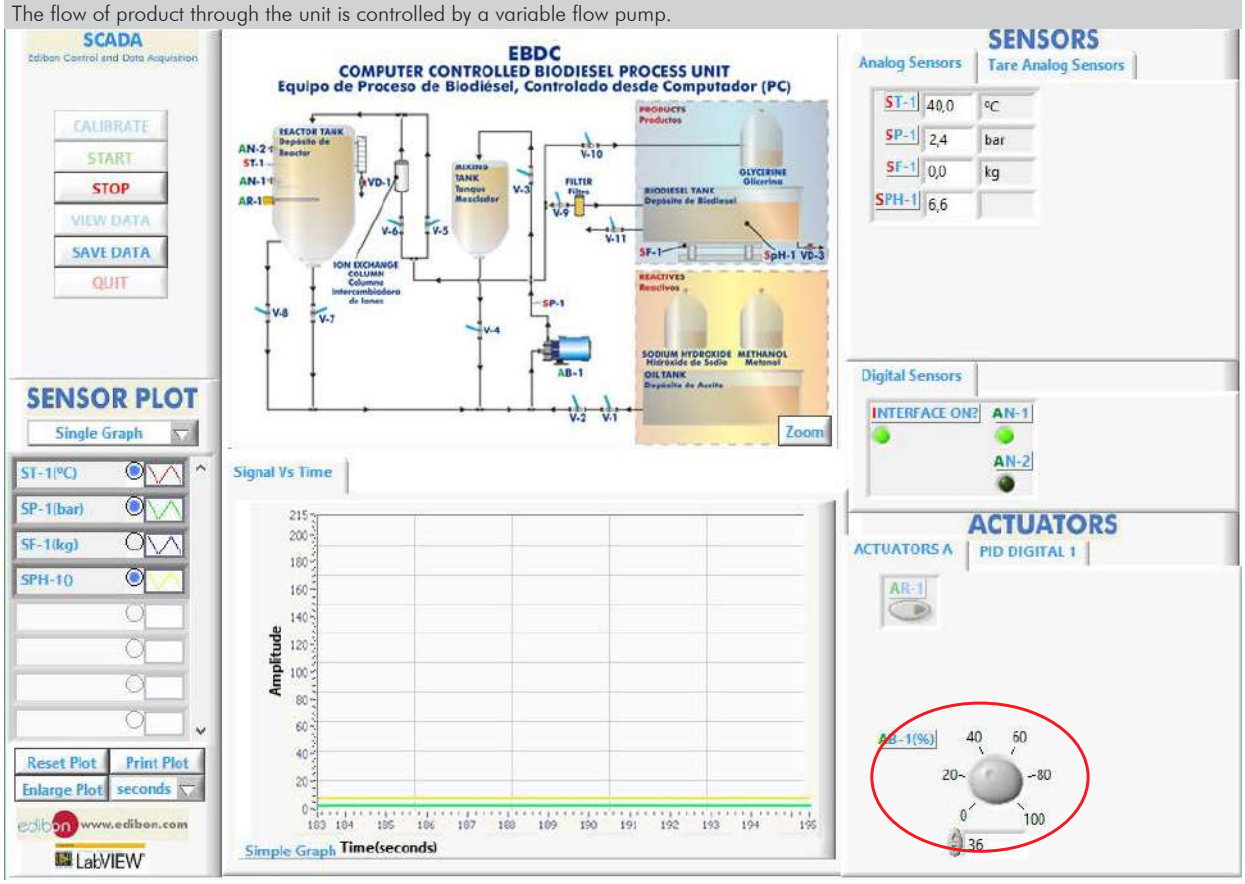


Some **real** results obtained from this Unit

Real time representation of any measured variable. Two graphs with pressure and temperature measures.



The flow of product through the unit is controlled by a variable flow pump.



Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 9.
All these items try to give more possibilities for:

a) Technical and Vocational Education configuration. (ICAI)
b) Multipost Expansions options. (MINI ESN and ESN)

a) Technical and Vocational Education configuration

⑦ EBDC/ICAI. Interactive Computer Aided Instruction Software.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

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

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- **User Data Base Management.**
- **Administration and assignment of Workgroup, Task and Training sessions.**
- **Creation and Integration of Practical Exercises and Multimedia Resources.**
- **Custom Design of Evaluation Methods.**
- **Creation and assignment of Formulas & Equations.**
- **Equation System Solver Engine.**
- **Updatable Contents.**
- **Report generation, User Progression Monitoring and Statistics.**

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

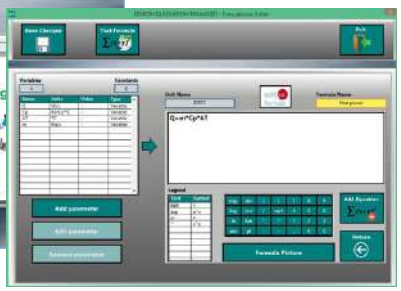
- **Student Log-In & Self-Registration.**
- **Existing Tasks checking & Monitoring.**
- **Default contents & scheduled tasks available to be used from the first session.**
- **Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- **Evaluation Methods to prove your knowledge and progression.**
- **Test self-correction.**
- **Calculations computing and plotting.**
- **Equation System Solver Engine.**
- **User Monitoring Learning & Printable Reports.**
- **Multimedia-Supported auxiliary resources.**

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

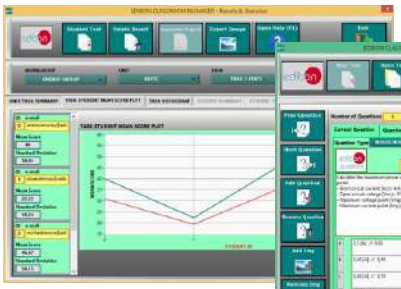
www.edibon.com/en/interactive-computer-aided-instruction-software

Instructor Software

ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen



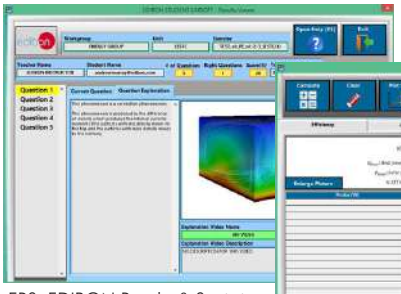
ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

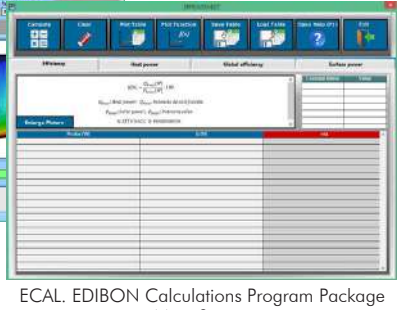
Student Software

ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

b) Multipost Expansions options

⑧ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

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 of the adaptation of any EDIBON Computer Controlled Unit with SCADA and PID Control integrated in a local network.

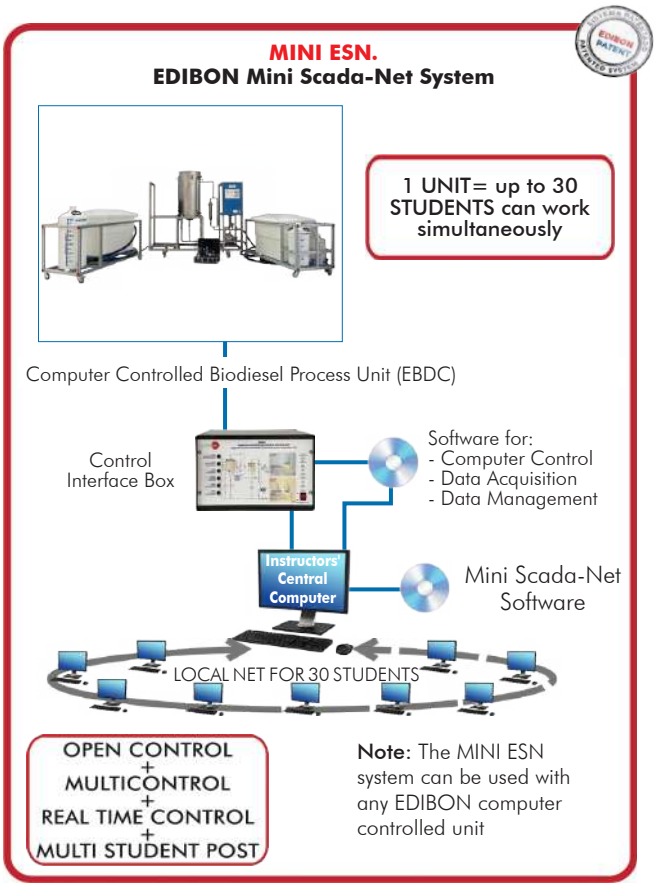
This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

Main characteristics:

- **It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA and PID Control, 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/en/edibon-scada-net

⑨ ESN. EDIBON Scada-Net Systems.

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

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

www.edibon.com/en/edibon-scada-net

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: EBDC. Computer Controlled Biodiesel Process Unit.**

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

③ **DAB. Data Acquisition Board.**

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

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

⑥ **Manuals.**

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

Optional items (supplied under specific order)

a) Technical and Vocational Education configuration

⑦ EBDC/ICAI. Interactive Computer Aided Instruction Software.

b) Multipost Expansions options

⑧ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

⑨ ESN. EDIBON Scada-Net Systems.

①EBDC. Unit:

Stainless steel frame and painted steel panels.
The unit includes wheels for easy mobility.
Main metallic elements made of stainless steel.
Diagram on the front panel with similar distribution to that of the elements in the real unit.
Circulation hose in specific polymer for fuels.
Cellulose filter with ten micron pore size.
Purification compartment with ion exchange resin.
Computer controlled single-phase pump specific for diesel fuels:
- Stainless steel interior.
- Seals in polymer resistant to chemicals and fuels.
- Max. flow rate: 80 l/min.
- Max. discharge height: 25 m.

Reactor tank:
- Truncated cone-shaped vessel made of AISI 304 stainless steel.
- Lower outlet for decanting.
- Intermediate outlet to obtain biodiesel without previous decantation.
- Capacity: 120 l.
- Incorporates:
  - 3 kW electric heating resistance, computer controlled.
  - Two level switches made of stainless steel.
  - "J" type temperature sensor.
  - Level sight glass made of stainless steel and glass, incorporates sampling valve.

Mixing tank:
- Truncated cone-shaped vessel made of AISI 304 stainless steel.
- Lower outlet for decanting.
- Capacity: 40 l.

Oil tank:
- Fuel resistant high density polyethylene container.
- Capacity: 250 l.
- Incorporates:
  - Lid to prevent the deposition of dust and other impurities.
  - Removable mesh filter for solid particles.
  - Manual shut-off valve.
  - Drain valve.
  - Graduated volumetric scale up to 250 l.

Methylate tank:
- Chemical resistant high density polyethylene container.
- Capacity: 25 l.
- Incorporates:
  - Lower tap for sampling.
  - Graduated volumetric scale up to 25 l.

Glycerin tank:
- Container made of high density polyethylene resistant to fuels.
- Capacity: 60 l.
- Incorporates:
  - Lower tap for sampling.
  - Graduated volumetric scale up to 60 l.

Biodiesel tank:
- Container made of high density polyethylene resistant to fuels.
- Capacity: 250 l.
- Incorporates:
  - Lid to prevent the deposition of dust and other impurities.
  - Removable mesh filter for solid particles.
  - Manual shut-off valve.
  - Drain valve.
  - Graduated volumetric scale up to 250 l.

Instrumentation:
- Load cell for measuring the mass of glycerin and biodiesel obtained; range: 0 - 300 kg.
- pH sensor for the study of the quality of the biodiesel obtained; range: 0 - 14 pH.
- Pressure sensor; range: 0 - 6 bar.

Titration kit:
- Bottle suitable for methanol.
- Titrant bottle.
- Four 7 ml droppers.
- Three 250 ml glass beakers.
- Pipette with hand pump 10 ml.
- Plastic wash bottle 500 ml.

The complete unit includes as well:
- Advanced Real-Time SCADA and PID Control.
- 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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.
- 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.

②EBDC/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 PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process.
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 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.

③DAB. 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.
The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.

④EBDC/CCSOF. PID 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.
Analog and digital PID control. PID menu and set point selection required in the whole work range.
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.

⑤Cables and Accessories, for normal operation.

⑥Manuals:
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 the Main Items

1.- Study and performance of tests to determine the appropriate amount of catalyst to be used in the biodiesel generation process (titration).
2.- Familiarization with the operation of a biodiesel production unit during the products reaction, extraction and washing process.
3.- Study of the agitation and mixing level influence on the final quality of the obtained biodiesel.
4.- Study of the washing and purifying stage influence on the final quality of the obtained biodiesel.
5.- Study of the influence of temperature during the vegetable oils preheating and reaction stage on the final quality of the obtained biodiesel.
6.- Analysis and tests to determine the biodiesel quality.

Additional practical possibilities:

7.- Study of vegetable oils transesterification with an alcohol to produce biodiesel.
8.- Sensors calibration.

Other possibilities to be done with this unit:

9.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
10.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.
11.- The Computer Control System with SCADA and PID Control allow a real industrial simulation.
12.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
13.- This unit can be used for doing applied research.
14.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
15.- Control of the EBDC unit process through the control interface box without the computer.
16.- Visualization of all the sensors values used in the EBDC unit process.
- Several other exercises can be done and designed by the user.

a) Technical and Vocational Education configuration

⑦ EBDC/ICAI. Interactive Computer Aided Instruction Software.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
- Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- Test self-correction.
- Calculations computing and plotting.
- Equation System Solver Engine.
- User Monitoring Learning & Printable Reports.
- Multimedia-Supported auxiliary resources.

b) Multipost Expansions options

⑧ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

MINI ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA and PID Control 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 and PID Control, 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 improvement of the product.

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