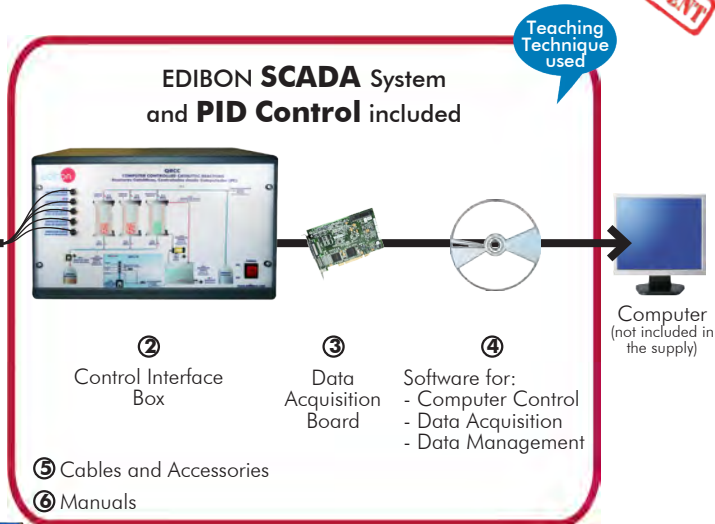


EDIBON PATENT



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

Optional accessory:
QRCC-IF. Flow Injection Analysis (FIA) Unit

① Unit: QRCC. Computer Controlled Catalytic Reactors

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 CAL software helps the user perform calculations and comprehend the results.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

www.edibon.com

Products
Products range
Units
11.- Chemical Engineering

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)



Certificate and Worlddidac Member

INTRODUCTION

In a chemical reaction, the process of catalysis is the increase or decrease in the speed of the chemical reaction (reaction kinetics) caused by what we call a catalyst.

Nowadays, research and development of catalysts are extremely important in the chemical industry. It is thought that approximately 90% of industry-made chemical products involve some catalytic process in their processing.

One of the main characteristics of catalysts is that they are not consumed by the chemical reaction, although they may suffer some deterioration. This deterioration is due to the loss of their catalytic features. Besides, the student must understand the immobilization of catalysts in the reactors, a fact that prevents them from being dragged by the final product.

GENERAL DESCRIPTION

The Computer Controlled Catalytic Reactors "QRCC" is an unit designed to perform the saccharose hydrolysis reaction in a continuous way by using catalytic fixed-bed reactors.

Saccharose hydrolysis is the industrial process to obtain glucose and fructose from saccharose. It is a reversible chemical reaction.

The QRCC unit is composed of three fixed-bed reactors. Two of them are fixed-bed reactors for chemical catalysis with the same chemical catalyst, called ionic exchange resin but with different grain size. The third reactor is a fixed-bed reactor for biological (enzymic) catalysis with an immobilized enzyme. To start the hydrolysis process our product (saccharose) has to pass through this enzyme.

Saccharose hydrolysis is favoured with temperatures around 50°C - 60°C. For that end, the reactors have a jacket through which hot water will flow. The water temperature is controlled with the PID control through the control software.

Feeding saccharose to our reactors is done through a peristaltic pump which allows the regulation of speed through the control software.

The resulting solution is pumped to the final-product flask. From this point on it will be analysed with a spectrophotometer that is adapted to QRCC unit interface.

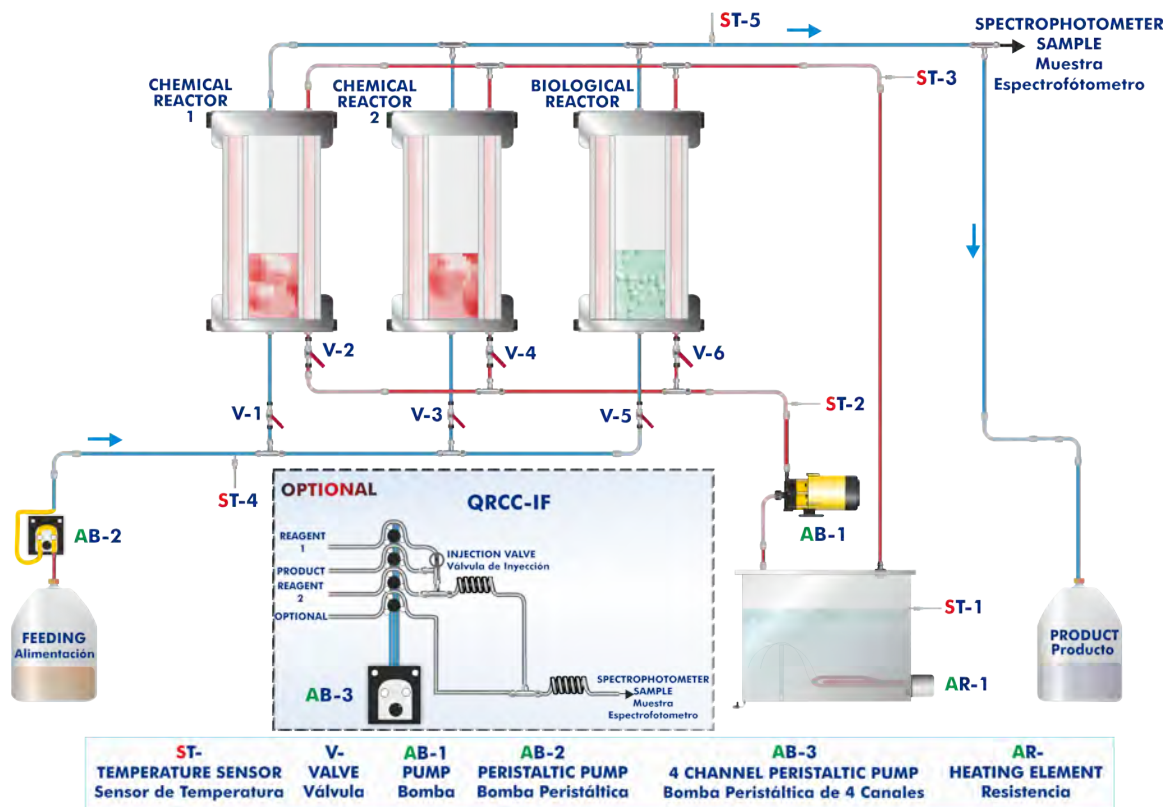
As an optional supply, there is the possibility of acquiring the QRCC-IF. Flow Injection Analysis (FIA) Unit. This unit is a Flow Injection Analysis system, which is used to measure the conversion degree of the reaction of the saccharose hydrolysis in a continuous way.

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

3 actuators and 5 sensors controlled from any computer and working simultaneously

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



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 QRCC. Unit:

Bench-top unit.

Anodized aluminum structure and panels in painted steel.

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

2 Glass flasks of 2 litres of capacity, for the initial solution and the final product.

Reactors:

Two fixed-bed reactors for chemical catalysis, composed by acid ion exchange resins.

A fixed-bed reactor for biological (enzymic) catalysis. (Recommended use with an immobilized enzyme).

Reactors diameter: 50 mm. Reactors height: 160 mm.

Material: glass, with a methacrylate cover for protection.

Thermostatic bath, with heating resistance of 600W, controlled by a PID from the computer.

A heated water supply to the reactors jackets allows the automatic control of reaction temperature to a set point value.

Peristaltic pump, with speed regulation, computer controlled, that allows to regulate the feed flow from 0 to 32 ml/min.

5 Temperature sensors, "J" type, placed at key points of the system.

Spectrophotometer, computer controlled, for the final product analysis and absorbance measures:

Wavelength range: 325-1000 nm. Band width: 5 nm.

All electrical circuits are protected by adequate protection devices.

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

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



Unit: QRCC

Optional accessory: (NOT included in the supply)

- QRCC-IF. Flow Injection Analysis (FIA) Unit.

-QRCC-IF. Flow Injection Analysis (FIA) Unit.

This unit is a Flow Injection Analysis system, which we will use to measure the conversion degree of the saccharose hydrolysis in a continuous way.

This unit provides an easy method for measuring the saccharose concentration of the final product in continuous way without the need of the measuring it manually. The unit can also be useful for the teaching of the FIA technique and the demonstration of the advantages of this measuring method in continuous processes.

It consists of a peristaltic pump with four channels that is used to impulse the right quantities of the final product together with reagents that colour it. Then the solution are put through coil reactor in order to complete the mixture. The last stage of the QRCC-IF involves passing the reaction through the spectrophotometer measuring cell.

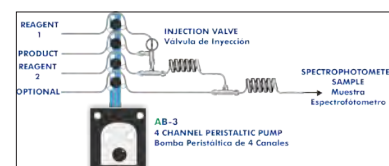
Specifications:

Four channels peristaltic pump, 0.01-35 ml/min. For each channel computer controlled.

6 Ports injection valve. Coil reactor.

Continuous measuring cell for spectrophotometer.

Dimensions: 500 x 500 x 350 mm. approx. Weight: 15 Kg. approx.



② QRCC/CIB. Control Interface Box:

The Control Interface Box is part of the SCADA system.

Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.

All sensors, with their respective signals, are properly manipulated from -10V. to +10V. computer output. Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.

Single cable between the control interface box and computer.

The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.

Simultaneous visualization in the computer of all parameters involved in the process.

Calibration of all sensors involved in the process.

Real time curves representation about system responses.

Storage of all the process data and results in a file.

Graphic representation, in real time, of all the process/system responses.

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

All the actuators and sensors values and their responses are displayed on only one screen in the computer.

Shield and filtered signals to avoid external interferences.

Real time 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.



QRCC/CIB

③ DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.

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

Analog input:

Number of channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536.

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

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

Analog output:

Number of channels=2. Resolution=16 bits, 1 in 65536.

Maximum output rate up to: 900 KS/s.

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

Digital Input/Output:

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

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



DAB

④ QRCC/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).

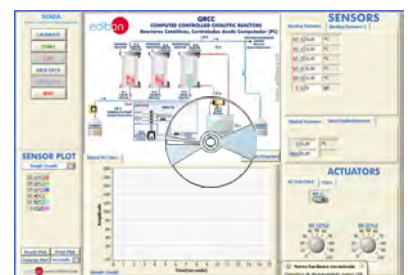
Calibration system for the sensors involved in the process.

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.



QRCC/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: QRCC + QRCC/CIB + DAB + QRCC/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 of the principles of catalytic fixed-bed reactors.
 - 2.- Effect of the variation in the particle's size in the effectiveness of a fixed-bed reactor.
 - 3.- Comparison of chemical and biological (enzymic) catalysis.
 - 4.- Checking the influence on different variables (feed flow, temperature of reaction, reagents concentration) on the obtained final product.
 - 5.- Spectrophotometer calibration.
 - 6.- Using the spectrophotometer and product analysis.
 - 7.- Study of the "FIA" Flow Injection Analysis technique and principles (with QRCC-IF optional accessory).
 - 8.- Examination of the reproducibility and sensitivity of the "FIA" analysis method as a function of the flow rate and sample concentration (with QRCC-IF optional accessory).
- Additional practical possibilities to be done by the end customer:
- 9.- Sensors calibration.
 - 10.- Studies of steady and unsteady state catalysis.
 - 11.- Flow characterisation in a fixed-bed.
 - 12.- Mass balances.
 - 13.- Determination of steady state and unsteady state kinetics of a catalytic fixed-bed reactor.
- Other possibilities to be done with this Unit:
- 14.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 15.- 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.
 - 16.- The Computer Control System with SCADA and PID Control allow a real industrial simulation.
 - 17.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 18.- This unit can be used for doing applied research.
 - 19.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
 - 20.- Control of the QRCC unit process through the control interface box without the computer.
 - 21.- Visualization of all the sensors values used in the QRCC unit process.
- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

- Electrical supply: single-phase, 220 V./50Hz. or 110V./60Hz.
- Water to fill the thermostatic bath.
- Computer.

DIMENSIONS AND WEIGHTS

- QRCC:
- Unit:
- Dimensions: 650x700x800mm.approx.
(25.59x27.55x31.49 inches approx.)
 - Weight: 50Kg. approx.
(110.23 pound approx.)
- Spectrophotometer :
- Dimensions: 470 x 380 x 140mm approx.
(18.50x14.96x5.51 inches approx.)
 - Weight: 10Kg. approx.
(22 pound approx.)
- Control Interface Box:
- Dimensions: 490 x 330 x 310mm. approx.
(19.29x12.99x12.20 inches approx.)
 - Weight: 10Kg. approx.
(22pounds approx.)

OPTIONAL ACCESSORY

- QRCC-IF. Flow Injection Analysis (FIA) Unit. (Not included in the unit)

AVAILABLE VERSIONS

- QRCC. Computer Controlled Catalytic Reactors.
Offered in this catalogue:
- QRCB. Catalytic Reactors.
Offered in other catalogue:

SCADA and PID Control
Main screen

① Main software operation possibilities.

② Sensors displays, real time values, and extra output parameters. Sensors: ST= Temperature sensor. C= Concentration.

③ Actuators controls. Actuators: AR= Heating element. AB=Pump.

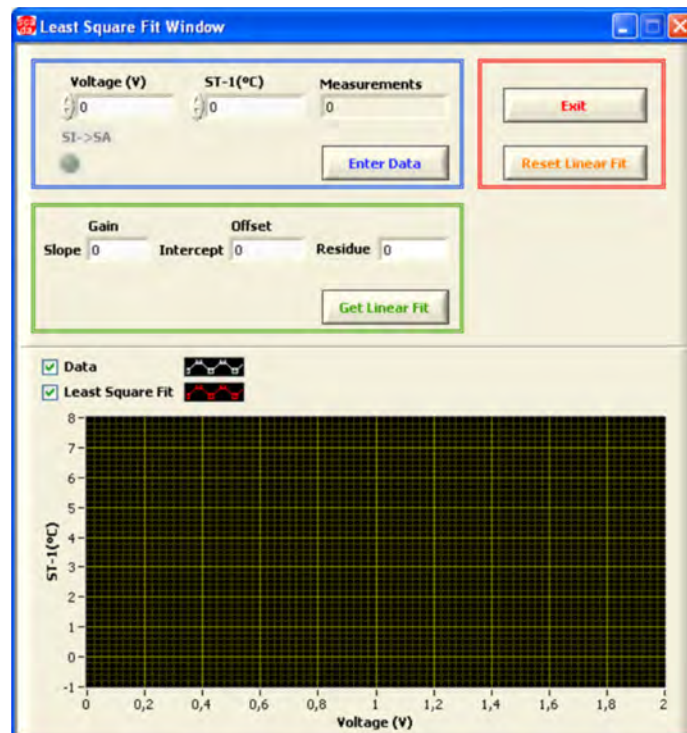
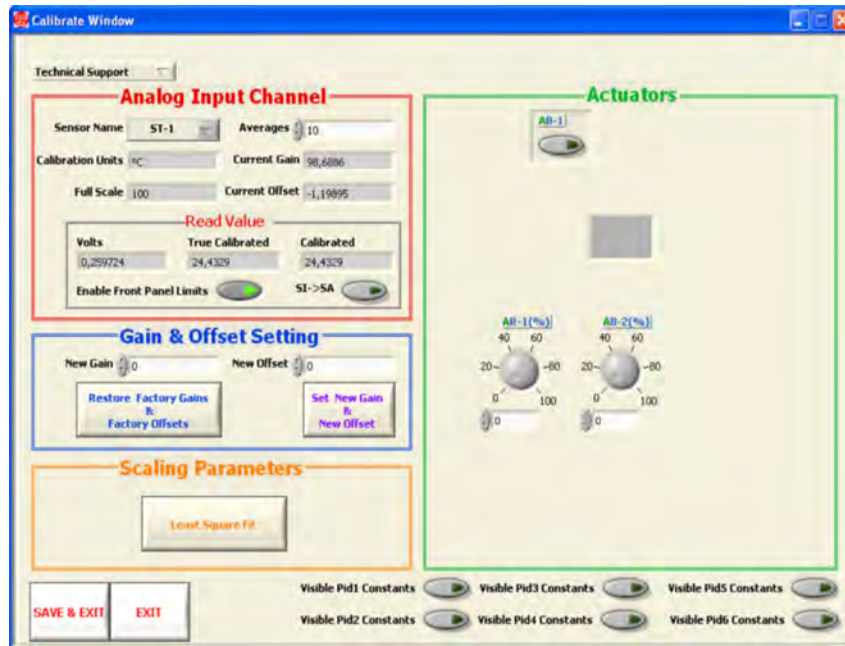
④ Channel selection and other plot parameters.

⑤ Real time graphics displays.

Software main screen

Software for Sensors Calibration

Example of screen

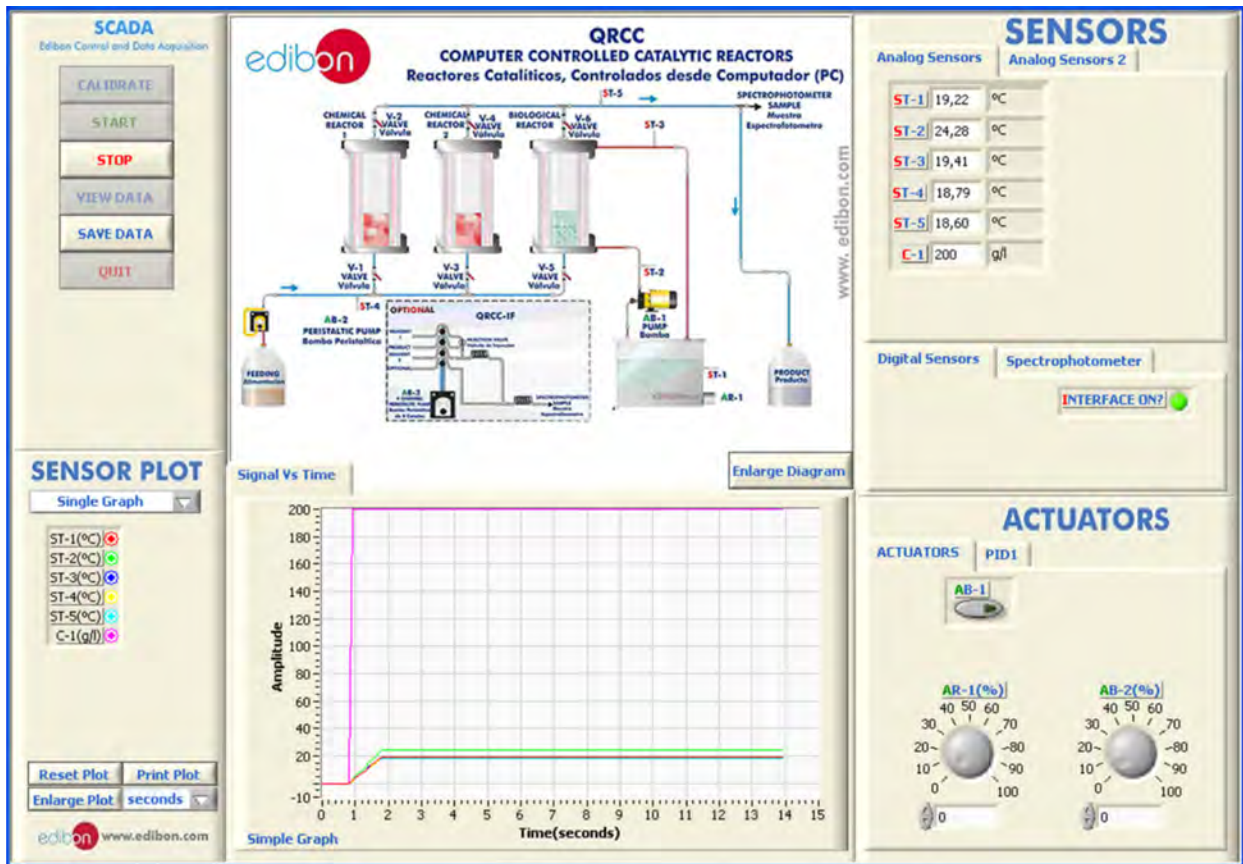


By using a free of charge code, the teacher and the students can calibrate the unit.

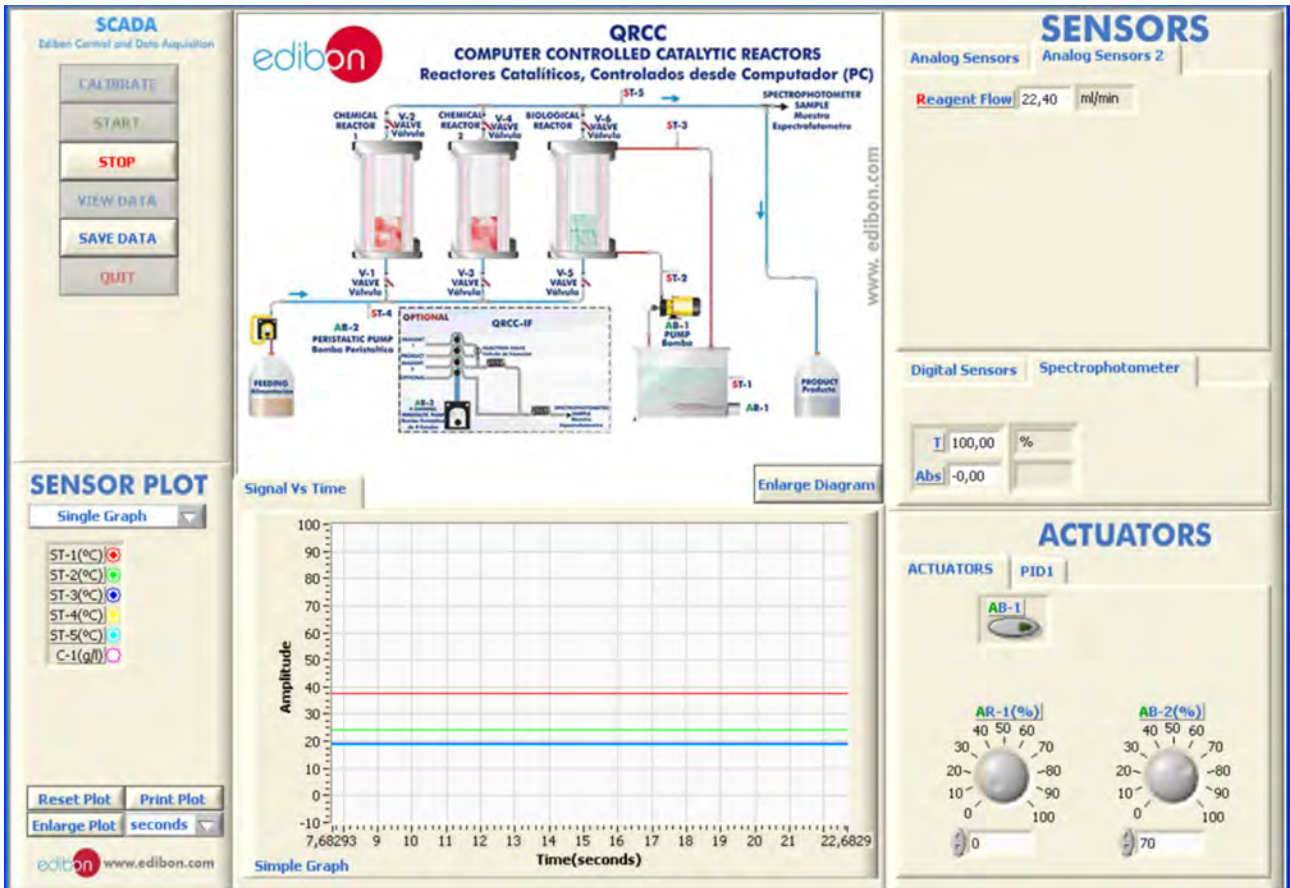
The teacher can recover his/her own calibration by using the EDIBON code that we give free of charge.

SOME REAL RESULTS OBTAINED FROM THIS UNIT

The different data collected by the sensors can be represented in function of time.

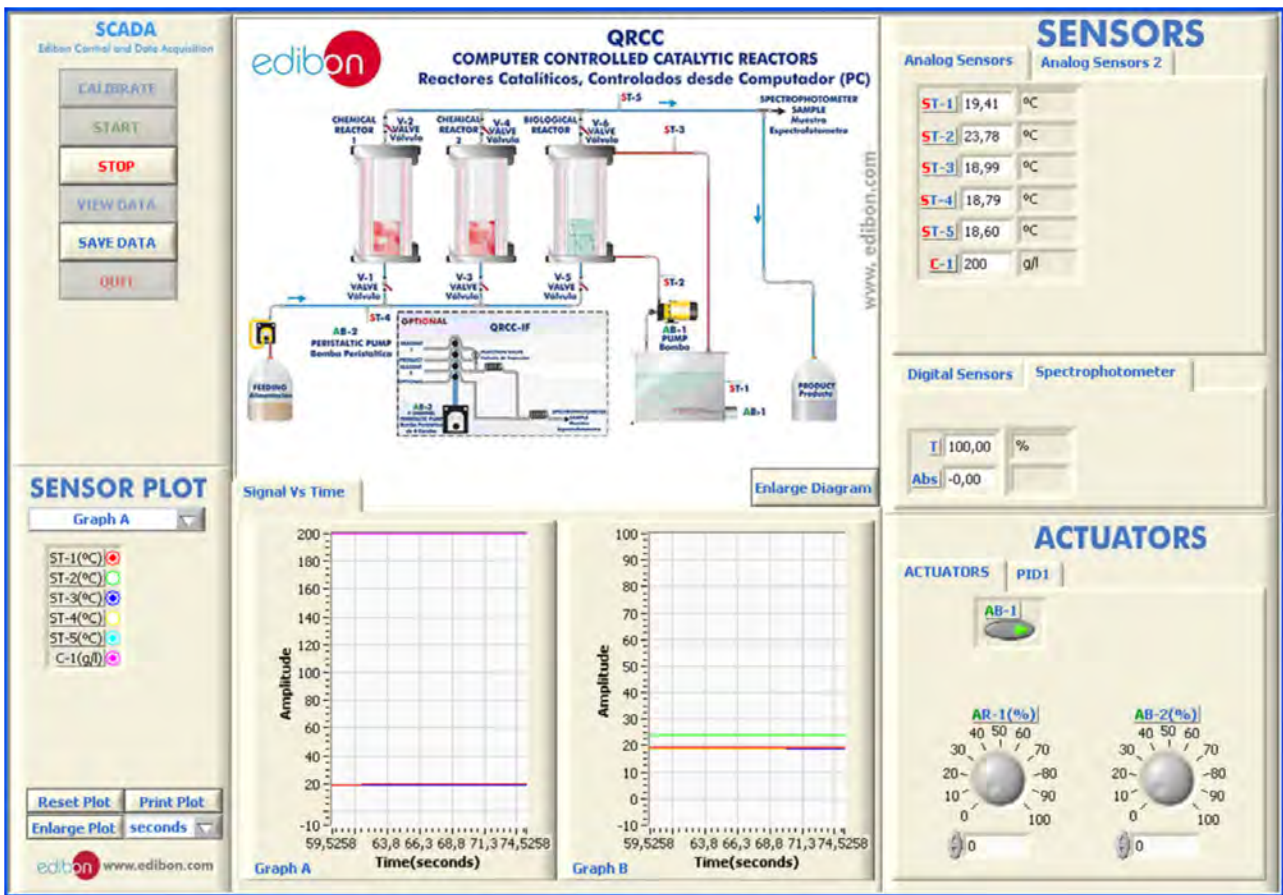


The reagent flow to be introduced into the different reactors (pump AB-2) can be controlled through a potentiometer. Such flow is visualized taking into account the pulses of the peristaltic pump.

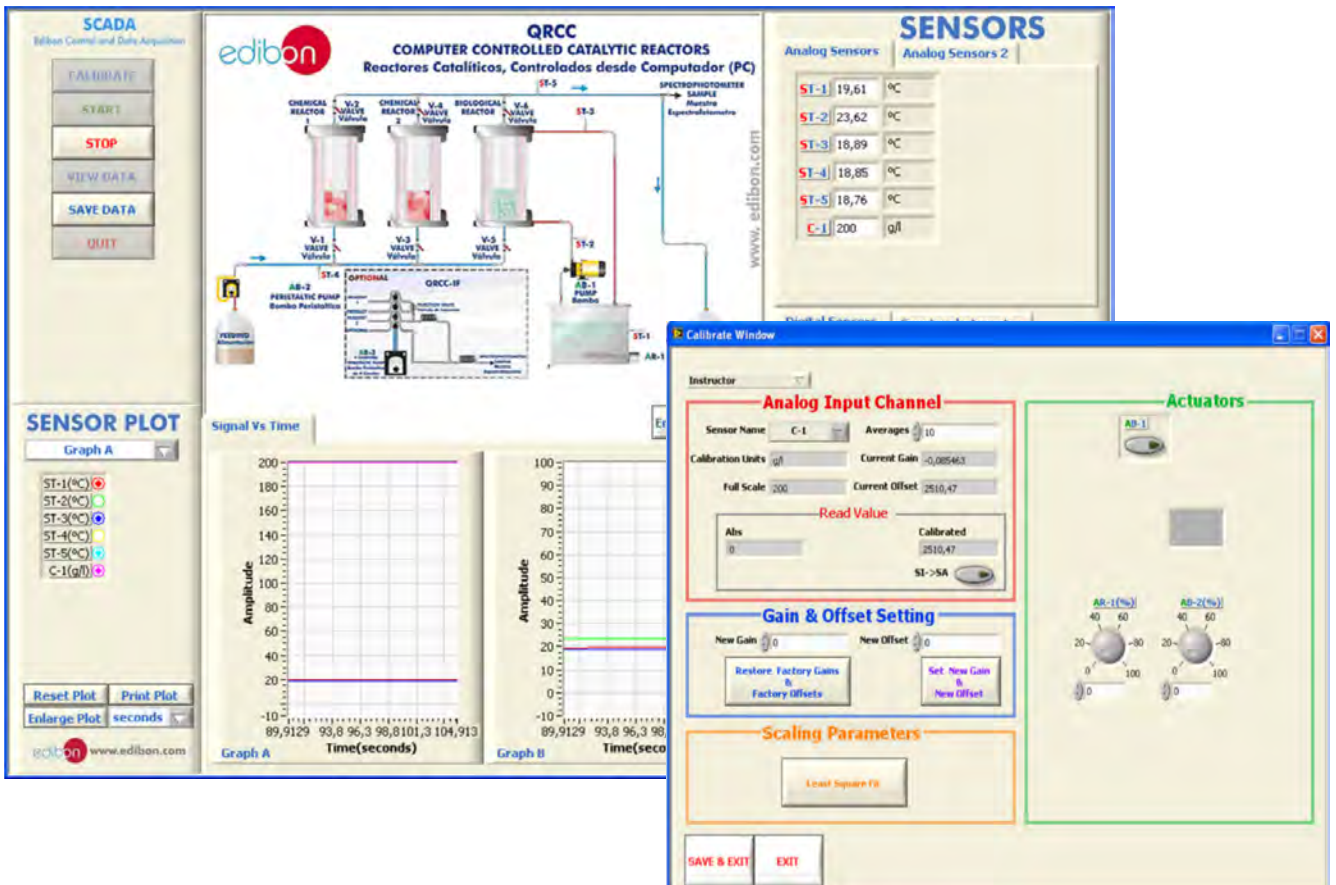


Some **real** results obtained from this Unit

The result of glucose concentration from the saccharose hydrolysis is obtained with a spectrophotometer. The absorbance and transmittance of such solution resulting from the reaction will be visualized through the software.



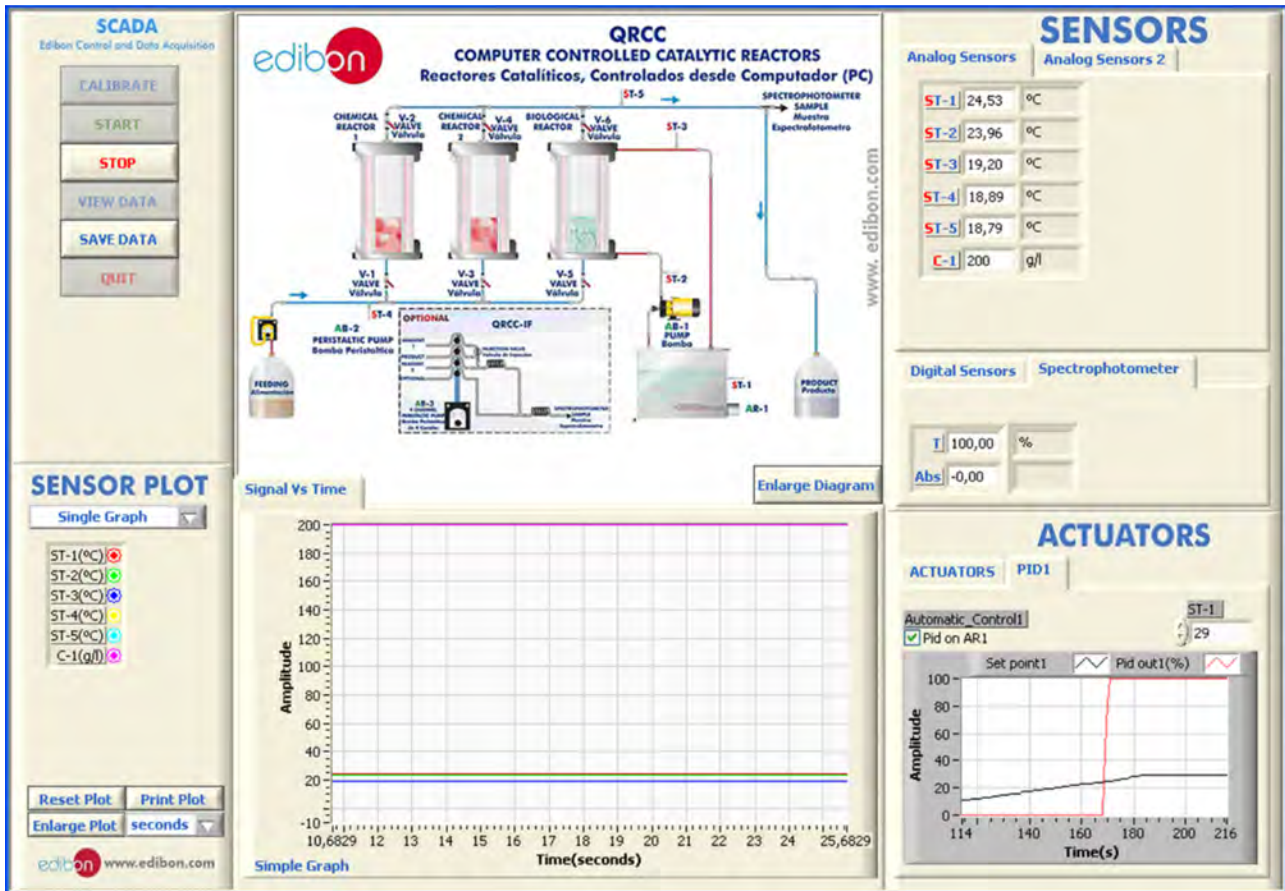
The result of glucose concentration from the saccharose hydrolysis can be obtained directly through the software. For that purpose, following the sensors calibration procedure, a prior calibration with solutions of known glucose concentration must be performed.



Some **real** results obtained from this Unit

The heating temperature of reactors is regulated through a PID control. When the target temperature is reached in temperature sensor (ST-1), the heating resistance switches off automatically. Thus, the influence of that heating temperature on the final result of the reaction can be studied.

The evolution graph allows us to compare the PID response (AR-1 heating resistance) against the setpoint (ST-1 temperature sensor).



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 **QRCC/ICAI. Interactive Computer Aided Instruction Software System.**

This complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM) totally integrated with the Student Software (EDIBON Student Labsoft -ESL). 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).

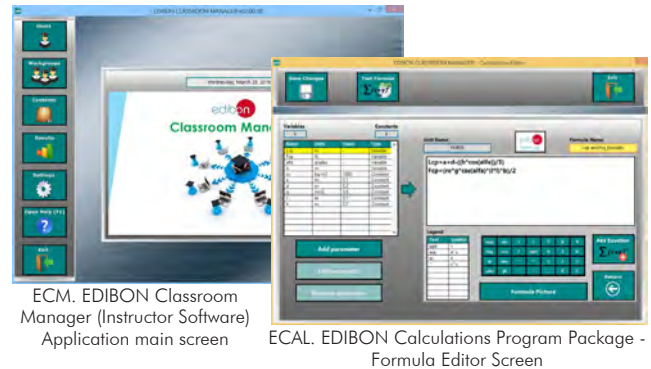
-ECM. EDIBON Classroom Manager (Instructor Software).

ECM 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.**

Instructor Software



ECM. 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

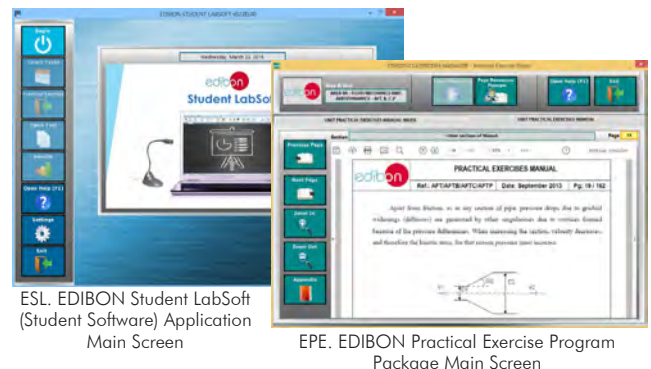
-ESL. EDIBON Student Labsoft (Student Software).

ESL 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:

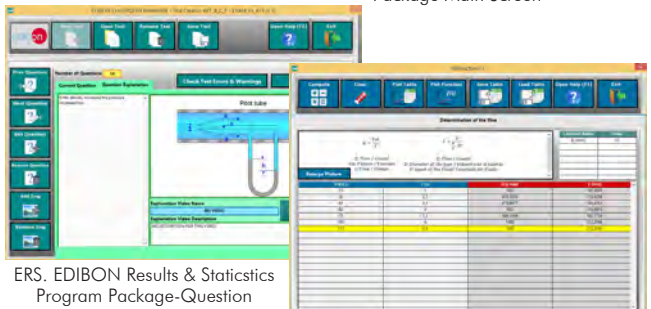
- Student Log-In & Self-Registration.**
- Existing Tasks checking & Monitoring.**
- Default contents & scheduled tasks available to be used from the first session.**
- Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- Evaluation Methods to prove your knowledge and progression.**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

Student Software



ESL. 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

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

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

b) Multipost Expansions options

⑧ **Mini ESN. EDIBON Mini Scada-Net System.**

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

The Mini ESN system consists 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.

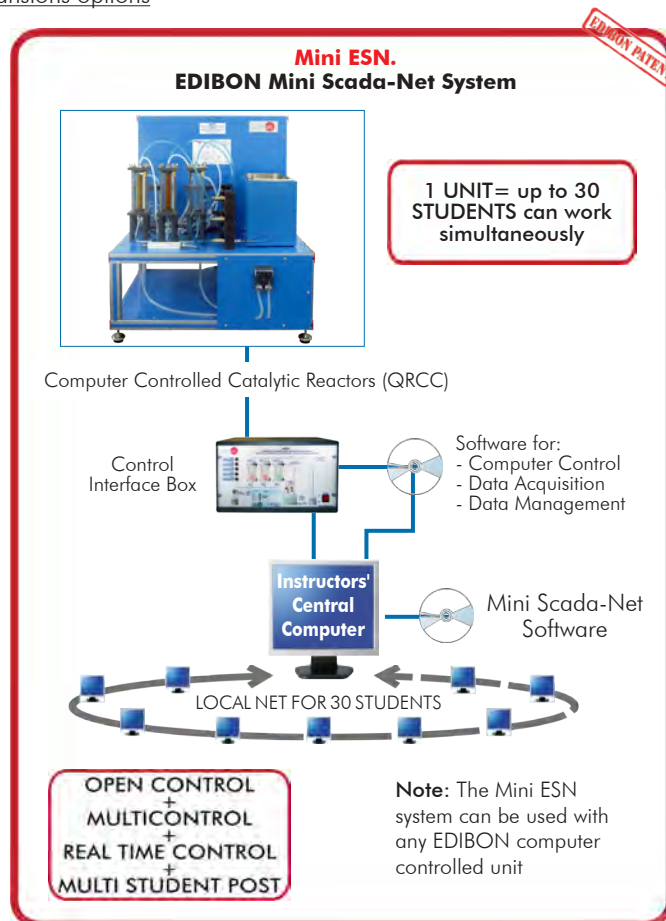
For more information see **Mini ESN** catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/Mini-ESN.pdf

⑨ **ESN. EDIBON Scada-Net System.**

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



ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

- ① Unit: QRCC. Computer Controlled Catalytic Reactors.
- ② QRCC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ QRCC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

***IMPORTANT:** Under QRCC 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 configuration

- ⑦ QRCC/ICAL. Interactive Computer Aided Instruction Software System.

b) Multipost Expansions options

- ⑧ Mini ESN. EDIBON Mini Scada-Net System.
- ⑨ ESN. EDIBON Scada-Net System.

① QRCC. Unit:

Bench-top unit.

Anodized aluminum structure and panels in painted steel.

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

2 Glass flasks of 2 litres of capacity, for the initial solution and the final product.

Reactors:

Two fixed-bed reactors for chemical catalysis, composed by acid ion exchange resins.

A fixed-bed reactor for biological (enzymic) catalysis. (Recommended use with an immobilized enzyme).

Reactors diameter: 50 mm. Reactors height: 160 mm.

Material: glass, with a methacrylate cover for protection.

Thermostatic bath, with heating resistance of 600W, controlled by a PID from the computer.

A heated water supply to the reactors jackets allows the automatic control of reaction temperature to a set point value.

Peristaltic pump, with speed regulation, computer controlled (PC), that allows to regulate the feed flow from 0 to 32 ml/min.

5 Temperature sensors, "J" type, placed at key points of the system.

Spectrophotometer, computer controlled, for the final product analysis and absorbance measures:

Wavelength range: 325-1000 nm. Band width: 5 nm.

All electrical circuits are protected by adequate protection devices.

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

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

Optional accessory (NOT included in the supply)

- QRCC-IF. Flow Injection Analysis (FIA) Unit.

-QRCC-IF. Flow Injection Analysis (FIA) Unit.

This unit is a Flow Injection Analysis system, which we will use to measure the conversion degree of the saccharose hydrolysis in a continuous way.

This unit provides an easy method for measuring the saccharose concentration of the final product in continuous way without the need of the measuring it manually. The unit can also be useful for the teaching of the FIA technique and the demonstration of the advantages of this measuring method in continuous processes.

It consists of a peristaltic pump with four channels that is used to impulse the right quantities of the final product together with reagents that colour it. Then the solution are put through coil reactor in order to complete the mixture. The last stage of the QRCC-IF involves passing the reaction through the spectrophotometer measuring cell.

Specifications:

Four channels peristaltic pump, 0.01-35 ml/min. For each channel computer controlled.

6 Ports injection valve. Coil reactor.

Continuous measuring cell for spectrophotometer.

Dimensions: 500 x 500 x 350 mm. approx. Weight: 15 Kg. approx.

② QRCC/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.

③ DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.

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

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

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

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

④ QRCC/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.

⑤ Cables and Accessories, for normal operation.**⑥ Manuals:**

This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Exercises and Practical Possibilities to be done with the Main Items

- 1.- Study of the principles of catalytic fixed-bed reactors.
- 2.- Effect of the variation in the particle's size in the effectiveness of a fixed-bed reactor.
- 3.- Comparison of chemical and biological (enzymic) catalysis.
- 4.- Checking the influence on different variables (feed flow, temperature of reaction, reagents concentration) on the obtained final product.
- 5.- Spectrophotometer calibration.
- 6.- Using the spectrophotometer and product analysis.
- 7.- Study of the "FIA" Flow Injection Analysis technique and principles (with QRCC-IF optional accessory).
- 8.- Examination of the reproducibility and sensitivity of the "FIA" analysis method as a function of the flow rate and sample concentration (with QRCC-IF optional accessory).

Additional practical possibilities to be done by the end customer:

- 9.- Sensors calibration.
- 10.- Studies of steady and unsteady state catalysis.
- 11.- Flow characterisation in a fixed-bed.
- 12.- Mass balances.
- 13.- Determination of steady state and unsteady state kinetics of a catalytic fixed-bed reactor.

Other possibilities to be done with this Unit:

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

a) Technical and Vocational Education configuration

⑦ **QRCC/ICAI. Interactive Computer Aided Instructor Software System.**

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

-ECM. EDIBON Classroom Manager (Instructor Software).

ECM 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. EDIBON Student Labsoft (Student Software).

ESL 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.**

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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