Computer Controlled **Chemical Reactors Trainer**

QRC

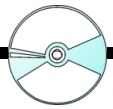
Technical Teaching Equipment

EDIBON PATENT

Always included in the supply:

Teaching Technique used

SCADA. EDIBON Computer Control System



(1) QUSC. Service Unit

(2) Control Interface Box

(3) Data Acquisition Board

(*) Computer Control Software for each Chemical Reactor

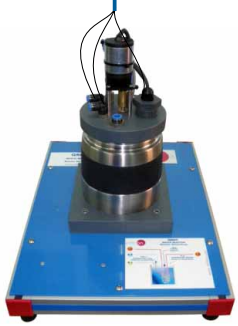
Computer (not included in the supply)

(5) Cables and Accessories

(6) Manuals

(4) Available Chemical Reactors to be used with Service Unit (QUSC) and SCADA System

(4.1) QRCAC. Continuous Stirred Tank Reactor (*)

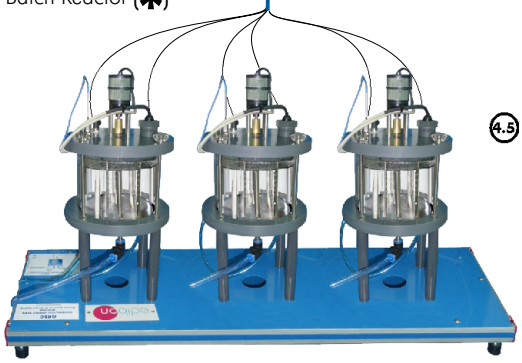


(4.3) QRDC. Batch Reactor (*)

(4.5) QRLC. Laminar Flow Reactor (*)

(4.6) QRPC. Plug Flow Reactor (*)

(4.2) QRTC. Tubular Flow Reactor (*)



(4.4) QRSC. Stirred Tank Reactors in Series (*)

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

www.edibon.com
Products
Products range
Units
11.-Chemical Engineering

ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

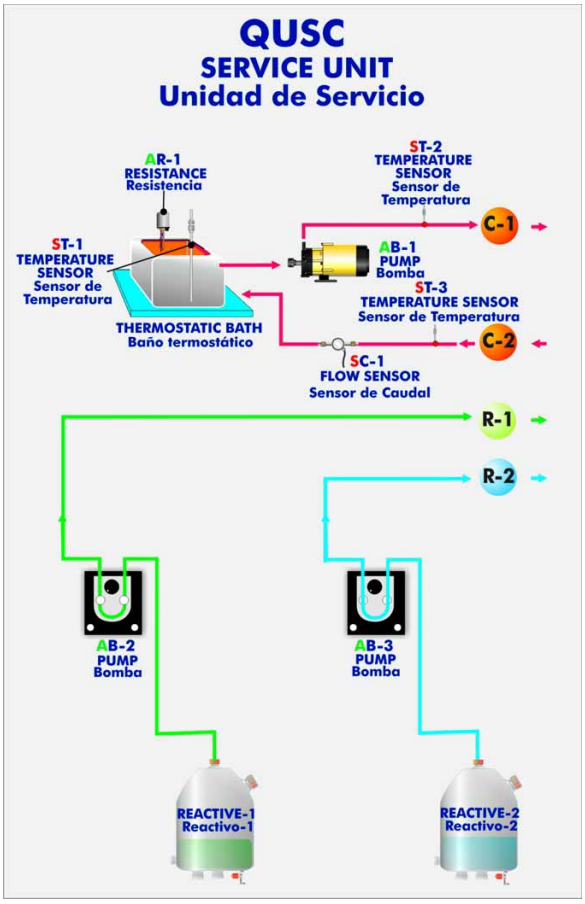
European Union Certificate
(total safety)

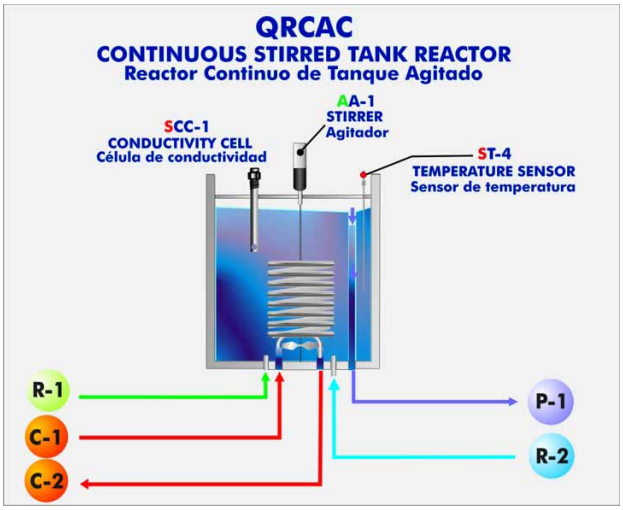
Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)

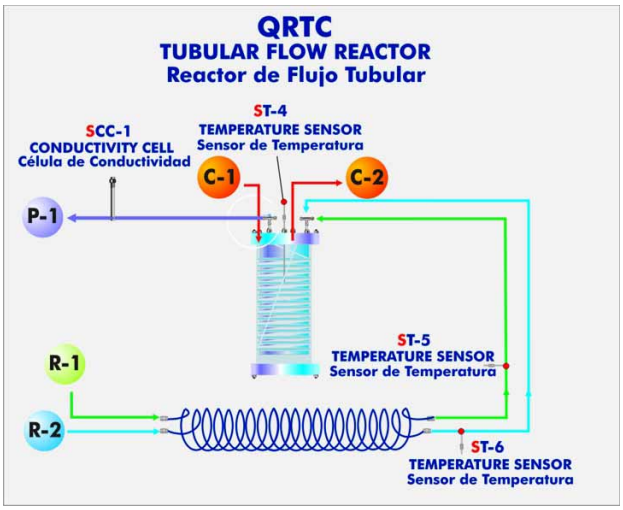
Worlddidac Quality Charter Certificate
(Worlddidac Member)

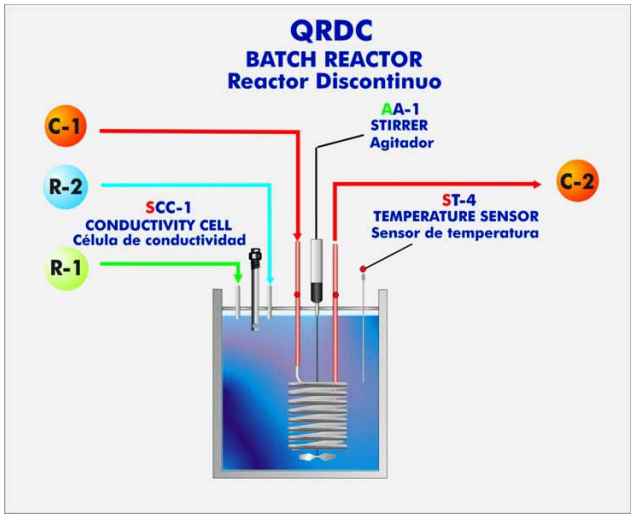
7 actuators and 10 sensors controlled from any computer, and working simultaneously

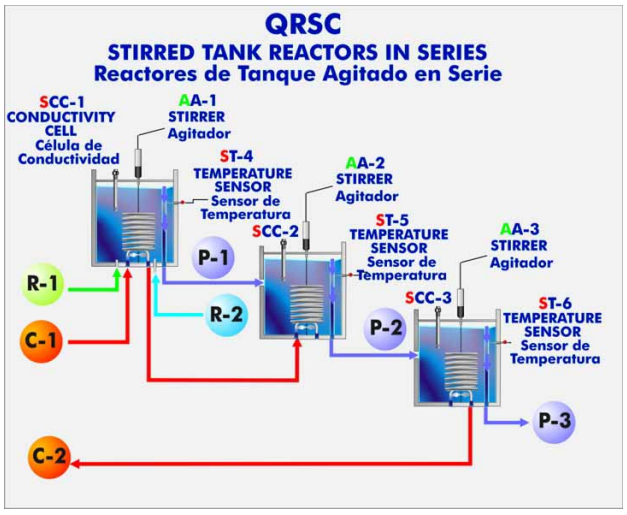
OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL











Note: AB= Pump. AR= Heating resistance. ST= Temperature sensor. SC= Flow sensor. SCC= Conductivity sensor. AA= Stirrer.

Common items for the Chemical Reactors

① QUSC. Service Unit:

This unit is common for the Chemical Reactors, and can work with one or several reactors.
Accommodation and exchange system of the reactors, quick and easy to handle.
It supplies all the services for the operation of each reactor.
Anodized aluminium structure and panels in painted steel (epoxy paint).
Main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
2 Peristaltic dosing pumps, with variable speed, computer controlled. Flow rate up to 3 l./h. (unit standard disposition). With another disposition, they could reach a flow rate up to 10 l./h.
Thermostatic bath of 9 l. capacity, computer controlled. Temperature PID control of the thermostatic bath.
Pump of 3 l./min., with variable flow, to impel the thermostatization water from the bath to the reactor. Flow sensor, range: 0-6 l./min.
2 Tanks for the reagents, of 1 liter capacity each one, made in Pyrex glass.
The control of the reaction is carried out by a conductivity sensor, which allows the reaction evolution parametrization in real time.
Three "J" type temperature sensors, one to know the thermostatic bath temperature in a continuous way and two sensors to know the water temperature at the thermostatic bath water inlet and outlet.
All elements of this unit are chemically resistant.

QUSC

② QRC/CIB. Control Interface Box:

This control interface is common for the Chemical Reactors and can work with one or several reactors.
Control interface box with process diagram in the front panel and with the same distribution to 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.

QRC/CIB

③ DAB. Data Acquisition Board:

This board common for the Chemical Reactors.
PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
Analog input:
Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.
Sampling rate up to: 250 KS/s (Kilo samples per second).
Input range (V)= ±10V.
Data transfers=DMA, interrupts, programmed I/0. Number of DMA channels=6.
Analog output:
Number of **channels=2**. **Resolution=16 bits**, 1 in 65536. Max. output rate up to: 833 KS/s.
Output range(V)=± 10V. Data transfers=DMA, interrupts, programmed I/0.
Digital Input/Output:
Number of **channels=24 inputs/outputs**. D0 or DI Sample Clock frequency: 0 to 1 Mhz.
Timing: **Counter/timers=2**. Resolution: Counter/timers: 32 bits.

DAB

Continue...

④ Chemical Reactors

④.1 QRCAC. Continuous Stirred Tank Reactor:

Small scale Continuous Stirred Tank Reactor, computer controlled, designed to demonstrate the behavior of a reactor used for homogeneous reactions liquid-liquid.

QRCAC

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

Reactor body made in borosilicate glass, with a maximum capacity of 2 liters, specially designed to work in continuous. It also allows batch operation.

Adjustable volume from 0.4 to 1.5 l.

Stainless steel heat transfer coil and a baffle (removable).

Stirring system with speed control and indication, computer controlled. Stirrer range: 0-220 rpm.

Reactor lip with connectors for the appropriate sensors.

Temperature sensor "J " type to control the temperature into the reactor.

Conductivity sensor to control the reaction. Measurement range up to 20 mS.

Easy and quick assembly on the Service Unit.

All elements of this unit are chemically resistant.

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

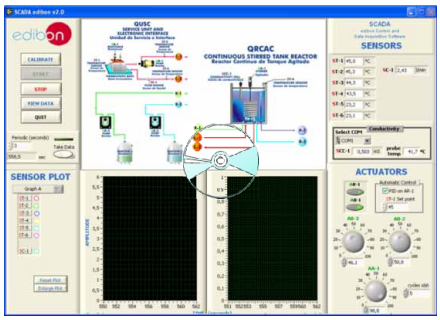
Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Continuous Stirred Tank Reactor (QRCAC).

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.

Continue...

④ Chemical Reactors (continuation)

④.2 QRTC. Tubular Flow Reactor:

Reactor composed by a continuous tube where the reagents are introduced through the coil end and the products are obtained through the inverse end. Into it, a continuous reagent mix is produced, so the composition will be different at each point. This type of reactors are industrially used for homogeneous reactions liquid-liquid, generally in isothermal conditions.

QRTC

With this small scale reactor, computer controlled, the behavior of this type of reactors used at industrial level can be observed.

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

Tubular flow reactor of volume 0.4 l. Coil shaped. Placed into an acrylic vessel through which the cooling or heating medium is circulated. Coil length of 20 m.

Electric pre-heater of 12 loops, and loop diameter of 70 mm approx., For the two reagents feed lines. It is before the mix and currents inlet to the reactor.

Temperature controlled by water jacketed. Temperature control by a temperature sensor "J" type.

Two temperature sensors "J" type to know the reagents outlet temperature from the pre-heater.

Conductivity sensor to control the reaction. Measurement range up to 20 mS.

Reactor lip with connectors for the appropriate sensors.

Easy and quick assembly on the Service Unit.

All elements of this unit are chemically resistant.

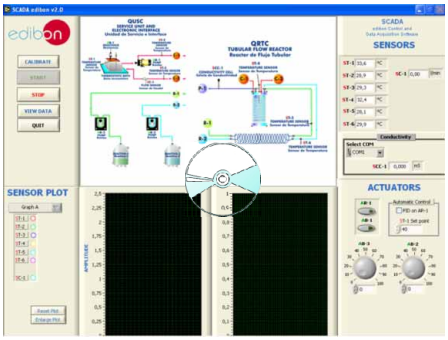
This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Tubular Flow Reactor (QRTC).

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.

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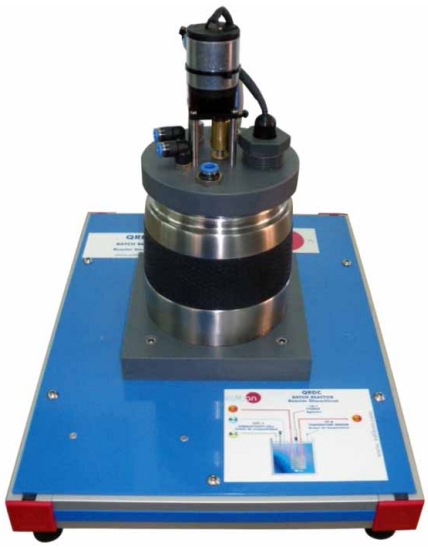
Continue...

④ Chemical Reactors (continuation)

④.3 QRDC. Batch Reactor:

Small scale Bath Reactor, computer controlled, designed for the kinetic study of homogeneous reactions liquid-liquid, both in adiabatic conditions and in isothermal conditions.



QRDC

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

The reactor body is an isolated vessel with a stainless steel external casing. The working volume is 1liter.

Heat transfer coil made in stainless steel and reactor baffle, of 4.5 loops of 76 mm of diameter and 1250 mm length. The tube internal diameter is of 6 mm and the external one is of 8 mm.

Stirring system with speed control and indication, computer controlled. Stirrer range: 0-220 rpm.

Temperature sensor "J" type to control the temperature into the reactor.

Conductivity sensor to control the reaction. Measurement range up to 20 mS.

Reactor lip with connectors for the appropriate sensors.

Easy and quick assembly on the Service Unit.

All elements of this unit are chemically resistant.

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

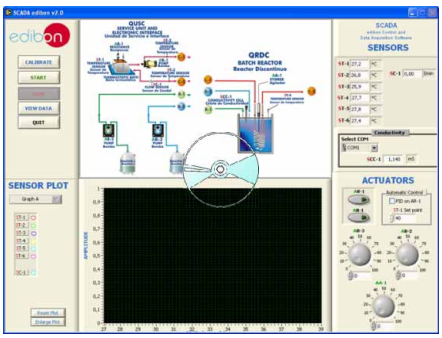
Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Batch Reactor (QRDC).

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 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.

Continue...

④ Chemical Reactors (continuation)

④.④ QRSC. Stirred Tank Reactors in Series:

The stirred tank reactors in series are used to increase the reagents conversion referred to an only reactor and so obtain product with higher purity.

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

3 Continuous stirred tank reactors connected in series, computer controlled.

Reactors body made in borosilicate glass.

Each reactor is fitted with a conductivity sensor.

Each one has a stirrer with variable speed, computer controlled.

The two reagent vessels and the two variable speed doging pumps (at the QUSC Service Unit) feed reagents into the first reactor in line.

QRSC

A dead-time residence coil can also be attached to the exit of the last reactor in the series.

For some experiments, the feed can be connected to the third reactor and a dead-time coil.

Temperature sensors.

Easy and quick assembly on the Service Unit.

All elements of this unit are chemically resistant.

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

Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Stirred Tank Reactors in Series (QRSC).

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 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.

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Continue...

④ Chemical Reactors (continuation)

④.5 QRLC. Laminar Flow Reactor:

QRLC

Small scale Laminar Flow Reactor, computer controlled, designed to demonstrate the flow pattern characterisation and the steady state conversion in a tubular reactor.

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

Working volume: 400 ml.

The reactor column is 1300 mm long approx., including 2 diffusers packed with glass balls.

At the bottom of the column a premixer provides a complete mixing of the reagents entering the reactor and improves the flow distribution.

The reactor refrigeration jacket keeps its contents at constant temperature to keep the laminar flow conditions.

The reagents are fed to the reactor by the peristaltic dosing pumps of the Service Unit.

Temperature sensors.

Conductivity sensor to control the reaction.

Easy and quick connection with the Service Unit.

All elements of this unit are chemically resistant.

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

Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Laminar Flow Reactor (QRLC).

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 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.

Continue...

④ Chemical Reactors (continuation)

④.6 QRPC. Plug Flow Reactor:

QRPC

Small scale Plug Flow Reactor, computer controlled, designed to demonstrate the flow pattern characterisation and the steady state conversion in a tubular reactor with axial dispersion.

Working volume: 1 litre.

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

The reactor column is 1100 mm long approx., packed with 3 mm diameter glass balls.

At the bottom of the column a premixer provides a complete mixing of the reagents entering the reactor and improves the flow distribution.

The reagents are fed to the reactor by the 2 peristaltic pumps of the Service Unit.

The unit uses a 6 ports injection valve which injects the reagent dose on the reagent carrier at the reactor tube inlet.

Temperature sensors.

Conductivity sensor to control the reaction.

Easy and quick connection with the Service Unit.

All elements of this unit are chemically resistant.

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

Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Plug Flow Reactor (QRPC).

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 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.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This trainer is **supplied with 8 manuals for each Chemical Reactor:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Continue...

Additional and optional items

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

PLC-PI

⑦ PLC-PI. PLC Module:

This unit is common for the Chemical Reactors and can work with one or several reactors.

Circuit diagram in the front panel.

Front panel:

Digital inputs(X) and Digital outputs (Y) block:

16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).

14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

Analog inputs block:

16 Analog inputs (-10V. to + 10V.)(through SCSI connector).

Analog outputs block:

4 Analog outputs (-10V. to + 10V) (through SCSI connector).

Touch screen:

High visibility and multiple functions.

Display of a highly visible status.

Recipe function.

Bar graph function.

Flow display function.

Alarm list.

Multi language function.

True type fonts.

Back panel:

Power supply connector.

Fuse 2A.

RS-232 connector to PC.

USB 2.0 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

Panasonic PLC:

High-speed scan of 0.32 μsec. for a basic instruction.

Program capacity of 32 Ksteps, with a sufficient comment area.

Free input AC voltage(100 to 240 V AC).

DC input:16 (24 V DC).

Relay output: 14 (250 V A AC/2 A).

High-speed counter.

Multi-point PID control.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

Communication RS232 wire, to computer (PC).

⑧ QRC/PLC-SOF. PLC Control Software.

Always included with PLC supply.

Each Chemical Reactor has its own Software.

Items available on request

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

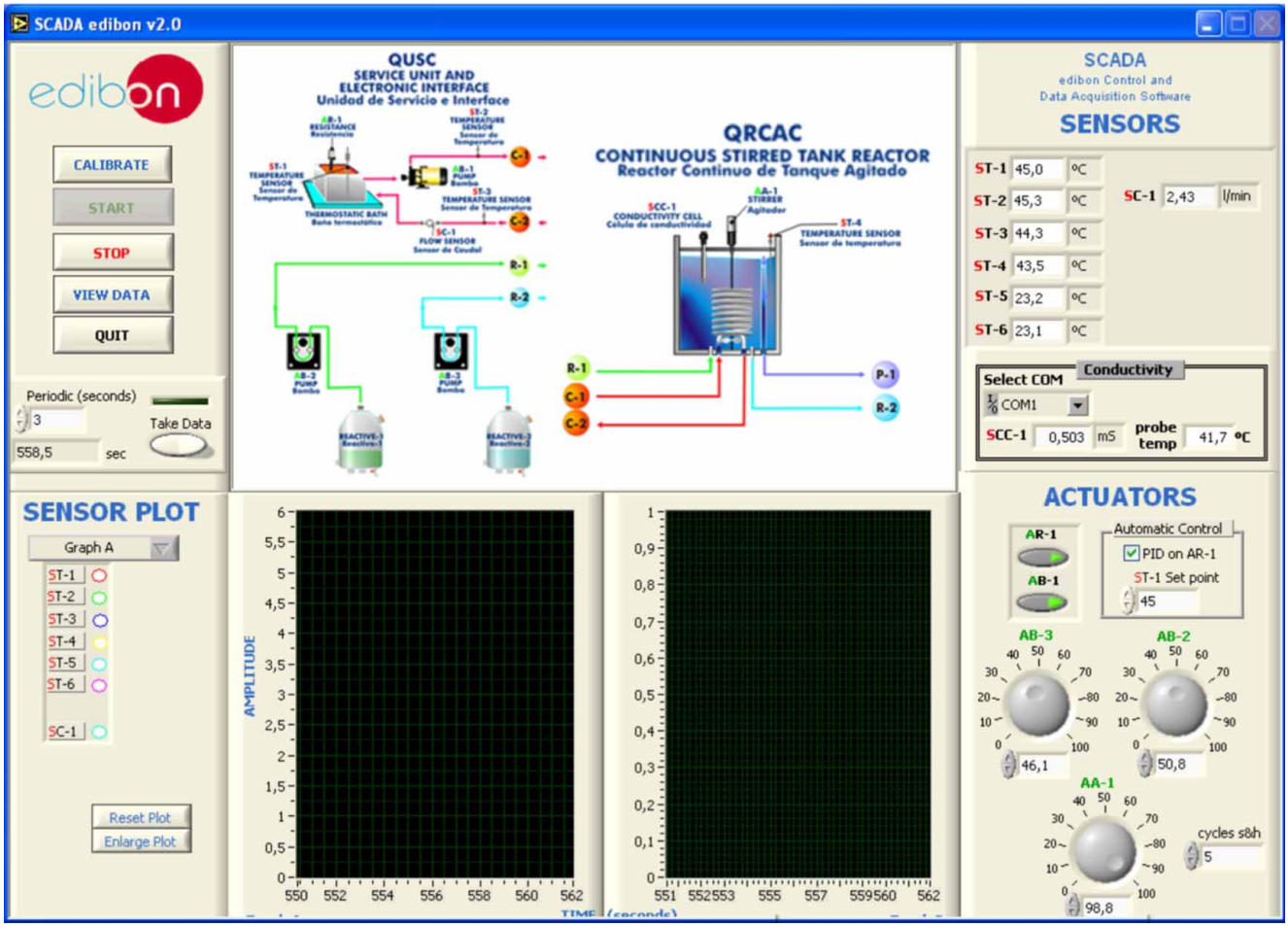
⑩ QRC/FSS. Faults Simulation System.

Software Main Screens

Initial Screen

Initial screen where the type of reactor is selected.

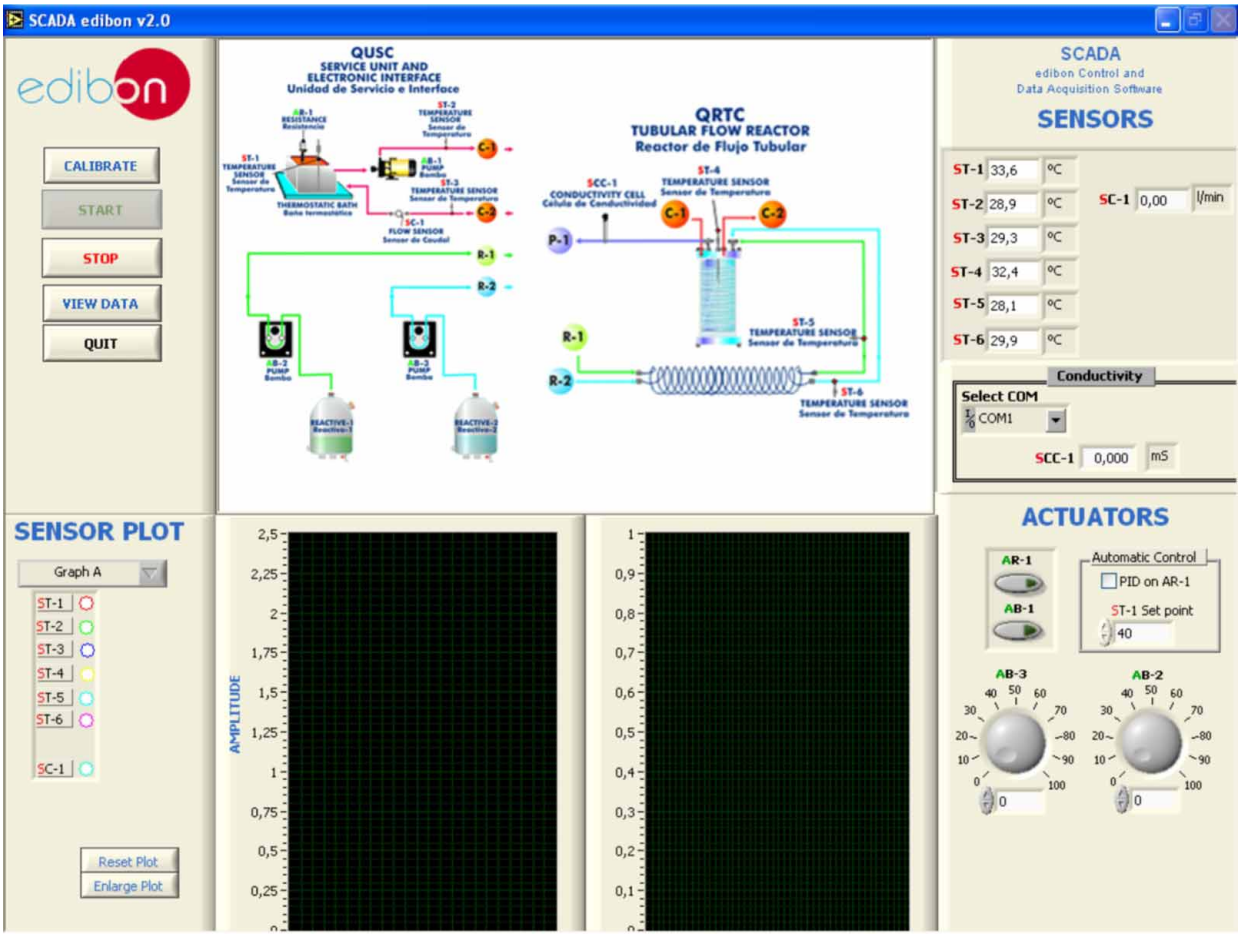
Continuous Stirred Tank Reactor (QRCAC) Main Screen



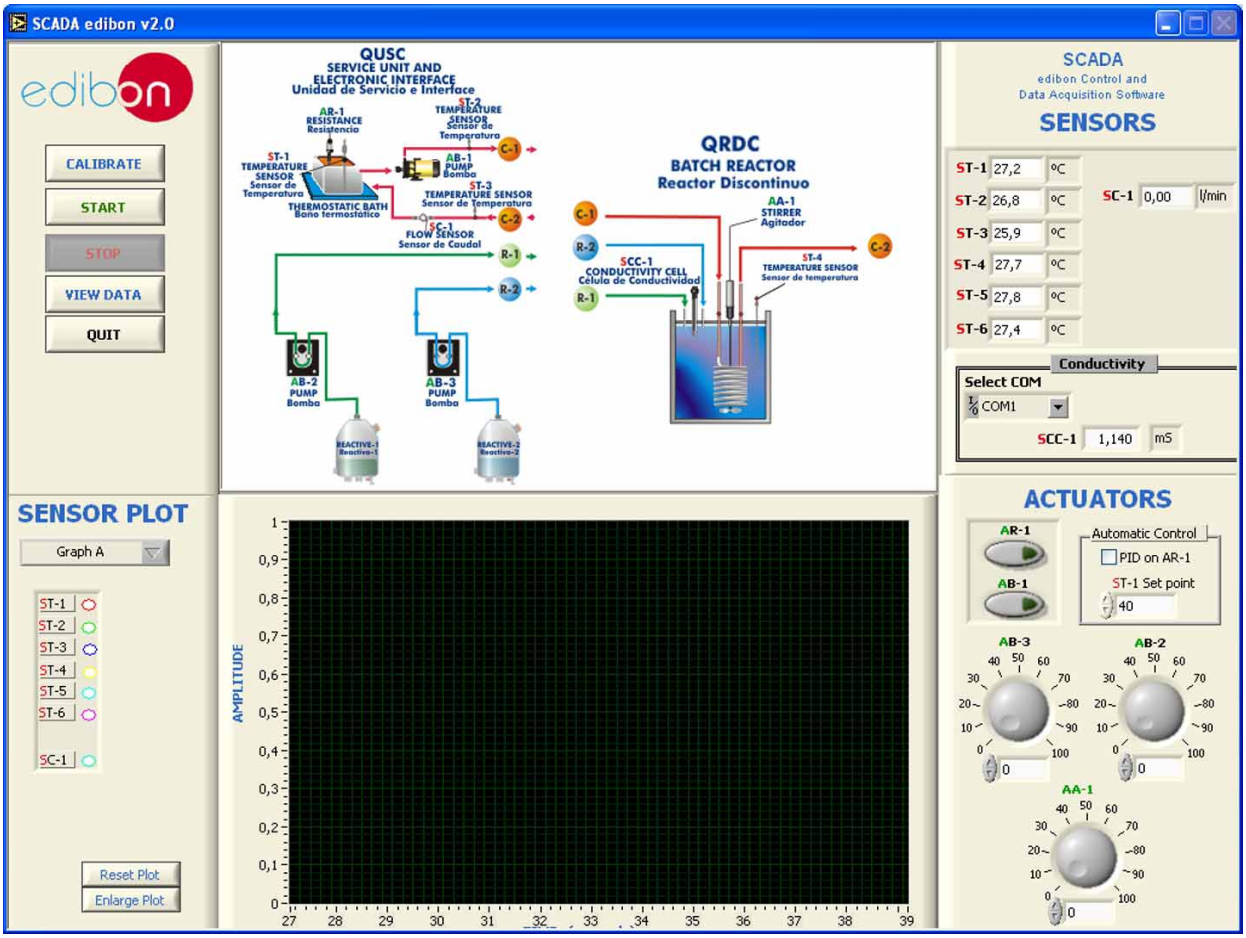
Note: AB= Pump. AR= Heating Resistance. ST= Temperature sensor. SC= Flow sensor. SCC= Conductivity sensor. AA= Stirrer.

Continue...

Tubular Flow Reactor (QRTC) Main Screen



Batch Reactor (QRDC) Main Screen

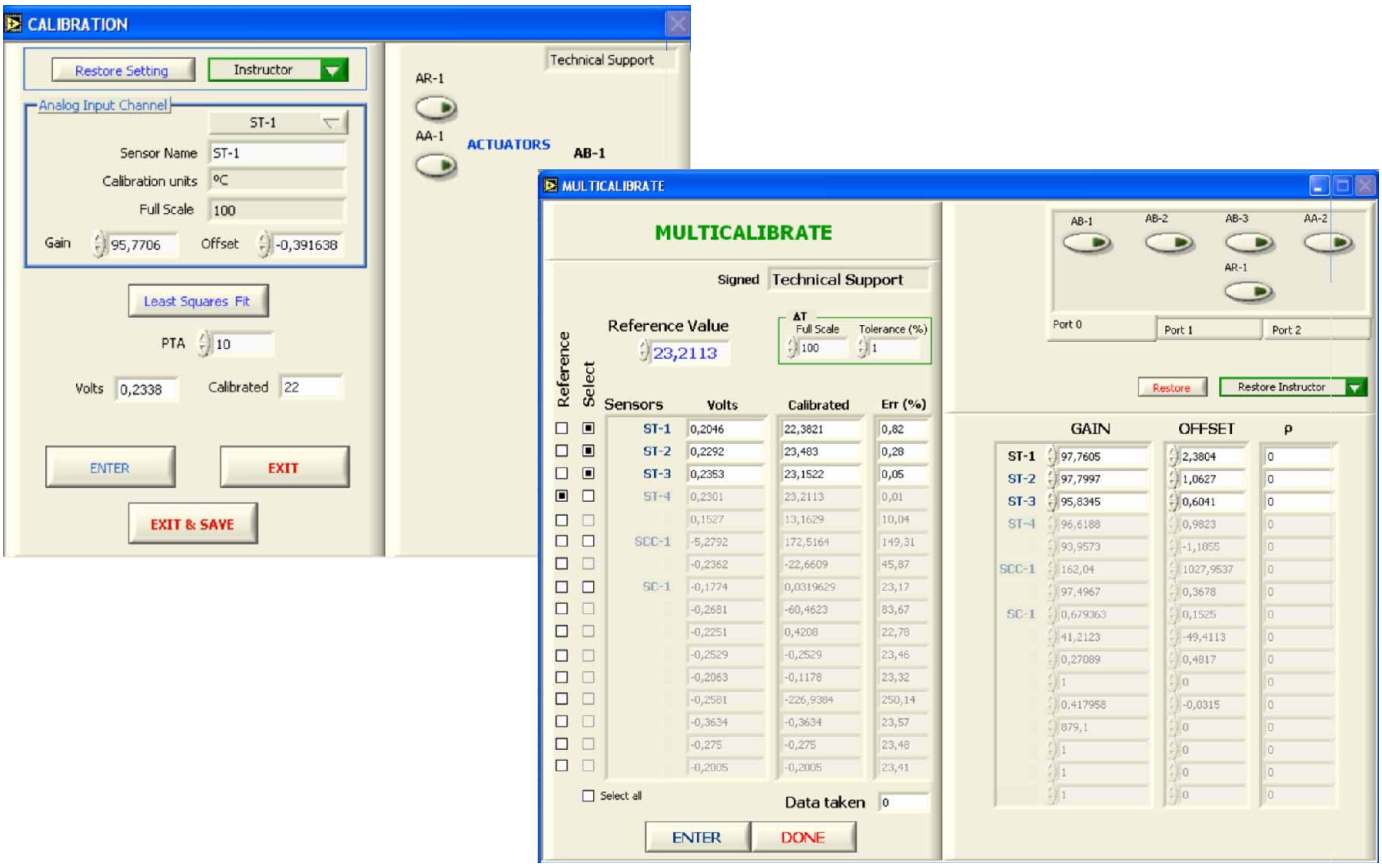


Note: AB= Pump. AR= Heating resistance. ST= Temperature sensor. SC= Flow sensor. SCC= Conductivity sensor. AA= Stirrer.

Continue...

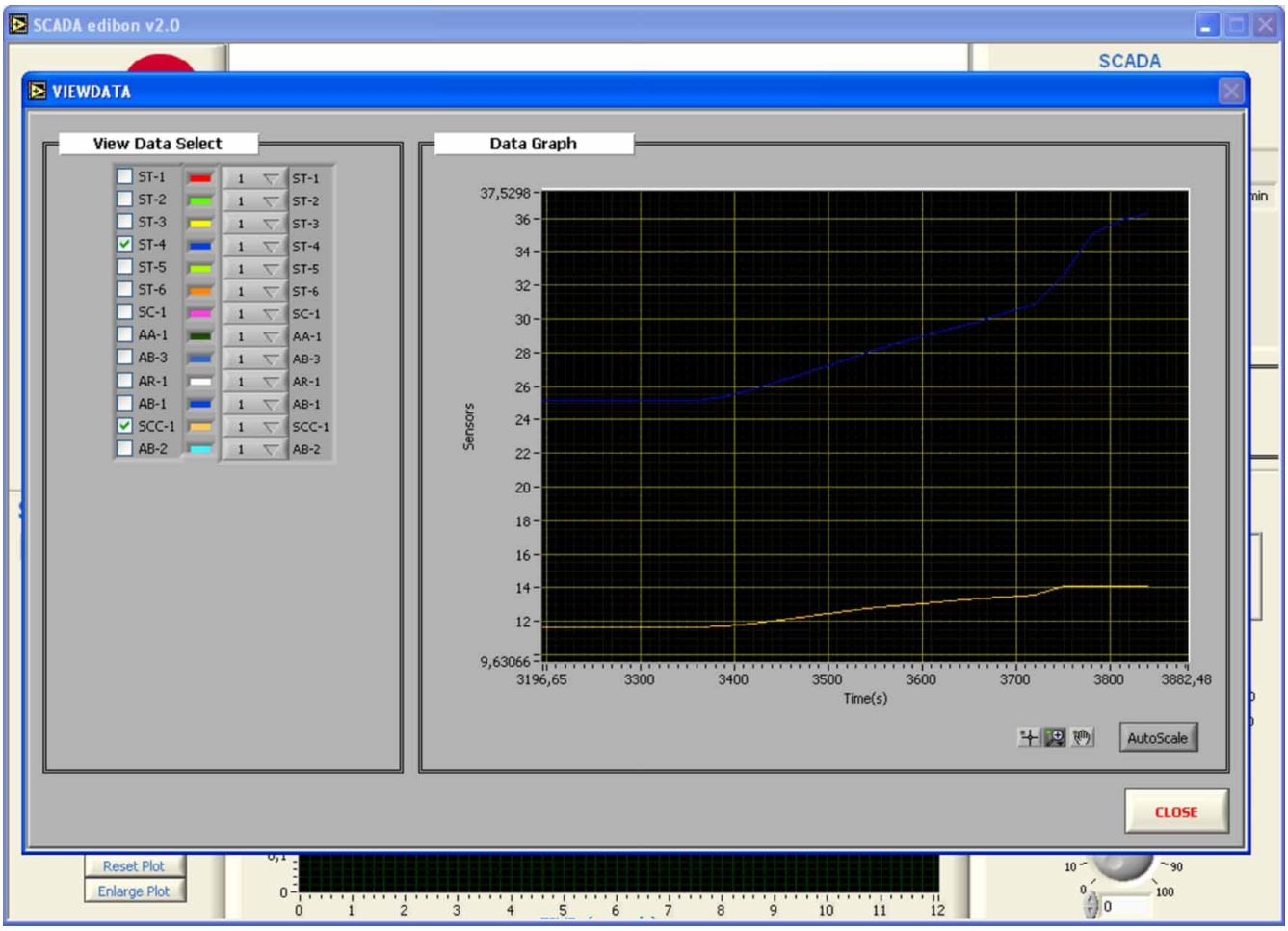
Software Main Screens

Examples of Sensors **Calibration** Screens



Some typical exercises results

Example of results of practices where a reactive conductivity (SCC) variation is represented according to the temperature variation into the reactor (ST4)



Some Practical Possibilities of the Trainer:

Practices to be done with the Continuous Stirred Tank Reactor (QRCAC):

1.- Determination of the ionic conductivities.

2.- Batch operation. Obtaining of the reaction order respect to ethyl-acetate. Initial velocity method.

3.- Batch operation. Obtaining of the reaction order respect to sodium hydroxide. Initial velocity method.

4.- Batch operation. Velocity Constant Computation. Constant sodium hydroxide initial concentration.

5.- Batch operation. Velocity Constant Computation. Constant ethyl-acetate initial concentration.

6.- Velocity equation formulation.

7.- Batch operation. Variation of the kinetic constant with temperature. Arrhenius Equation.

8.- Batch operation. Theoretical and experimental conversion comparative. Deviation from ideality.

9.- Batch operation. Mixture effects.

10.- Continuous operation.

11.- Continuous operation. Mixture effects.

12.- Measurement conductivity system: conductimeter.

13.- Variation of conversion with residence time.

14.- Residence time distribution.

15.- Determination of reaction rate constant.

16.- Calibration of the temperature sensors.

17.- Calibration of the conductivity sensor.

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

18.- Control of the QRCAC unit process through the control interface box without the computer.

19.- Visualization of the sensors values used in the QRCAC unit process.

20.- Calibration of all sensors included in the QRCAC unit process.

21.- Hand on of all the actuators involved in the QRCAC unit process.

22.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

23.- 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).

24.- PLC hardware general use and manipulation.

25.- PLC process application for QRCAC unit.

26.- PLC structure.

27.- PLC inputs and outputs configuration.

28.- PLC configuration possibilities.

29.- PLC program languages.

30.- PLC different programming standard languages.

31.- New configuration and development of new process.

32.- Hand on an established process.

33.- To visualize and see the results and to make comparisons with the QRCAC unit process.

34.- Possibility of creating new process in relation with the QRCAC unit.

35.- PLC Programming Exercises.

36.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Tubular Flow Reactor (QRTC):

37.- Analysis of reagents and products.

38.- Ionic conductivities determination.

39.- Theoretical conversion of the tubular reactor.

40.- Experimental determination of the conversion of the tubular reactor.

41.- Dependence in the residence time.

42.- Determination of the reaction order.

43.- Dependence of the speed constant and the conversion with the temperature.

44.- Measurement conductivity system: conductimeter.

45.- Complete emptying of the unit.

46.- Determination of reaction rate constant.

47.- Calibration of the sensors.

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

48.- Control of the QRTC unit process through the control interface box without the computer.

49.- Visualization of all the sensors values used in the QRTC unit process.

50.- Calibration of all sensors included in the QRTC unit process.

51.- Hand on of all the actuators involved in the QRTC unit process.

52.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

53.- 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).

54.- PLC hardware general use and manipulation.

55.- PLC process application for QRTC unit.

56.- PLC structure.

57.- PLC inputs and outputs configuration.

58.- PLC configuration possibilities.

59.- PLC program languages.

60.- PLC different programming standard languages.

61.- New configuration and development of new process.

62.- Hand on an established process.

63.- To visualize and see the results and to make comparisons with the QRTC unit process.

64.- Possibility of creating new process in relation with the QRTC unit.

65.- PLC Programming Exercises.

66.- Own PLC applications in accordance with teacher and student requirements.

Continue...

Some Practical Possibilities of the Trainer: (continuation)

Practices to be done with the Batch Reactor (QRDC):

67.- Determination of the ionic conductivities.

68.- Batch work. Calculation of the order of the reaction referred to the ethyl-acetate. Initial velocity method.

69.- Batch operation. Determination of the order of the reaction referred to the sodium hydroxide. Initial velocity method.

70.- Batch operation. Determination of the speed constant, the initial concentration of the sodium hydroxide is constant.

71.- Batch operation. Determination of the speed constant, the initial concentration of the ethyl acetate is constant.

72.- Formulation of the speed equation.

73.- Batch operation. Variation of the kinetic constant when the temperature is not constant: Arrhenius equation.

74.- Batch operation. Comparison of the theoretical and the experimental conversion: Deviation from the ideality.

75.- Calculation of the heat transference coefficient of the coil.

76.- Calculation of the hydrolysis reaction enthalpy.

77.- Batch operation. Mixture effects.

78.- Measurement conductivity system: conductimeter.

79.- Calibration of the temperature sensors.

80.- Calibration of the conductivity sensor.

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

81.- Control of the QRDC unit process through the control interface box without the computer.

82.- Visualization of all the sensors values used in the QRDC unit process.

83.- Calibration of all sensors included in the QRDC unit process.

84.- Hand on of all the actuators involved in the QRDC unit process.

85.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

86.- 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).

87.- PLC hardware general use and manipulation.

88.- PLC process application for QRDC unit.

89.- PLC structure.

90.- PLC inputs and outputs configuration.

91.- PLC configuration possibilities.

92.- PLC program languages.

93.- PLC different programming standard languages.

94.- New configuration and development of new process.

95.- Hand on an established process.

96.- To visualize and see the results and to make comparisons with the QRDC unit process.

97.- Possibility of creating new process in relation with the QRDC unit.

98.- PLC Programming Exercises.

99.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with Stirred Tank Reactors in Series (QRSC):

100.- Investigation of dynamic behaviour of stirred tank reactors in series.

101.- Determination of the ionic conductivities.

102.- Influence of flow rate.

103.- Work with just one reactor in continuous.

104.- Work with just one reactor in continuous with mixture effects.

105.- Work with 3 reactors in continuous.

106.- Effect of step input change.

107.- Response to an impulse change.

108.- Investigation of time constant using dead time coil.

109.- Calibration of the sensors.

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

110.- Control of the QRSC unit process through the control interface box without the computer.

111.- Visualization of all the sensors values used in the QRSC unit process.

112.- Calibration of all sensors included in the QRSC unit process.

113.- Hand on of all the actuators involved in the QRSC unit process.

114.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

115.- 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).

116.- PLC hardware general use and manipulation.

117.- PLC process application for QRSC unit.

118.- PLC structure.

119.- PLC inputs and outputs configuration.

120.- PLC configuration possibilities.

121.- PLC program languages.

122.- PLC different programming standard languages.

123.- New configuration and development of new process.

124.- Hand on an established process.

125.- To visualize and see the results and to make comparisons with the QRSC unit process.

126.- Possibility of creating new process in relation with the QRSC unit.

127.- PLC Programming Exercises.

128.- Own PLC applications in accordance with teacher and student requirements.

Continue...

Some Practical Possibilities of the Trainer: (continuation)

Practices to be done with the Laminar Flow Reactor (QRLC):

129.- Determination of the residence time distribution of the reactor.

130.- Effect of flow rate and feed concentration on the determination of flow pattern.

131.- Steady state conversion for a reaction with laminar flow.

132.- Effect of flow rate and feed concentration on the steady state conversion.

133.- Demonstration of the flow pattern in the reactor and comparison with the theoretical model.

134.- Effect of the temperature on the laminar flow characterisation.

135.- Determination of the steady state conversion of a second order reaction.

136.- Flow pattern characterisation in a laminar flow reactor.

137.- Measurement conductivity system: conductimeter.

138.- Calibration of the temperature sensors.

139.- Calibration of the conductivity sensor.

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

140.- Control of the QRLC unit process through the control interface box without the computer.

141.-Visualization of all the sensors values used in the QRLC unit process.

142.-Calibration of all sensors included in the QRLC unit process.

143.- Hand on of all the actuators involved in the QRLC unit process.

144.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

145.- 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).

146.- PLC hardware general use and manipulation.

147.- PLC process application for QRLC unit.

148.- PLC structure.

149.- PLC inputs and outputs configuration.

150.- PLC configuration possibilities.

151.- PLC program languages.

152.- PLC different programming standard languages.

153.- New configuration and development of new process.

154.- Hand on an established process.

155.- To visualize and see the results and to make comparisons with the QRLC unit process.

156.- Possibility of creating new process in relation with the QRLC unit.

157.- PLC Programming Exercises.

158.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with Plug Flow Reactor (QRPC):

159.- Determination of the residence time distribution of the reactor.

160.- Effect of flow rate and feed concentration on the determination of flow pattern.

161.- Study of the reactor response to different perturbations: step and pulse change.

162.- Effect of flow rate and feed concentration on the steady state conversion.

163.- Demonstration of the flow pattern in the reactor and comparison with the theoretical model.

164.- Determination of the steady state conversion of a second order reaction.

165.- Understanding the principles of tracer techniques in flow pattern characterisation.

166.- Measurement conductivity system: conductimeter.

167.- Calibration of the temperature sensors.

168.- Calibration of the conductivity sensor.

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

169.- Control of the QRPC unit process through the control interface box without the computer.

170.- Visualization of all the sensors values used in the QRPC unit process.

171.- Calibration of all sensors included in the QRPC unit process.

172.- Hand on of all the actuators involved in the QRPC unit process.

173.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

174.- 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).

175.- PLC hardware general use and manipulation.

176.- PLC process application for QRPC unit.

177.- PLC structure.

178.- PLC inputs and outputs configuration.

179.- PLC configuration possibilities.

180.- PLC program languages.

181.- PLC different programming standard languages.

182.- New configuration and development of new process.

183.- Hand on an established process.

184.- To visualize and see the results and to make comparisons with the QRPC unit process.

185.- Possibility of creating new process in relation with the QRPC unit.

186.- PLC Programming Exercises.

187.- Own PLC applications in accordance with teacher and student requirements.

Expansion 1:

EDIBON PATENT

Teaching Technique used

⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System

6 available Chemical Reactors

1 UNIT = 30 STUDENTS can work simultaneously

Service Unit (QUSC)

Control Interface Box

Computer Control Software: Computer Control + Data Acquisition + Data Management

Teacher's Central Computer

Mini Scada-Net Software

30 Student Post

LOCAL NET

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL + MULTI STUDENT POST

Note: The Mini-ESN system can be used with any EDIBON computer controlled unit.

Expansion 2:

EDIBON PATENT

Teaching Technique used

⑫ ESN. Multipost EDIBON Scada-Net System

Continuous Distillation Unit (UDCC)

Gas Absorption Column (CAGC)

Liquid-Liquid Extraction Unit (UELLC)

Chemical Reactors Trainer (QRC)

Rising Film Evaporator (EPAC)

"n" Any other additional computer controlled unit

"n" Control (1)Interface

"n" PLC

PLC

CENTRAL PLC

"REAL TIME MULTICONTROL SYSTEMS"

"SCADA" CENTRAL COMPUTER

30 Student Post

LOCAL NET

Option

"ETDL" EDIBON TECHNICAL DISTANCE LEARNING SYSTEM

30 students can work at the same time

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL + MULTI STUDENT POST

Note: The ESN system can use any EDIBON computer controlled unit.

ORDER INFORMATION

Items always supplied as minimum configuration

Common items for the Chemical Reactors:

① QUSC. **Service Unit.** (Common for Chemical Reactors and can work with one or several reactors).

② QRC/CIB. **Control Interface Box.** (Common for the Chemical Reactors and can work with one or several reactors).

③ DAB. **Data Acquisition Board.** (Common for the Chemical Reactors).

④ Available Chemical Reators:

④.1 QRCAC. **Continuous Stirred Tank Reactor,** and/or

④.2 QRTC. **Tubular Flow Reactor,** and/or

④.3 QRDC. **Batch Reactor,** and/or

④.4 QRSC. **Stirred Tank Reactors in Series,** and/or

④.5 QRLC. **Laminar Flow Reactor,** and/or

④.6 QRPC. **Plug Flow Reactor.**

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

⑥ **Manuals:** This trainer is **supplied with 8 manuals for each Chemical Reactor:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Additional and optional items

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

⑦ PCL-PI.PLC Module. (Common for the Chemical Reactors and can work with one or several reactors).

⑧ QRC/PLC-SOF. PLC Control Software. (Each Chemical Reactor has its own Software).

⑨ QRC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).

⑩ QRC/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/60 Hz.
- Water supply and drainage.
- Computer (PC).

RECOMMENDED ACCESSORIES

- Chemical reagents: ethyl acetate, sodium acetate and sodium hydroxide.
- Laboratory materials as: burettes, test tubes, glasses, balance and a 1litre glass flask.

DIMENSIONS & WEIGHTS

QUSC Unit:	- Dimensions: 800 x 800 x 1000 mm. approx. - Weight: 50 Kg. approx.
QRCAC Unit:	- Dimensions: 330 x 330 x 500 mm. approx. - Weight: 10 Kg. approx.
QRTC Unit:	- Dimensions: 330 x 350 x 500 mm. approx. - Weight: 15 Kg. approx.
QRDC Unit:	- Dimensions: 330 x 330 x 500 mm. approx. - Weight: 10 Kg. approx.
QRSC Unit:	- Dimensions: 950 x 450 x 500 mm. approx. - Weight: 35 Kg. approx.
QRLC Unit:	- Dimensions: 330 x 330 x 1490 mm. approx. - Weight: 25 Kg. approx.
QRPC Unit:	- Dimensions: 330 x 330 x 1350 mm. approx. - Weight: 25 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.

AVAILABLE VERSIONS

Offered in this catalogue:

- QRC. Computer Controlled **Chemical Reactors Trainer.**

Offered in other catalogues:

- QR. **Chemical Reactors Trainer.**
- QRQC. Computer Controlled **Chemical Reactors Training System.**

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

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