Summarized
Catalogue

five (5)

11. Chemical Engineering

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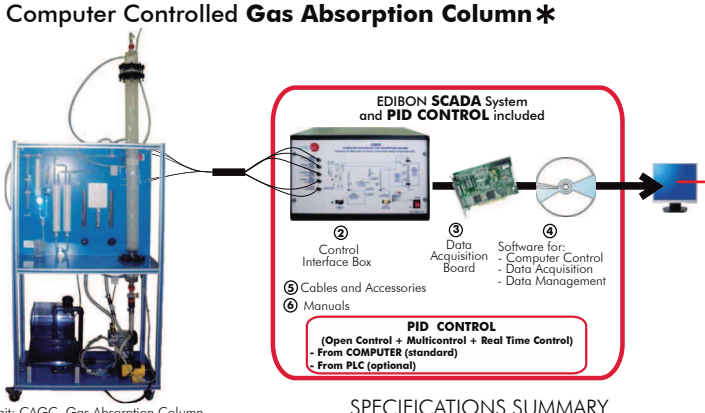
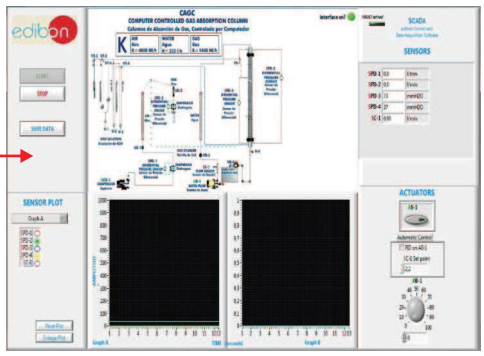
11.- Chemical Engineering

Equipment list

CAGC. Computer Controlled **Gas Absorption Column** ✱





① Unit: CAGC. Gas Absorption Column

SPECIFICATIONS SUMMARY

Items supplied as standard

① CAGC. Unit:
The Gas Absorption Column (CAGC) is a scale unit designed to study hydrodynamic and absorption processes in packed columns. This system absorbs ammonia or CO_2 from a mixture with air in a watery solution that flowing down the column.
This unit is mounted on an anodized aluminum rigid structure, with panels of painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Packed column: It consists of a glass cylindrical column of 1400 mm of height and 75 mm of internal diameter. It is filled with Raschig rings. 2 Differential pressure sensors.
Liquid circuit (water): a storage tank (40 l. capacity). A computer controlled centrifugal pump. The liquid flow that arrives at each moment to the column is measured with a flow sensor and a flowmeter. Liquid flow is controlled by PID control. A glass diffusion shower.
Gas circuit (air and Co_2): Compressor (blower), computer controlled. The gas (CO_2 or ammonia) is supplied by a cylinder, type bottle. Mixing system for the 2 gases streams. Both gas flows are measured by sensors.
CO_2 measuring device: A syringe to extract the specific quantities of a sample to be analysed. Two glass tanks located at different heights and interconnected that contain an aqueous solution of KOH, in which the contained CO_2 will be absorbed in the sample of gas to analyze. 3 Way-valves to direct the gaseous currents during the analysis process.

② CAGC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ CAGC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1000 x 740 x 2600 mm. Weight: 100 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringbasic/CAGC.pdf

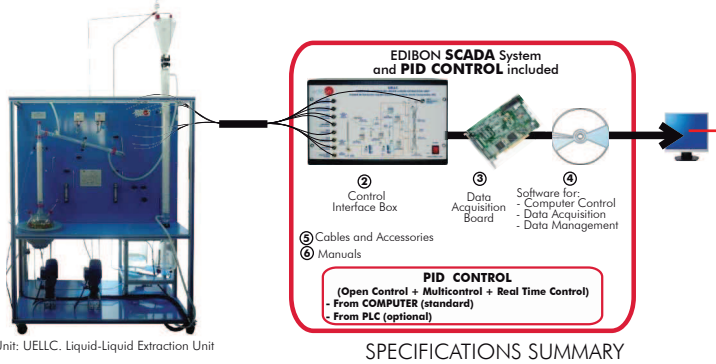
PRACTICAL POSSIBILITIES

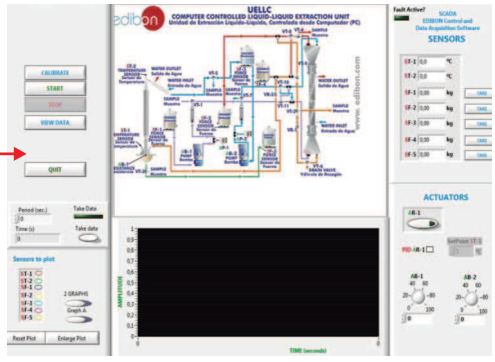
1.- Study of the basic principles of the absorption of a gas into a liquid using a packed column.
2.- Gas stream analysis.
3.- Study of the hydrodynamic characteristics of a packed column.
4.- Determination of the drag and flooding flows.
5.- Determination of the mass transfer coefficient.
6.- Checking of the mass balances.
7.- Demonstration of methods of gas and liquid quantitative analysis.
8.- Investigations of the variables influencing the effectiveness of the absorption.
9.- PID control system.
10.- Study of the hysteresis in the water flow sensor.

Additional practical possibilities:
11.- Sensors calibration.
12.- Determination of the water, CO_2 and air flow.
13.- Head loss in the column.

Other possible practices:
14-32.- Practices with PLC.

UELLC. Computer Controlled **Liquid-Liquid Extraction Unit** ✱





① Unit: UELLC. Liquid-Liquid Extraction Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① UELLC. Unit:
The UELLC unit is a laboratory scale unit designed to study the separation of the components of liquid mixtures by contact of the mixture with an immiscible solvent in which these components are preferentially soluble.
Anodized aluminum structure and panels of painted steel. Diagram in the front panel.
Extraction process: Jacketed glass column packed with glass Raschig rings; length: 1200 mm and internal diameter: 50 mm. Two enlargement pieces at the ends, capacity: 2 l.
Distillation process: Boiler for the distillation, heated by an adjustable electric heating mantle and with control of the temperature. Jacketed glass column packed with glass Raschig rings; length: 500 mm and internal diameter: 25 mm. A coolant column.
5 Pyrex storage tanks for the feed, refined, solvent, extract and solute. They include drain valves and force sensors. Two computer controlled diaphragm pumps. Computer controlled electrical heating mantle. Two temperature sensors to measure the temperature in the column head and the boiler temperature in the distillation process. Two flowmeters to measure the feed and solvent flow.

② UELLC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, other electronic in the control interface and, the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ UELLC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)=Unit: 1400 x 700 x 1950 mm. Weight: 100 Kg. Control Interface Box: 490 x 330 x 310 mm Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringbasic/UELLC.pdf

PRACTICAL POSSIBILITIES

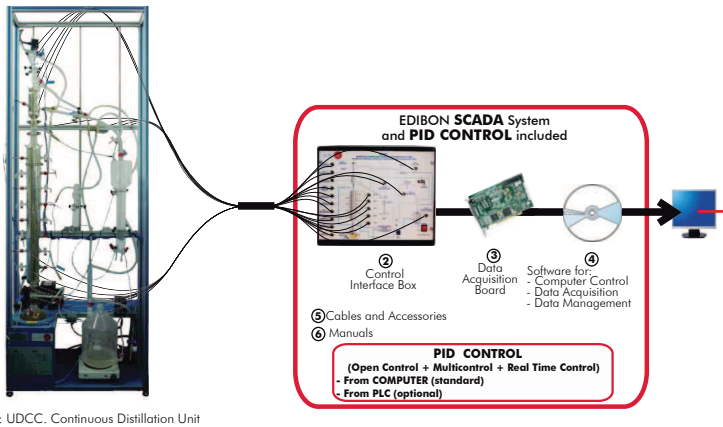
1.- Preparation of acid–base titration of the feed.
2.- Obtaining of the binodal curve.
3.- Study of theoretical and experimental mass balances.
4.- Calculation of the flooding velocity of the extraction column.
5.- Regulation of the height of the interface in the extraction column.
6.- Determination of the critical point existence.
7.- Study of the effect of the temperature in the liquid-liquid extraction process.
8.- Calculation of the mass transfer volumetric coefficient, referred to the continuous phase.
9.- Study of the efficiency of the extraction.
10.- Study of the batch operation regarding the solvent or the supply.
11.- Study of the extraction process for industrial processes.
12.- Calculation of the solvent recovery effectiveness.
13.- Study of the distillation process control.
14.- Repetition of the previous practical exercises for different compounds.

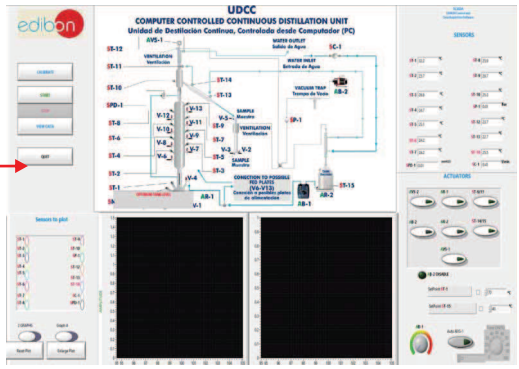
Additional practical possibilities:
15.- Calibration of the pumps.
16.- Sensors calibration.

Other possible practices:
17-35.- Practices with PLC.

✱ Non computer controlled version available too.

UDCC. Computer Controlled **Continuous Distillation Unit** ✱





①Unit: UDCC. Continuous Distillation Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

①UDCC. Unit:

Anodized aluminum structure and panels of painted steel.

Main metallic elements in stainless steel.

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

Sieve Plates Column with 8 plates with temperature taking (sensor) and sample in every plate; 50mm. internal diameter and 1000 mm. length. Vacuumed, silver-plated and double transparent band for vision.

The unit allows continuous operation and batch operation.

Column head with temperature taking, conical output for distilled product and ball refrigerator.

Column head with a valve for the steam distribution.

2 l. Boiler (with sample outputs), with heating mantle (computer controlled, PID Control).

2 l. Distillation collector of graduated glass.

Liebig-West coolant.

Feeding system in continuous with preheating (heating element, computer controlled, PID Control) at the specified temperature and a pump (computer controlled).

Feed vessel, 10 l. capacity.

Vacuum pump that allows to decrease the atmospheric pressure to 0.5 bar.

Pressure sensor.

Temperature measurement system. 14 temperature sensors.

Flow sensor.

Differential pressure sensor.

Solenoid valve, computer controlled (Reflux ratio).

Solenoid valve to discharge the boiler.

Level switch to control the level in the boiler.

The computer control system acts directly on:

The temperature of the heating elements.

The solenoid valve (reflux ratio).

The feeding pump.

Optional Columns (available other 4 different columns):

- CAR1. Raschig Rings Column.
- C8P1. 8 Plates Type Column (1 Temperature point).
- C10P10. 10 Plates Type Column (10 Temperature points).
- C14P14. 14 Plates Type Column (14 Temperature points).

②UDCC/CIB. Control Interface Box:

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process.

Calibration of all sensors involved in the process. Real time curves representation.

All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences.

Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process.

Open control allowing modifications, at any moment and in real time, of parameters involved in the process.

3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④UDCC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤Cables and Accessories, for normal operation.

⑥Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 900 x 600 x 2600 mm. Weight: 200 Kg. Control Interface Box: 490 x 450 x 470 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringbasic/UDCC.pdf

PRACTICAL POSSIBILITIES

1.- Preparation of solutions.

2.- Analytic valuation techniques.

3.- Filling of the column.

4.- Batch operation. Continuous operation.

5.- Obtaining the McCabe-Thiele diagram. Without reflux.

6.- Obtaining the number of plates. Without reflux.

7.- Efficiency calculations. Without reflux.

8.- Variation of the composition of the distilled product: constant reflux ratio.

9.- Constant composition of the distilled product: variation of reflux ratio.

10.- Constant composition of the distilled product: constant reflux ratio.

11.- Continuos feeding of the column.

12.- Mass and energy balances across the system.

13.- Plates fluid dynamics studies, including load loss and column flooding.

14.- Study of the feed temperature effect on the continuos processes.

15.- Calculation of the theoretical number of floors in the plates columns, and the equivalent height of the theoretical floor (HEPT) in the Raschig rings columns.

16.- Pursuit of the temperatures in all plates in the column (Plates columns).

17.- Study of the rectification efficiency at different pressures.

18.- Effect of feed pre-heat.

19.- Effect of feed position.

20.- Demonstration of azeotropic distillation.

21.- Work different heating contribution with regulation by the computer.

22.- Studies of heating interchange in glass refrigerators.

Additional practical possibilities:

23.- Dosing pump calibration.

24.- Temperature sensors calibration.

25.- Flow sensor calibration.

26.- Pressure sensor calibration.

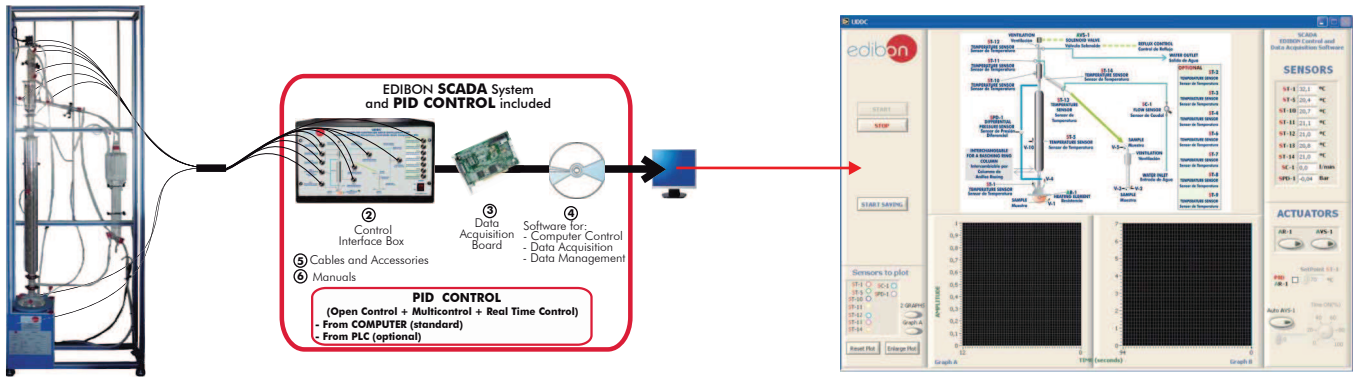
27.- Study of PID controls.

Other possible practices:

28-47.- Practices with PLC.

✱ Non computer controlled version available too.

UDDC. Computer Controlled **Batch Distillation Unit** ✱



① Unit: UDDC. Batch Distillation Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① UDDC. Unit:

Anodized aluminum structure and panel of painted steel.

Main metallic elements in stainless steel.

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

Sieve Plates Column with 8 plates with one temperature taking and sample, 50 mm. internal diameter and 1000 mm length. Vacuumed, silver-plated and double transparent band for vision.

Column head with temperature taking and conical output for distilled product.

Column head with a valve for the steam distribution.

2 l. Boiler (with sample outputs) with heating mantle, computer controlled.

Boiler temperature computer controlled. Temperature PID control.

2 l. Distillation collector of graduated glass.

Refrigerator.

Temperature measurement system.

7 Temperature sensors.

Flow sensor.

Differential pressure sensor.

Working temperature: ambient temperature up to 125°C.

Solenoid valve, computer controlled.

The computer control system acts directly on:

The temperature of the heating element (heating mantle).

The solenoid valve (reflux ratio).

Optional Columns (available other 4 different columns):

-CAR1. Raschig Rings Column.

-C8P8. 8 Plates Type Column (8 Temperature points).

-C10P10. 10 Plates Type Column (10 Temperature points).

-C14P14. 14 Plates Type Column (14 Temperature points).

② UDDC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process.

Calibration of all sensors involved in the process. Real time curves representation.

All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences.

Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process.

Open control allowing modifications, at any moment and in real time, of parameters involved in the process.

3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ UDDC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 900 x 600 x 2600 mm. Weight: 170 Kg. Control Interface Box: 490 x 330 x 310 mm Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringbasic/UDDC.pdf

PRACTICAL POSSIBILITIES

1.- Preparation of solutions.

2.- Analytic valuation techniques.

3.- Filling of the column.

4.- Batch operation.

5.- Obtaining the McCabe-Thiele diagram. Without reflux.

6.- Obtaining the number of plates. Without reflux.

7.- Efficiency calculations. Without reflux.

8.- Variation of the composition of the distilled product: constant reflux ratio.

9.- Constant composition of the distilled product: variation of reflux ratio.

10.- Constant composition of the distilled product: constant reflux ratio.

11.- Mass and energy balances across the system.

12.- Plates fluid dynamics studies, including load loss and column flooding.

13.- Calculation of the theoretical number of floors in the plates columns, and the equivalent height of the theoretical floor (HEPT) in the Raschig rings columns.

14.- Pursuit of the temperatures in all plates in the column (Plates columns).

15.- Study of the rectification efficiency.

16.- Demonstration of azeotropic distillation.

17.- Work different heating contribution with regulation by the computer.

18.- Studies of heating interchange in glass refrigerators.

Additional practical possibilities:

19.- Temperature sensors calibration.

20.- Flow sensor calibration.

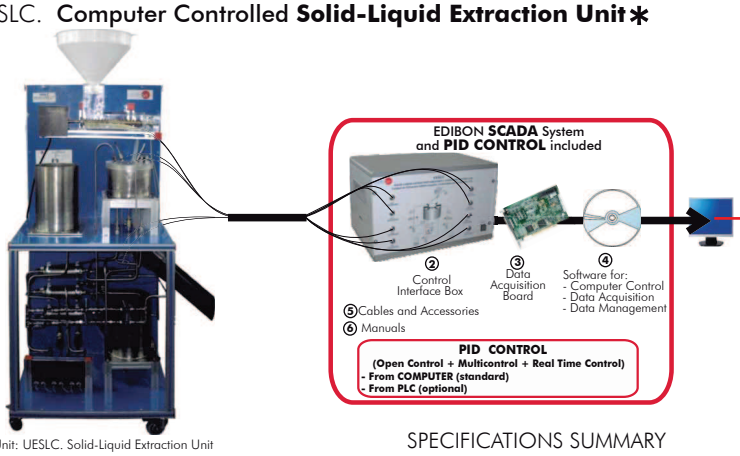
21.- Pressure sensor calibration.

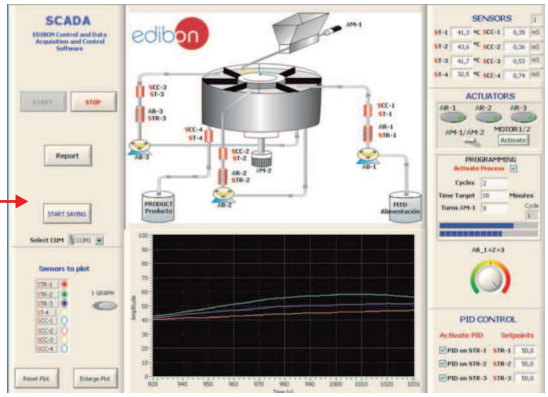
Other possible practices:

22-40.- Practices with PLC.

✱ Non computer controlled version available too.

UESLC. Computer Controlled **Solid-Liquid Extraction Unit** ✱





① Unit: UESLC. Solid-Liquid Extraction Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① UESLC. Unit:
The "UESLC" is an unit designed for studying the separation of a soluble fraction from a solid with the help of a solvent in a continuous multistage and countercurrent way.
Anodized aluminum structure and steel painted panels. Diagram in the front panel. Feed liquid vessel. Product liquid vessel. Feed hopper with feed endless screw for solids. Motor for feed endless screw. Main rotary extraction vessel with 8 cells of extraction. Motor for the rotation of the main extraction vessel. Variable rotation speed. 3 Sprinklers. Solid products exit. 3 Decanting filters. 4 Conductivity sensors. 4 Temperature sensors. 3 Heating elements, computer controlled. 3 Safety thermostats. 3 Peristaltic pumps, computer controlled. Circulation valves.

② UESLC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ UESLC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

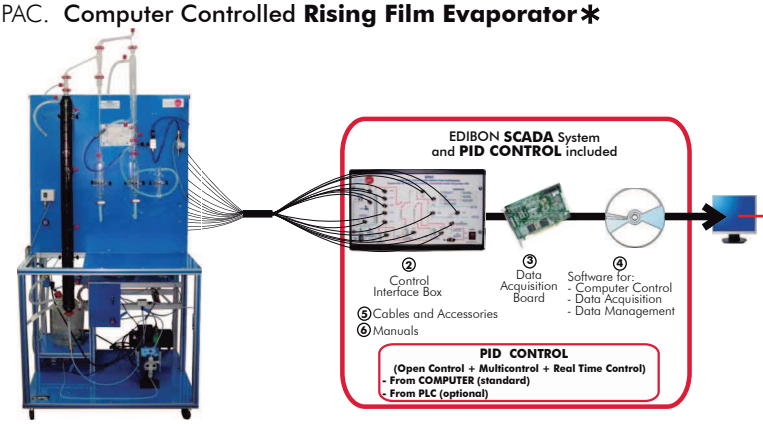
Dimensions (approx.)= Unit: 705 x 570 x 1680 mm. Weight : 120 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

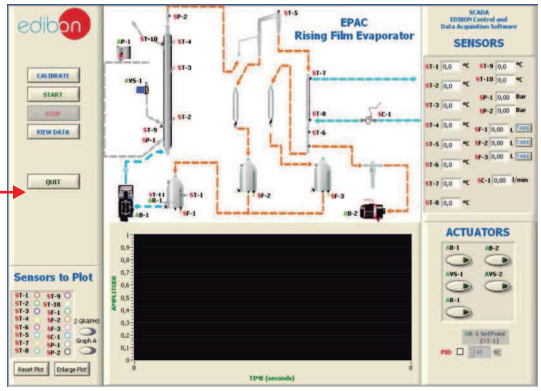
More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/UESLC.pdf

PRACTICAL POSSIBILITIES

1.- Demonstration of the operation of a continuous multiple stage process.
2.- Closed circuit percolation extraction (batch reaction).
3.- Open loop percolation extraction (continuous operation).
4.- Investigation of one, two and three stage continuous processes.
5.- Investigation into effect of solvent temperatures.
6.- Investigation into effect of solvent flow rates.
7.- Investigation into effect of processing time.
8.- Process economics. Process efficiency.
9.- Mass balances.
10.- Influence of the particle size.
11.- Influence of the stages numbers.
12.- Influence of the solvent type.
13.- Extractions of inorganic and aqueous components.
14.- Test of extractions for industrial use.
Other possible practices:
15.- Sensors calibration.
16-34.- Practices with PLC.

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





① Unit: EPAC. Rising Film Evaporator

SPECIFICATIONS SUMMARY

Items supplied as standard

① EPAC. Unit:
Anodized aluminum structure and panels of painted steel. Diagram in the front panel. Evaporation double jacket column, with a heating surface of 0.122m^2, 30mm of internal diameter, 60 mm of external diameter and 1300 mm of length. Membrane dosing pump, computer controlled. Single effect vacuum pump, computer controlled. Three 10 l. tanks (for feeding, concentrated and evaporated). Two 500 ml graduated vessels for the storage of concentrated and evaporated product. Heating element, computer controlled. Automatic temperature control. Coil coolant. High safety pressure cut out for pressure control in the column. 10 Temperature sensors. 1 Flow sensor. 3 Force sensors, one in each of the three tanks (for feeding, concentrated and evaporated), for measuring the amount of substance. 2 Pressure sensors. Solenoid valve, computer controlled.
Optional accessory: (not included in the standard supply)
EPDC. Computer Controlled Falling Film Evaporator (for adding to EPAC).

② EPAC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ EPAC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1000 x 805 x 2300 mm. Weight: 115 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

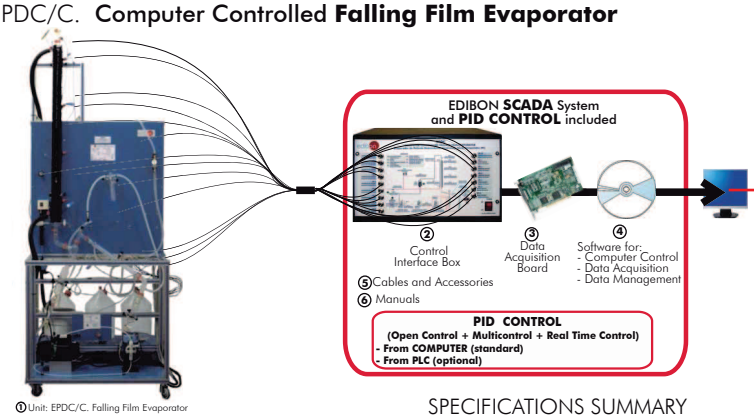
More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/EPAC.pdf

PRACTICAL POSSIBILITIES

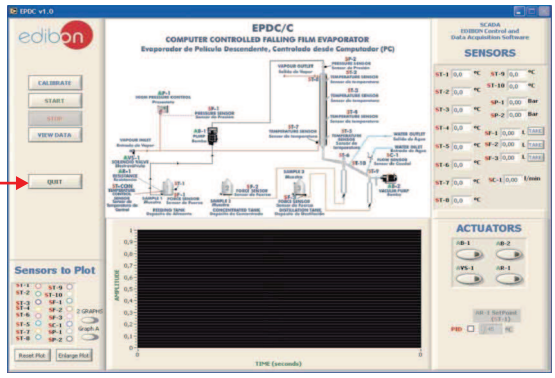
1.- Determination of the capacity of the evaporator.
2.- Study of the capacity of the evaporator in function of the work conditions.
3.- Study of the relation between condensed product and evaporated product.
4.- Verification of the mass balance over all system.
5.- Study of the mass balance of the solute.
6.- Verification of the mass balance of the water.
7.- Determination of the concentration of a sugared solution.
8.- Calculate the enthalpy of the volatile vapours.
9.- Calculate the mass of steam is used by means of an energy balance calculation.
10.- Determination the economy of evaporator.
11.- Energy balance of the tubular condenser.
12.- Determination of the heat transfer global coefficient.
13.- Determination of the C_i coefficient for a tubular condenser.
14.- Investigation of effect of varying process parameters such as: vacuum, flow rate, temperature, recycle rate.
15.- Fruit juices and vegetable extracts concentration.
16.- Concentrated milk obtaining .
17.- Determination of the efficiency of the steam generator.
Additional practical possibilities:
18.- Sensors calibration.
19.- Feed pump calibration.
Other possible practices:
20-38.- Practices with PLC.

✱ Non computer controlled version available too.

EPDC/C. Computer Controlled **Falling Film Evaporator**



①Unit: EPDC/C. Falling Film Evaporator



SPECIFICATIONS SUMMARY

Items supplied as standard

① EPDC/C. Unit:
Anodized aluminum structure and panels of painted steel. Diagram in the front panel. Evaporation double jacket column, with a heating surface of 0.122 m², 30 mm. of internal diameter, 60 mm. of external diameter and 1300 mm. of length. Membrane dosing pump, computer controlled. Single effect vacuum pump, computer controlled. Three 10 l. tanks (for feeding, concentrated and evaporated). Two 500 ml. graduated vessels for the storage of concentrated and evaporated product. Liebing West condenser. Heating element, computer controlled. Automatic temperature control. High safety pressure cut out for pressure control in the column. Sensors: 10 temperature sensors, 1 flow sensor, 3 force sensors, 2 pressure sensors. Solenoid valve, computer controlled.

② EPDC/C/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ EPDC/C/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1000 x 805 x 2500 mm. Weight :115 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

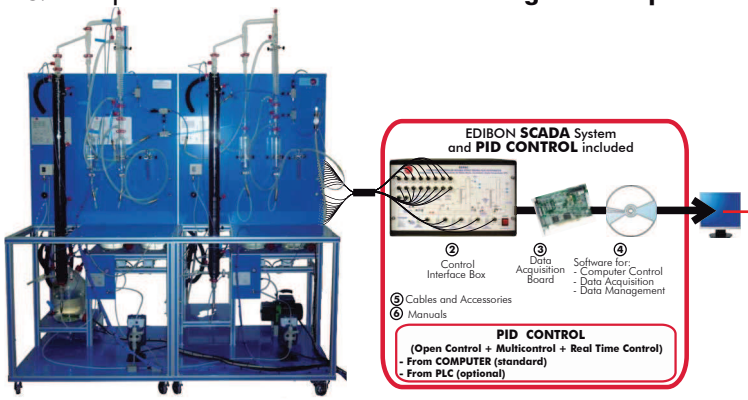
More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/EPDC-C.pdf

PRACTICAL POSSIBILITIES

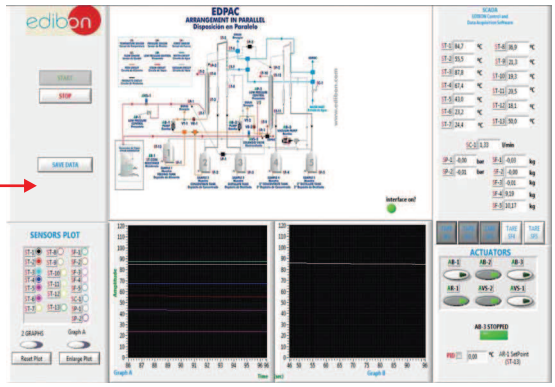
1.- Determination of the capacity of the evaporator.
2.- Study of the capacity of the evaporator in function of the work conditions.
3.- Study of the relation between condensed and evaporated product.
4.- Verification of the global mass balance of the system.
5.- Study of the mass balance for the solute.
6.- Verification of the mass balance for the water.
7.- Determination of the concentration of a sugar solution.
8.- Calculation of the enthalpy of the volatile vapours.
9.- Calculation of the mass of steam used by means of an energy balance calculation.
10.- Determination of the economy of the evaporator.
11.- Determination of the efficiency of the steam generator.
12.- Investigation of the effects of varying the process parameters such as: vacuum, flow rate, temperature, etc.
13.- Concentration of fruit juices and vegetable extracts.
14.- Obtaining concentrated milk.

Other possible practices:
15.- Sensors calibration.
16.- Feeding pump calibration.
17-35.- Practices with PLC.

EDPAC. Computer Controlled **Double Effect Rising Film Evaporator** ✱



①Unit: EDPAC. Double Effect Rising Film Evaporator



SPECIFICATIONS SUMMARY

Items supplied as standard

① EDPAC. Unit:
The "EDPAC" unit allows to observe and control a serial, parallel or double effect evaporation process. Three diagrams with the arrangement of the elements in the front panel with the three possible configurations. 2 Evaporation double jacket columns, with a heating area of 0.122 m², 30 mm of inner diameter, 60 mm of outer diameter and length of 1300 mm. 2 Membrane dosing pumps, computer controlled. Simple effect vacuum pump, computer controlled. Five 10 l. tanks (for feeding, concentrated and evaporated). Four 500 ml graduated vessels for storage of concentrated and evaporated product. Heating element, computer controlled. Included a safety temperature sensor with internal temperature controller. Automatic temperature control (PID Control). 2 Coil coolants. 2 High safety pressure cut out for pressure control in the columns. 13 Temperature sensors. 1 Flow sensor. 2 Pressure sensors. 5 Force sensors, one in each one of the five tanks (for feeding, concentrated and evaporated), for measuring the amount of fed or collected substance. 2 Solenoid valves, computer controlled.

The unit allows to work with several configurations:
a) Double-effect: the steam generated in the first stage of the evaporation is introduced in the second column.
b) Steam from the first column´s jacket can be used to heat the second column.
c) Columns receive steam from the generator in an independent way.

OPTIONAL Accessory: (not included in the standard supply)
-EDPDC. Computer Controlled Double Effect Falling Film Evaporator (for adding to EDPAC).

② EDPAC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ EDPAC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 2300 x 1000 x 2300 mm. Weight :200 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/EDPAC.pdf

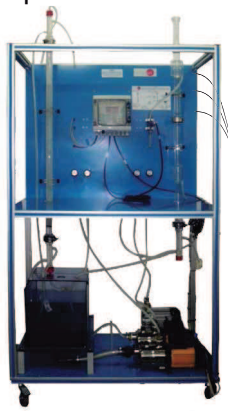
PRACTICAL POSSIBILITIES

1.- Heating efficiency calculation.
2.- Sugared solution concentration.
3.- Evaporation velocity determination.
4.- Study of the evaporation velocity in function of the working conditions.
5.- Study of the relation between condensed and evaporated product.
6.- Study of the mass balance of the solute.
7.- Study of the mass balance of the solvent.
8.- Energy balance of the evaporation unit.
9.- Energy balance of the tubular refrigerator.
10.- Heat transfer global coefficient determination.
11.- Heat transfer coefficient determination of a tubular refrigerator.
12.- Study of the mass balance of the solute in one column.
13.- Fruit juices and vegetable extracts concentration.
14.- Concentrated milk obtaining.
15.- Efficiency determination of the steam used in the process.
16.- Steam generator efficiency determination.
17.- Investigation of effect of varying process parameters such as: vacuum, flow rate, temperature, recycle rate.

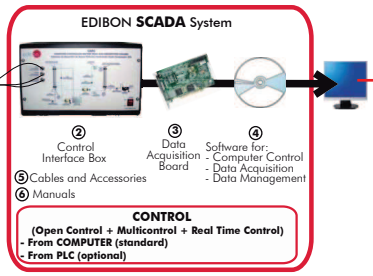
Additional practical possibilities:
18.- Sensors calibration.
19.- Feed pumps calibration.
20-38.- Practices with PLC.

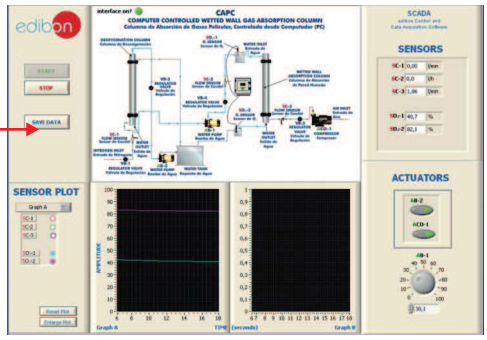
✱ Non computer controlled version available too.

CAPC. Computer Controlled **Wetted Wall Gas Absorption Column**



① Unit: CAPC. Wetted Wall Gas Absorption Column





SPECIFICATIONS SUMMARY

Items supplied as standard

① CAPC. Unit:
Anodized aluminum structure and panels of painted steel. Wetted walls absorption column, consisting of a glass cylindrical tube of 900 mm. long and 32 mm. of inner diameter. It has two overflows connected in series to two membrane electrodes which allow the measurement of the oxygen dissolved in the water. Desorption column, consisting of a glass cylindrical tube of 1400 mm. long and 26 mm. of inner diameter. Water tank. Two supply centrifugal pumps, computer controlled, for the wetted wall absorption column and for the desorption column respectively. Air compressor, computer controlled. Air flow sensor. Nitrogen flow sensor. Water flow sensor. An O_2 measuring device that allows to determine the concentration and saturation of such gas in the water currents belonging to the inlet and outlet of the wetted wall absorption column. Two sample takings for the inlet and outlet water, respectively, of the absorption column, for the study of the oxygen contained in the water flows. The gas supplied to the desorption column comes from a cylinder of compressed nitrogen with pressure regulator (not included in the unit supply).

② CAPC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the PC keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ CAPC/CCSOF. Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1000 x 500 x 2000 mm. Weight: 200 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/CAPC.pdf

PRACTICAL POSSIBILITIES

1.- Absorption process study.

2.- Calculation of liquid film mass transfer coefficients.

3.- Study of the variation of the coefficient depending on mass flow rate.

4.- Variation of oxygen flow rate to determine power law relationship.

5.- Effect of water flow rate.

6.- Effect of oxygen flow rate.

Additional practical possibilities:

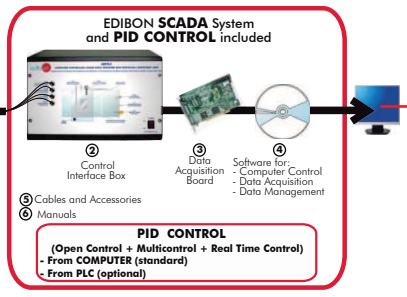
7.- Sensors calibration.

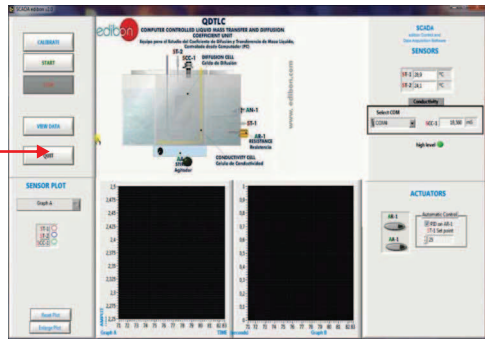
Other possible practices:

8-26.- Practices with PLC.

QDTLC. Computer Controlled **Liquid Mass Transfer and Diffusion Coefficient Unit** ✱

① Unit: QDTLC. Liquid Mass Transfer and Diffusion Coefficient Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

① QDTLC. Unit:
The QDTLC is an unit that allows the students to familiarise with the notions of mass transfer theory, specially the diffusion in liquid systems, obtaining experimental data and results which are very useful for an ideal practice understanding of the process and consequently, for the technical teaching of the students. Anodized aluminum structure and panels of painted steel. Diagram in the front panel. Transparent tank for liquids (experimentation vessel). Magnetic stirrer (computer controlled) and magnet. Conductivity meter and conductivity cell. Temperature sensor. Diffusion cell.
Thermostatic bath, including: water vessel; heating element, computer controlled, with PID Control; level switch; temperature sensor.

② QDTLC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QDTLC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 500 x 370 x 500 mm. Weight: 20 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/QDTLC.pdf

PRACTICAL POSSIBILITIES

1.- Fick´s law application to calculate the diffusivity.

2.- Direct measurement of mass transfer rates.

3.- Determination of molar density rate.

4.- Effect of concentration of diffusion coefficients.

5.- Simple analysis of a first order unsteady state process.

6.- Concentration and conductivity relation.

7.- Study the temperature effect on diffusion coefficients.

Additional practical possibilities:

8.- Sensors calibration.

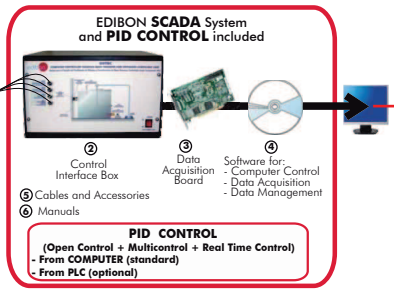
Other possible practices:

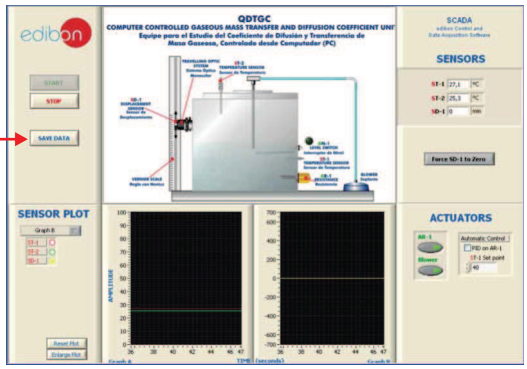
9-27.- Practices with PLC.

✱ Non computer controlled version available too.

QDTGC. Computer Controlled **Gaseous Mass Transfer and Diffusion Coefficient Unit** ✱

① Unit: QDTGC. Gaseous Mass Transfer and Diffusion Coefficient Unit





SPECIFICATIONS SUMMARY
Items supplied as standard

① QDTGC. Unit:
The QDTGC is an unit that allows to students familiarise with the notions of mass transfer theory, specifically about the diffusion of a volatile liquid into an inert gas, obtaining experimental data and results which are very useful for a correct practice understanding of the process and, consequently, for the technical teaching of the students.
Anodized aluminum structure and panels of painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
A precision glass capillary tube (a narrow vertical tube with a known inside diameter). Air pump with air regulation, computer controlled. Travelling optic system with accurate focus adjustment and mounted for vertical axis movement. Distance measurement by displacement sensor.
A thermostatically controlled water transparent-sided Bath.
Heating element (500 W), computer controlled. 2 Temperature sensors. Level switch.

② QDTGC/CIB. 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. All the actuators' values can be changed at any time from the keyboard. 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. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QDTGC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 600 x 570 x 570 mm. Weight: 30 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/QDTGC.pdf

PRACTICAL POSSIBILITIES

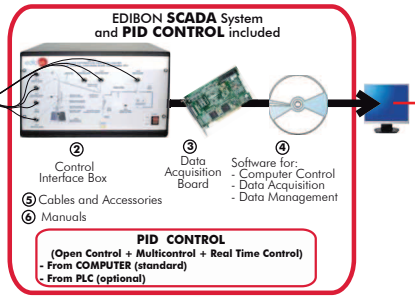
1.- Fick´s law application to calculate the diffusivity.
2.- Direct measurement of mass transfer rates.
3.- Determination of molar density transfer rate.
4.- Study of the effect of temperature on diffusion coefficients.
5.- Use of gas laws to calculate concentration differences in terms of partial pressures.
6.- Graphic representation of concentration profiles.

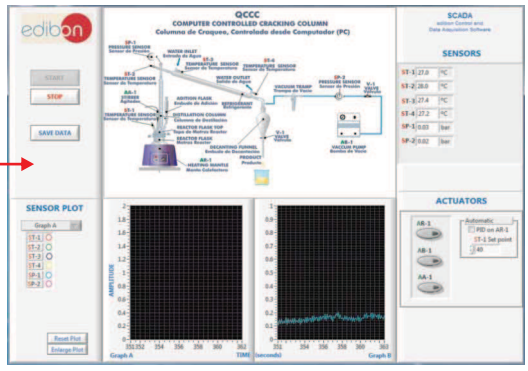
Other possible practices:

7.- Sensors calibration.
8-26.- Practices with PLC.

QCCC. Computer Controlled **Cracking Column**

① Unit: QCCC. Cracking Column





SPECIFICATIONS SUMMARY
Items supplied as standard

① QCCC. Unit:
The QCCC unit for cracking and distilling oil is a complete lab tool that allows to the students to carry out a cracking reaction, and the study and the control of different variables that condition it. Also, the production cycle will be completed by means of a separation, purification and analysis of the obtained products in that cracking reaction.
Anodized aluminum structure and panels of painted steel. Diagram in the front panel.
Glass elements made of "Pyrex" of high thermal and mechanical resistance. 1 l. Reactor flask, with discharge key. Reactor´s cap, with 4 inlets. Distillation column. Stirring rod with stirring lock , that assures a perfect insulation of the system. Graduated filling funnel. Heating through electrical heating mantle, computer controlled. Maximum working temperature: 300 °C. Liebig-West condenser with interchangeable fittings. Decantation funnel. Vacuum pump, computer controlled. Vacuum trap. Pressure and temperature intakes placed in the main points of the system. 4 Temperature sensors. 2 Pressure sensors.

② QCCC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QCCC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1000 x 470 x 1070 mm. Weight: 75 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/QCCC.pdf

PRACTICAL POSSIBILITIES

1.- Carry out cracking reactions.
2.- Influence of the temperature in the Ricinoleic Acid cracking reaction (gradual increment of temperature).
3.- Influence of the temperature in the Ricinoleic Acid cracking reaction (sudden increment of temperature).
4.- Influence of the pressure in the Ricinoleic Acid pyrolysis reaction (working pressure too low).
5.- Influence of pressure in the Ricinoleic Acid pyrolysis reaction (low working pressure).
6.- Work with different heating gradients, regulated through the computer.
7.- Work with different pressures, regulated through the computer.
8.- Pitch as a catalyst.
9.- Simple distillation. Separation in its components of the product mixture of cracking.
10.- Heptanal purification.
11.- Undecylenic acid purification.
12.- Application of samples on TLC plates.
13.- Thin layer chromatography plates analysis.
14.- Study of several parameters that influence the analysis by thin layer chromatography.
15.- Other simple practices as calibration of instruments, preparation of samples, etc.

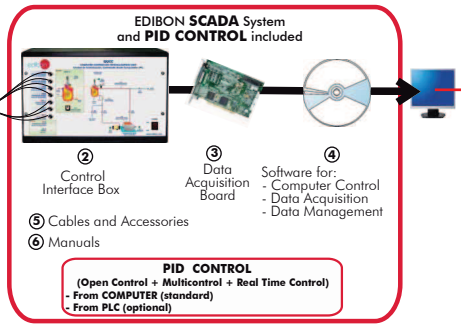
Additional practical possibilities:
16.- Sensors calibration.
17.- Cleaning the system.
18.- Monogram of pressure.

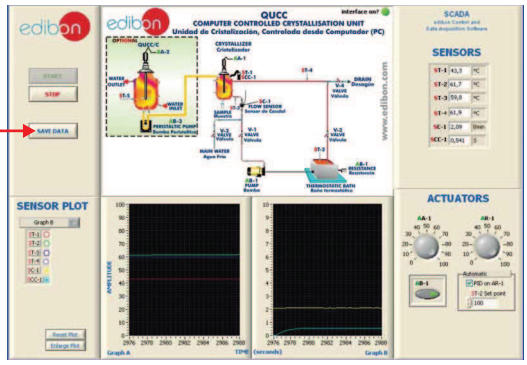
Other possible practices:
19-37.- Practices with PLC.

✱ Non computer controlled version available too.

QUCC. Computer Controlled **Crystallisation Unit** ✱

① Unit: QUCC. Crystallisation Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

① QUCC. Unit:
The QUCC is an unit for the study of the cooling crystallization process. Unit to study the crystallization reaction of those constituents whose solubility changes with the temperature.
Anodized aluminium structure and panels of painted steel. Diagram in the front panel. Crystallizer composed of jacketed reactor made in glass (capacity 1 l.), which includes temperature sensors and stirrer. Batch operation. Variable speed stirrer, computer controlled. The crystallization reactor is thermally controlled by means of heated water circulating in the reactor jacket. PID control over the reactor temperature. Thermostatic bath, with feed water impulsion pump, computer controlled. Water flow sensor. 4 Two way valves to allow the water circulation, according to the process. 4 Temperature sensors, located at key points of the system. Pressure regulation valve to protect the system. Conductivity cell to measure the solution conductivity. Set of sieves, composed of: 3 sieves of different light size. Vessel to collect the crystals.
Optional (NOT included in the supply):
- QUCC/C. Continuous Feed Unit.

② QUCC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QUCC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 800 x 700 x 1000 mm. Weight: 55 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/QUCC.pdf

PRACTICAL POSSIBILITIES

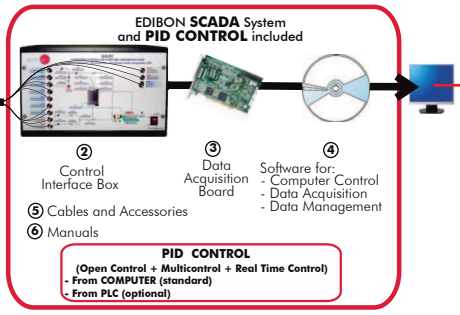
1.- Understanding the principles of solution cooling crystallization.
2.- Study of crystal size distribution.
3.- Batch operation.
4.- Obtaining crystals by the cooling method.
5.- Demonstration of the effects of varying the following parameters on the crystallization process:
Concentration of solute.
Stirring level.
Cooling temperature.
Solute supply flow (optional if the QUCC/C unit is purchased).

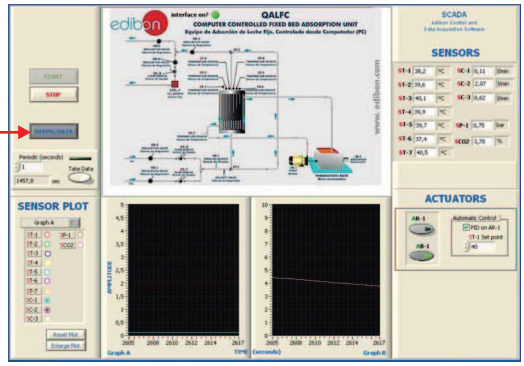
Additional practical possibilities:
6.- Sensors calibration.
7.- Mass and energy balances.
8.- Evaluation of crystallization efficiency and crystallization kinetics.
9.- Operation in continuous (optional, if the unit "QUCC/C" is acquired).
10.- Demonstration the effect of varying the solute supply flow on the crystallization process (optional, if the unit "QUCC/C" is acquired).

Other possible practices:
11-29.- Practices with PLC.

QALFC. Computer Controlled **Fixed Bed Adsorption Unit**

① Unit: QALFC. Fixed Bed Adsorption Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

① QALFC. Unit:
The QALFC unit is designed to demonstrate the gas adsorption phenomenon using a fixed bed adsorption column. The overall objective of this unit is to analyze the behaviour of the adsorption breakthrough and desorption elution curves associated with the separation of CO_2 from He using activated carbon.
Two pressure regulators, one for the He inlet an the other for the CO_2 inlet, to control the inlet pressure of both gases to the unit. The two gases (CO_2 and He) are fed from compressed gas cylinders.
Fixed bed adsorption column: height: 310mm; diameter: 80 mm., stainless steel jacket, bed of glass beads for gas distribution, gas distribution plate at the column inlet, six temperature sensors, a column bypass is incorporated for system calibration purposes that includes two 3-way directional valves which divert the gas stream between the fixed bed adsorption column and the bypass, the column is loaded with activated carbon supplied.
Hot water circulation system, including: pump (computer controlled), thermostatic bath computer controlled, temperature sensor (this temperature sensor works with the PID controller to maintain the desired temperature inside the column), flexible tubing used to connect the pump to the column's jacket and the column's jacket to the thermostatic bath. 3 mass sensors. A CO_2 infrared detector measures the CO_2 concentration at the column outlet. A sensor shows the system pressure. 5 needle valves.

② QALFC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QALFC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1100 x 670 x 700 mm. Weight: 50 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalengineeringgeneral/QALFC.pdf

PRACTICAL POSSIBILITIES

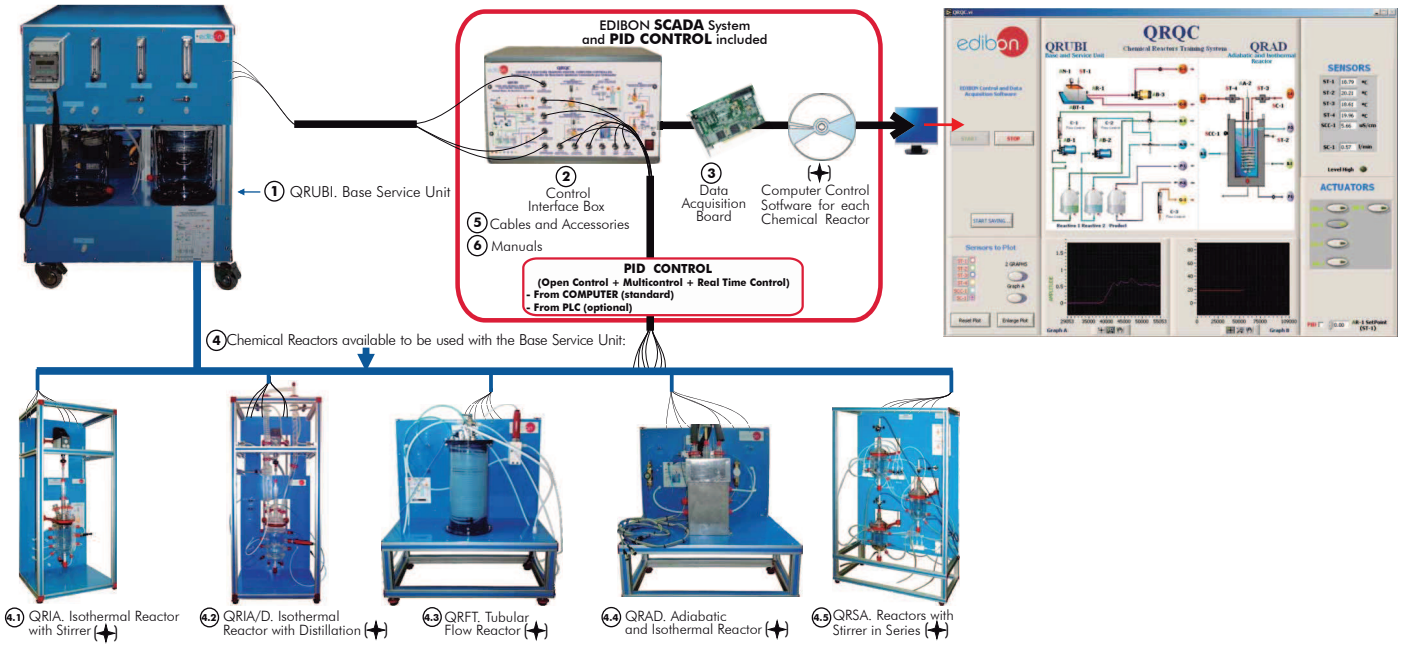
1.- Study of adsorption/desorption processes under different operational conditions such as: temperature, flow rates, pressure, molar fraction.
2.- Study of the Solute Movement Theory model.
3.- Study of the breakthrough curves of temperature profiles during the process.
4.- Analysis of the breakthrough curves of CO_2 during the adsorption and desorption/regeneration processes.
5.- Study of the quasi-isothermal regime at low concentrations and pressures.
6.- Study of the formation of the compressive and dispersive fronts in adsorption processes.

Additional practical possibilities:
7.- Sensors calibration.
8.- Obtaining of the adsorption equilibrium isotherm of CO_2 from the desorption curve.

Other possible practices:
9-27.- Practices with PLC.

✱ Non computer controlled version available too.

QRQC. Computer Controlled **Chemical Reactors Training System:**



SPECIFICATIONS SUMMARY

Common items for Chemical Reactors type "QR":

① QRUBI. Base Service Unit:

This unit is common for Chemical Reactors and can work with one or several reactors. It supplies all the services for the operation of each reactor.

2 Dosing pumps, computer controlled. 3 Tanks of 10 l.: two for the reagents and the other for the product. 2 Flow meters for liquids. Flow meter for gas. Thermostatic bath that regulates the temperature . Level switch. A pump, computer controlled, to impel the water that comes from the thermostatic bath and goes to the reactor. Temperature sensor to get the temperature of the reactor in a continuos way. Temperature control thought the computer. Control system of the reaction. The control of the reaction is carry out by means of a conductivity cell and a conductimeter, connected to the control interface box.

Dimensions (approx.)= 1100 x 1000 x 980 mm. Weight: 100 Kg.

② QRQC/CIB. Control Interface Box :

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

It has a process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: one mechanical in the unit, electronic in the control interface, and the third one in the control software.

Dimensions (approx.): 490 x 330 x 310 mm. Weight: 10 Kg.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ Chemical Reactors:

④.1 QRIA. Isothermal Reactor with Stirrer:

Anodized aluminum structure and panels of painted steel.

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

Reactor insulated made of Pyrex-glass, with a maximum volume of 2 l.

Inlets of reagents. Outlet of products. Conductivity cell connection. Water outlet. Water inlet.

Temperature sensor connection. Gas inlet. Gas outlet.

Agitation system with agitation speed control.

Temperature sensor. Conductivity sensor.

Safety, easy and quick connections.

This unit is supplied with 8 manuals.

Computer Control + Data Acquisition + Data Management Software for Isothermal Reactor with Stirrer (QRIA):

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.)= 750 x 500 x 700 mm. Weight: 50 Kg.

Continue...

PRACTICAL POSSIBILITIES

Practices to be done with the Isothermal Reactor with Stirrer (QRIA):

1.- Determination of the ionic conductivities.
2.- Discontinuous operation. Obtaining of the reaction order respect to ethyl-acetate. Initial velocity method.
3.- Discontinuous operation. Obtaining of the reaction order respect to sodium hydroxide. Initial velocity method.
4.- Discontinuous operation. Velocity Constant Computation. Constant sodium hydroxide initial concentration.
5.- Discontinuous Operation. Velocity Constant Computation. Constant ethyl-acetate initial concentration.
6.- Velocity equation formulation.
7.- Discontinuous Operation. Variation of the kinetic constant with temperature. Arrhenius Equation.
8.- Discontinuous Operation. Theoretical and experimental conversion comparative. Deviation from ideality.
9.- Discontinuous Operation. Mixture effects.
10.- Continuous Operation.
11.- Continuous Operation. Mixture effects.
12.- Measurement conductivity system: conductimeter.
13.- Calibration of the temperature sensors.
14.- Calibration of the conductivity cell.
15-33.- Practices with PLC.

Continue...

QRQC. Computer Controlled **Chemical Reactors Training System:**

SPECIFICATIONS SUMMARY

④ Chemical Reactors:

4.3 QRIA/D. Isothermal Reactor with Distillation:

Anodized aluminum structure and panels of painted steel.

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

Reactor insulated made of Pyrex-glass, with a maximum volume of 2 l.

Inlets of reagents. Outlet of products. Conductivity cell connection. Water outlet. Water inlet.

Temperature sensor connection. Gas inlet. Gas outlet.

Agitation system with agitation speed control.

Distillation column. Balls coolant. Coil coolant. Vacuum pump. Vacuum tramp. Graduated funnel.

Temperature sensors. Conductivity sensor.

Safety, easy and quick connections.

This unit is supplied with 8 manuals.

Computer Control + Data Acquisition + Data Management Software for Isothermal Reactor with Distillation (QRIA/D):

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.)= 750 x 500 x 700 mm. Weight: 70 Kg.

4.3 QRFT. Tubular Flow Reactor:

Anodized aluminum structure and panels of painted steel.

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

Temperature controlled by a jacket of water, through a temperature sensor "J" type.

Electrical pre-heater for both feeding lines.

Reactor with inner coil made of teflon of 6mm of interior diameter, length 14.5 m, volume: 0.393 l.

Temperature sensor "J" type , that controls the preheating temperature.

Conductivity sensor.

Safety, easy and quick connections.

This unit is supplied with 8 manuals.

Computer Control + Data Acquisition + Data Management Software for Tubular Flow Reactor (QRFT):

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.)= 700 x 500 x 500 mm. Weight: 75 Kg.

4.4 QRAD. Adiabatic and Isothermal Reactor:

Anodized aluminum structure and panels of painted steel.

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

Reactor insulated made of Pyrex-glass, with a maximum volume of 2 l.

Nickel-plated cooper coil of 2500 mm long, outer diameter of 6.7 mm and inner one of 4.1 mm.

Stirrer.

Water flow control of 0-6 l./min.

Outer jacket made of anodised aluminium and inner jacket made of expanded polyurethane foam rubber.

3 Temperature sensors. Conductivity sensor.

Safety, easy and quick connections.

This unit is supplied with 8 manuals.

Computer Control + Data Acquisition + Data Management Software for Adiabatic and Isothermal Reactor (QRAD):

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.)= 1000 x 600 x 400 mm. Weight: 100 Kg.

4.5 QRSA. Reactors with Stirrer in Series:

Anodized aluminum structure and panels of painted steel.

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

3 Reactors insulated made of Pyrex-glass, with a maximum volume of 1 l. each one.

Agitation system with agitation speed control, for each reactor.

3 Temperature sensors.

Conductivity sensors.

Safety, easy and quick connections.

This unit is supplied with 8 manuals.

Computer Control + Data Acquisition + Data Management Software for Reactors with Stirrer in Series (QRSA):

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.) = 1000 x 1000 x 1000 mm. Weight: 100 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/reactors/QRQC.pdf

PRACTICAL POSSIBILITIES

Practices to be done with the Isothermal Reactor with Distillation (QRIA/D):

34.- Determination of the ionic conductivities.
35.- Discontinuous operation. Obtaining of the reaction order respect to ethyl-acetate. Initial velocity method.
36.- Discontinuous operation. Obtaining of the reaction order respect to sodium hydroxide. Initial velocity method.
37.- Discontinuous operation. Velocity Constant Computation. Constant sodium hydroxide initial concentration.
38.- Discontinuous Operation. Velocity Constant Computation. Constant ethyl-acetate initial concentration.
39.- Velocity equation formulation.
40.- Discontinuous Operation. Variation of the kinetic constant with temperature. Arrhenius Equation.
41.- Discontinuous Operation. Theoretical and experimental conversion comparative. Deviation from ideality.
42.- Discontinuous Operation. Mixture effects.
43.- Continuous Operation.
44.- Continuous Operation. Mixture effects.
45.- Measurement conductivity system: conductimeter.
46.- Study of the reactive distillation.
47.- Study of alcohols condensation.
48.- Study of the organic anhydrides.
49.- Synthesis of esters.
50.- Calibration of the temperature sensors.
51.- Calibration of the conductivity cell.
52-70.- Practices with PLC.

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

71.- Analysis of reagents and products.
72.- Ionic conductivities determination.
73.- Theoretical conversion of the tubular reactor.
74.- Experimental determination of the conversion of the tubular reactor.
75.- Dependence in the residence time.
76.- Determination of the reaction order.
77.- Dependence of the speed constant and the conversion with the temperature.
78.- Measurement conductivity system: conductimeter.
79.- Complete emptying of the unit.
80.- Calibration of the temperature sensors.
81-99.- Practices with PLC.

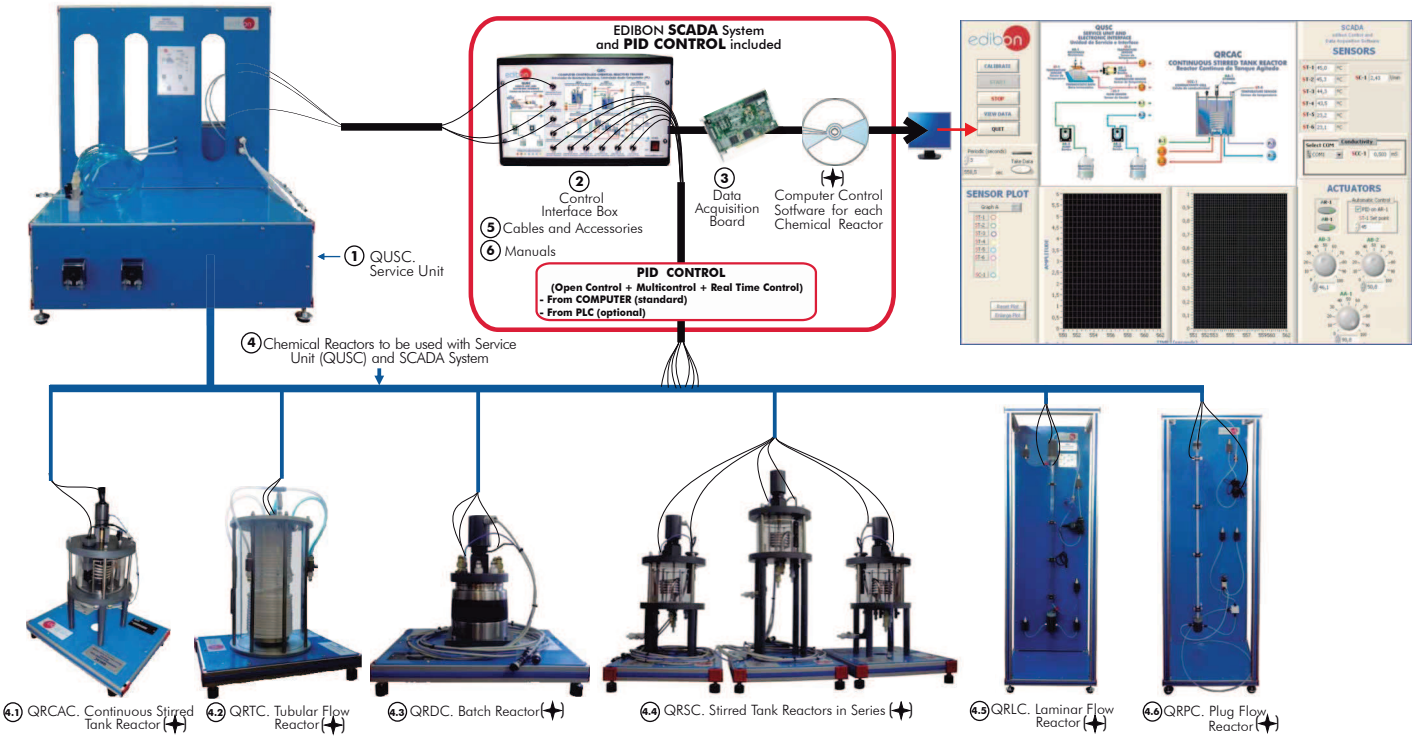
Practices to be done with the Adiabatic and Isothermal Reactor (QRAD):

100.- Determination of the ionic conductivities.
101.- Discontinuous work. Calculation of the order of the reaction referred to the ethyl-acetate. Initial velocity method.
102.- Discontinuous operation. Determination of the order of the reaction referred to the sodium hydroxide. Initial velocity method.
103.- Discontinuous operation. Determination of the speed constant, the initial concentration of the sodium hydroxide is constant.
104.- Discontinuous operation. Determination of the speed constant, the initial concentration of the ethyl acetate is constant.
105.- Formulation of the speed equation.
106.- Discontinuous operation. Variation of the kinetic constant when the temperature is not constant: Arrhenius equation.
107.- Discontinuous operation. Comparison of the theoretical and the experimental conversion: Deviation from the ideality.
108.- Calculation of the heat transference coefficient of the coil.
109.- Calculation of the hydrolysis reaction enthalpy.
110.- Discontinuous operation. Mixture effects.
111.- Continuous operation.
112.- Measurement conductivity system: conductimeter.
113.- Calibration of the temperature sensors.
114.- Calibration of the flow sensor.
115.- Calibration of the conductivity sensor.
116-134.- Practices with PLC.

Practices to be done with the Reactors with Stirrer in Series (QRSA):

135.- Determination of the ionic conductivities.
136.- Work with just one reactor in continuous.
137.- Work with just one reactor in continuous with mixture effects.
138.- Work with 3 reactors in continuous.
139.- Calibration of the temperature sensors.
140.- Calibration of the conductivity cell.
141-159.- Practices with PLC.

QRC. Computer Controlled **Chemical Reactors Trainer:** ✱



SPECIFICATIONS SUMMARY

Common items for 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 aluminum structure and panels of painted 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, computer controlled. Temperature PID control of the thermostatic bath.

Pump, with variable flow, to impel the thermostatization water from the bath to the reactor.

Flow sensor.

2 Tanks for the reagents, of 1 l. 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.

Quick connections with shutoff valve that enable an easy coupling of the Service Unit to the chosen reactor.

Dimensions (approx.): 800 x 800 x 1000 mm. Weight: 50 Kg.

② QRC/CIB. Control Interface Box :

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

It has a process diagram in the front panel.

The unit control elements are permanently computer controlled.

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

Calibration of all sensors involved in the process.

Real time curves representation.

All the actuators' values can be changed at any time from the keyboard.

Shield and filtered signals to avoid external interferences.

Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process.

Open control allowing modifications, at any moment and in real time, of parameters involved in the process.

3 safety levels: one mechanical in the unit, electronic in the control interface, and the third one in the control software.

Dimensions (approx.): 490 x 330 x 310 mm. Weight: 10 Kg.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board.

16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

Continue...

✱ **Non computer controlled version available too.**

QRC. Computer Controlled **Chemical Reactors Trainer:** ✱

SPECIFICATIONS SUMMARY

④ Chemical Reactors:

43 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.

Anodized aluminum structure and panel of painted 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 l., 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 (5 loops of 60 mm of diameter) and a baffle (removable).

Stirring system with speed control and indication, computer controlled.

Temperature cell to control the temperature into the reactor.

Conductivity cell to control the reaction.

Quick connections with shutoff valve that enable an easy coupling of the reactor to the Service Unit.

This unit is supplied with 8 manuals.

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

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.) = 330 x 330 x 500 mm. Weight: 10 Kg.

43 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.

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

Anodized aluminum structure and panel of painted 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 circulates.

Electric pre-heater of 12 loops, and loop diameter of 70 mm approx., for the two reagents feed lines.

Temperature controlled by water jacketed. Temperature control by a temperature sensor (PID).

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

Conductivity cell to control the reaction.

Quick connections with shutoff valve that enable an easy coupling of the reactor to the Service Unit.

This unit is supplied with 8 manuals.

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

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.) = 330 x 350 x 500 mm. Weight: 15 Kg.

43 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.

Anodized aluminum structure and panel of painted 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 1 l.

Heat transfer coil made in stainless steel and reactor baffle, of 5 loops of 60 mm. of diameter. 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.

Temperature sensor to control the temperature into the reactor. Conductivity cell to control the reaction.

Quick connections with shutoff valve that enable an easy coupling of the reactor to the Service Unit.

This unit is supplied with 8 manuals.

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

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.) = 330 x 330 x 500 mm. Weight: 10 Kg.

Continue...

PRACTICAL POSSIBILITIES

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.
18-36.- Practices with PLC.

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.
48-66.- Practices with PLC.

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.
81-99.- Practices with PLC.

✱ **Non computer controlled version available too.**

QRC. Computer Controlled **Chemical Reactors Trainer:**✱

SPECIFICATIONS SUMMARY

④ Chemical Reactors:

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 aluminum structures and panel of painted 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.

The three reactors have different height to let product from the first reactor go to the second one and so on.

Reactors body made in pyrex glass. Adjustable volume from 0.4 to 1.5 l.

Each reactor is fitted with a conductivity cell.

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.

A dead-time residence coil can also be attached to the exit of the last reactor in the series. 3 Temperature sensors, one in each reactor.

Quick connections with shutoff valve that enable an easy coupling of the reactor to the Service Unit.

This unit is supplied with 8 manuals.

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

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.)= 950 x 450 x 500 mm. Weight: 35 Kg.

④.⑤ QRLC. Laminar Flow Reactor:

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

Anodized aluminum structure and panels of painted steel.

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

Working volume: 400 ml. Laminar flow reactor constituted by a glass column of 400 ml and 1000 mm long, 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.

Temperature sensor. Conductivity cell to control the reaction.

Quick connections with shutoff valve that enable an easy coupling of the reactor to the Service Unit.

This unit is supplied with 8 manuals.

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

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.)= 330 x 330 x 1490 mm. Weight: 25 Kg.

④.⑥ QRPC. Plug Flow Reactor:

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 l.

Anodized aluminum structure and panels of painted steel.

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

Column of 1 l., 1100 mm long, 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 unit uses a 6 ways injection valve, which allows either the feeding of reagents in a continuous way or the possibility to carry out pulse and step changes to characterization of the flow pattern.

Temperature sensor.

Conductivity cell to control the reaction.

Quick connections with shutoff valve that enable an easy coupling of the reactor to the Service Unit.

This unit is supplied with 8 manuals.

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

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

Dimensions (approx.)= 330 x 330 x 1350 mm. Weight: 25 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/reactors/QRC.pdf

PRACTICAL POSSIBILITIES

Practices to be done with the 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.

110-128.- Practices with PLC.

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.

140-158.- Practices with PLC.

Practices to be done with the 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.

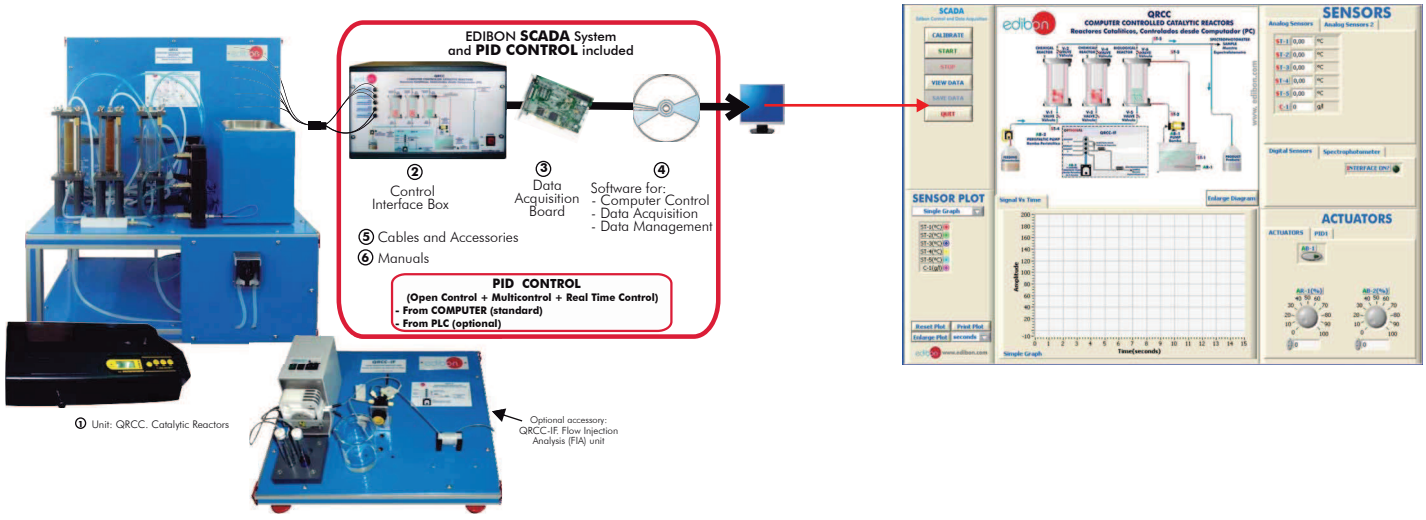
167.- Calibration of the temperature sensors.

168.- Calibration of the conductivity sensor.

169-187.- Practices with PLC.

✱ Non computer controlled version available too.

QRCC. Computer Controlled **Catalytic Reactors** ✱



SPECIFICATIONS SUMMARY

Items supplied as standard

① QRCC. Unit:

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

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.

Anodized aluminum structure and panels of painted steel.

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

2 Glass flacks of 2 l. 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 element, controlled by a PID from the computer (PC).

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).

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

Spectrophotometer, computer controlled (PC), for the final product analysis and absorbance measures.

Optional accessory (not included in the standard supply):

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

② QRCC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QRCC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions and weights (approx.)= Unit: 650 x 700 x 800 mm. Weight: 50 Kg.
Spectrophotometer: 470 x 380 x 140 mm. Weight: 10 Kg.
Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/reactors/QRCC.pdf

PRACTICAL POSSIBILITIES

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:

9.- Sensors calibration.

10.- Studies of steady and unsteady state catalysis.

11.- Flow characterisation in a fixed-bed.

12.- Mass balances.

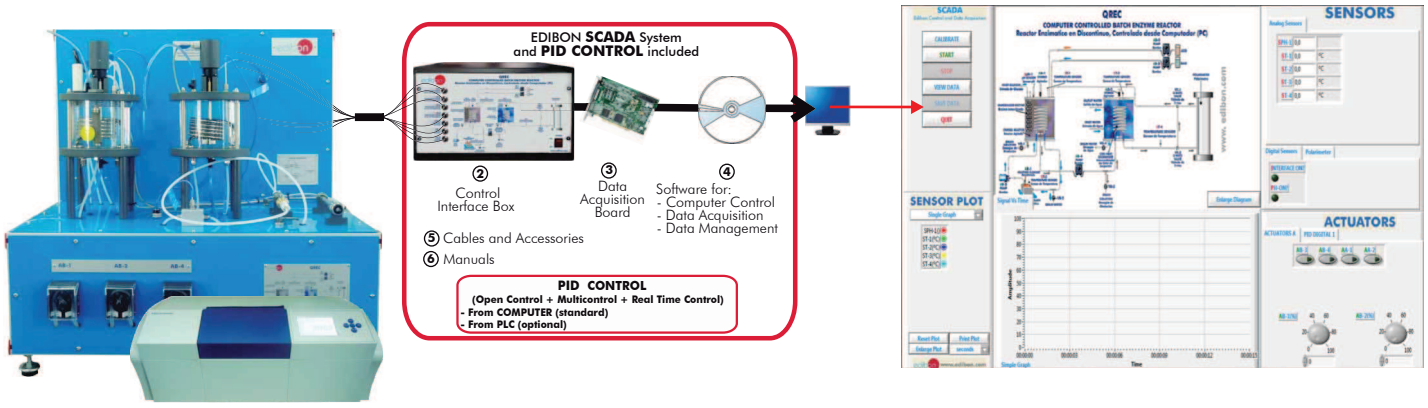
13.- Determination of steady state and unsteady state kinetics of a catalytic fixed-bed reactor.

Other possible practices:

14-32.- Practices with PLC.

✱ Non computer controlled version available too.

QREC. Computer Controlled **Batch Enzyme Reactor**



① Unit: QREC. Batch Enzyme Reactor

SPECIFICATIONS SUMMARY

Items supplied as standard

① QREC. Unit:

The Computer Controlled Batch Enzyme Reactor (QREC) is an unit designed to perform the glucose isomerisation reaction catalyzed by glucose isomerase in a batch reactor. This unit allows to demonstrate batch enzyme kinetics and enzyme characteristics.

Anodized aluminum structure and panels of painted steel.

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

Stirred batch reactor:

A reactor, made of acrylic material and glass, where the isomerisation reaction takes place. It allows the visualization of the reaction. Reactor volume: 1.8 l.

An inner coil through which hot water circulates to favor the isomerisation reaction.

A fixed catalyst basket immobilizes the enzyme.

A computer controlled stirrer to increase the efficiency of the enzyme-solution mixture.

The pH value of the solution can be adjusted by using the acid/base circuit system.

Coil heat exchanger:

A reactor, made of acrylic material and glass, where a small volume of the transferred solution of the reactor is cooled.

Exchanger volume: 1.8 l.

An inner coil through which the reaction solution circulates.

A computer controlled stirrer to homogenize the temperature in the heat exchanger.

Polarimeter to allow to measure the angle of rotation of polarized light to determine the concentration of glucose and fructose in the solution.

A computer controlled peristaltic pump to transfer a small volume of solution from the stirred batch reactor to the coil heat exchanger.

4 "J" type temperature sensors:

1 Temperature sensor located at the stirred batch reactor.

2 Temperature sensors located at the coil heat exchanger to measure the temperature of the water inside the heat exchanger and the outlet temperature of the solution.

1 Temperature sensor located at the thermostatic bath of the hot water circulation system.

A pH sensor measures the pH of the mixture inside the stirred batch reactor.

A hot water circulation system, including:

Computer controlled pump.

Thermostatic bath, controlled by a PID from the computer (PC).

An acid/base circuit system, including:

Two peristaltic pumps (computer controlled) to introduce an acid or base solution into the stirred batch reactor.

Two vessels to contain the acid and base solutions.

A pressure reducer at the water inlet of the coil heat exchanger.

② QREC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QREC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions and weights (approx.) = Unit: 800 x 700 x 800 mm. Weight: 60 Kg.
Polarimeter: 600 x 320 x 220 mm. Weight: 18 Kg.
Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/reactors/QREC.pdf

PRACTICAL POSSIBILITIES

1.- Study of the principles of catalytic batch reactors.

2.- Study of the type of enzyme in the specific activity of a catalytic batch reactors.

3.- Determination of optical rotation of fructose and glucose.

4.- Demonstration of Biot's law.

5.- Study of the principles of polarimetry.

6.- Determination of the glucose and fructose concentration by polarimetry.

7.- Study of the influence of different variables (solution concentration, reaction temperature, reaction pH) on enzyme activity.

8.- Determination of Michaelis-Menten rate equation constants in a batch enzyme reactor.

9.- Determination of the enzyme specific activity through Michaelis-Menten equation and Lineweaver-Burke plots.

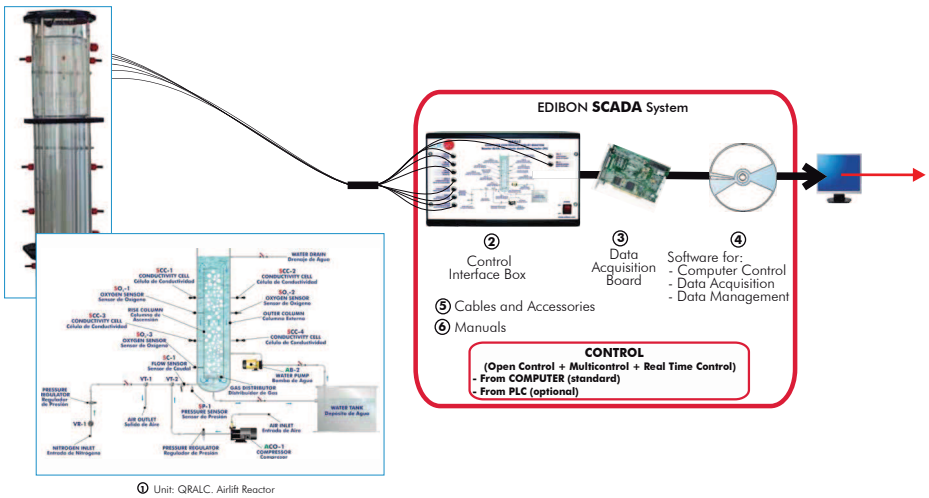
10.- Study of the principles of batch enzyme kinetics.

Other possible practices:

11.- Sensors calibration.

12-30.- Practices with PLC.

QRALC. Computer Controlled **Airlift Reactor**



① Unit: QRALC. Airlift Reactor

SPECIFICATIONS SUMMARY

Items supplied as standard

① QRALC. Unit:

The Computer Controlled Airlift Reactor, (QRALC) allows to study the influence of the superficial gas velocity on the mixing time and superficial fluid velocity, the mass transfer coefficient and the gas content.

The Computer Controlled Airlift Reactor (QRALC) is an aerobic submerged reactor designed to determine the characteristic variables of the airlift reactor.

Anodized aluminum frame with panels of painted steel.

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

Airlift reactor, made of transparent material:

Diameter of outer column (reactor column): 200 mm.

Diameter of the riser column: 60 mm.

Height: 2000 mm.

PVC tank to store water (capacity 60 l. approx.).

Supply centrifugal pump, computer controlled.

Air compressor, computer controlled.

Two pressure regulators situated in the air and nitrogen lines to reduce the pressure in the inlet reactor.

Pressure sensor situated in the air line inlet.

Flow sensor situated in the air line inlet.

Four conductivity sensors.

Three oxygen sensors to measure the oxygen concentration at several levels of the reactor.

Two 3-way directional valves to select the gas fed to the reactor.

② QRALC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the PC keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QRALC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions and weights (approx.)= Unit: 950 x 550 x 2100 mm. Weight: 100 Kg.

Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/reactors/QRALC.pdf

PRACTICAL POSSIBILITIES

1.- Study of the influence of the superficial gas velocity on the mixing time and superficial fluid velocity.

2.- Study of the influence of the superficial gas velocity on the mass transfer coefficient.

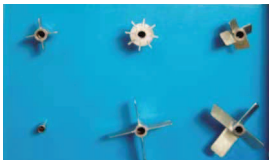
3.- Study of the influence of the superficial gas velocity on the gas content.

Additional practical possibilities:

4.- Sensors calibration.

5-23.- Practices with PLC.

EMLS. **Liquid/Solid Mixing Unit**



The panel with the different types of agitators

SPECIFICATIONS SUMMARY

The EMLS unit has been designed to demonstrate the factors affecting mixing using visualization and measurement techniques as appropriate.
This unit allows the study of the agitation process in order to familiarize the student with the different magnitudes (torque, turning speed, etc) that take part in the process.
Metallic frame and panels made of painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Brake Dynamo Motor, with speed regulation: its purpose is to make the agitator turn at preset revolutions value.
Torque meter (load cell): its objective is to measure the torque established between the motor and the solution to be mixed, crowbar: 18.3 cm., force range: 0 to 39.2 N.
Vertical platform: it allows to displace the brake dynamo motor vertically.
Agitators holder: it is the element that allows to install different types of agitators.
Agitators of different shapes and sizes:
- 2 Paddle, diameters: 100 mm. and 50 mm.
- 2 Propeller, diameters: 100 mm. and 50 mm.
- 2 Turbine, diameters: 100 mm. and 50 mm.

Tanks:
- Their purpose is to contain the fluid that we will use in the experiment.
- They are cylindrical and are made of transparent material.
  - 2 Tanks of 300 mm diameter and 300 mm height, one with deflectors and the other without deflectors.
  - 2 Tanks of 150 mm diameter and 300 mm height, one with deflectors and the other without deflectors.
- The capacity of the tanks is approximately 21 and 5 l.

Control panel:
- ON/OFF motor switch, speed controller and speed display.
- Torque display.

Cables and Accessories, for normal operation.
Manuals: This unit is supplied 8 Manuals.
Dimensions (approx.) = 700 x 910 x 1940 mm. Weight: 95 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/EMLS.pdf

PRACTICAL POSSIBILITIES

1.- Visualization of fluid fields.
2.- Power required in the agitation process.
3.- Suspensions of solid in liquids.
4.- Formation of solids-liquids solutions.
5.- Emulsion of immiscible liquids.
6.- Mixing of miscible liquids.
7.- Heating process of liquid mass.
8.- Test with models at scale.
9.- Quality of mixing/mixing time.
10.- Power speed of the different impellers.
11.- Demonstration of the different factors (deposits, deflectors, agitators...), that affect the mixing, using visualization techniques and appropriate measurement.

EEC. **Corrosion Study Unit**

SPECIFICATIONS SUMMARY

The EEC unit allows the corrosion simultaneous study of up to 8 corrosion cells, each containing different test specimens.
Anodized aluminum structure and panels of painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
8 Glass cells, each one consisting on: a 600 ml. vessel (Pyrex) with a cover; such cover has four orifices: two to adapt the test sheets, one for the reference electrode and another one for the gases diffuser tube.
Number of cells selector. Simultaneous study of corrosion in several cells. Ag/AgCl reference electrode.
A group of test sheets (electrodes): It consists of 40 x 20 mm. sheets of variable thickness depending on the material, and on materials such as stainless steel, carbon steel, zinc, brass, copper, aluminum, graphite, and iron (nails). Connection cables with 4 mm terminals for the reference electrode (Ag/AgCl) and the test sheets.
Digital pH-meter. Air pump for agitation. Air pump switch.
Inert gas inlet. (If the customer wants to work in other kind of atmosphere).
Milliammeter. Millivoltmeter. Milliammeter/Millivoltmeter selector.
Two rotameters (flow meters): One for the air and another one for the gas.
Power supply of direct current (D. C.) with 0-30V and 0-3A output, with intensity and voltage indicator.
Control valves for air and gas flow.
Manuals: This unit is supplied 8 Manuals.
Dimensions (approx.)= 1200 x 300 x 500 mm. Weight: 50 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/EEC.pdf

PRACTICAL POSSIBILITIES

1.- Galvanic potentials.
2.- Galvanic pairs study.
3.- Iron passivation.
4.- pH influence.
5.- Aluminium anodization.
6.- Cathodic protection.
7.- Galvanic corrosion + oxidation.
8.- Effect of dissolved oxygen concentration.
9.- Electrolytic corrosion.
10.- Chemical inhibition.
11.- Prevention of scaling.
12.- Effect of internal stress.
13.- Simultaneous study of corrosion in several cells.

Other possible practices:
14.- Water treatment studies:
- Calcium carbonate stabilization.
- Oxidation of iron and manganese in ground waters.
- Water softening by chemical precipitation.
- Disinfection of waste water with chlorine solutions.

ESED. **Sedimentation Study Unit**

SPECIFICATIONS SUMMARY

The sedimentation is a process widely used in the classification, water clarification and wastewater treatment.
"ESED" unit provides a facility for studying the basic physical process involved in sedimentation, which the applications cover fields like chemical engineering, water treatment and other industrial processes.
Anodized aluminum structure and panels of painted steel.
Five sedimentation graduated cylinders of methacrylate (1m x 50mm approx.) mounted vertically on a panel, illuminated from behind, and with the possibility of being removable for cleaning.
Light diffuser screen and two fluorescent lamps.
Stopwatch.
Three beakers.
Specific gravity bottle.
Manuals: This unit is supplied with 8 manuals.
Dimensions (approx.) = 550 x 400 x 1300 mm. Weight: 35 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/ESED.pdf

PRACTICAL POSSIBILITIES

1.- Variation of the sedimentation characteristics with the concentration and suspension height.
2.- Effect of initial concentration on sedimentation characteristics.
3.- Effect of initial suspension height on sedimentation characteristics.
4.- Construction of settling rate curves against concentration form a single batch test.
5.- Effect of particle size distribution.
6.- Identification of the different sedimentation regimes.
7.- Use of flocculating additives.
8.- Construction of settling rate curves.
9.- Visualization of the retarded sedimentation.
10.- Study of the differences between a clarifier and a classifier.
11.- Study and visualization of the differential sedimentation.
12.- Study of the methods of sinking and floating.

QMS. **Solids Handling Study Unit**

SPECIFICATIONS SUMMARY

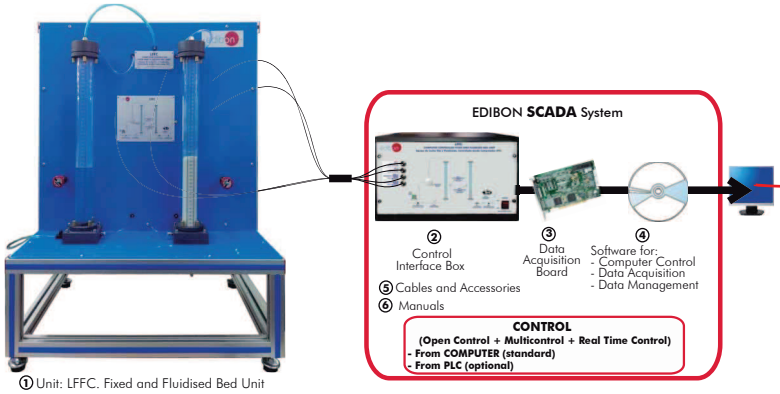
This unit is designed to introduce the students in different aspect of solids behaviour, unit operations as size reduction, mixing, transport, discharge, etc.
Bench with anodized aluminum structure, metallic panels, and with wheels for mobility. Diagram in the front panel with similar distribution to the elements in the real unit.
Ball mill with variable speed and various sizes of balls, total volume: 5 l., capacity: 1.25 l.
Motor for the ball mill.
Vibratory shaker and a set of eight sieves with several hole mesh from 2 mm to 0.063 mm.
V-Blender, total volume: 1 l.
Motor for the V-Blender.
Blowing and ejector.
Compressor.
Glass cyclone (inlet diameter: 10 mm.), and pneumatic conveyor.
Transparent horizontal angle of repose rotary cylinder with protractor.
Cylindrical hopper (capacity: 100 cc.) with different size of exit orifices.
Collecting tray. Balance. Graduated test tube.
Control panel.
Manuals: This unit is supplied 8 manuals.
Dimensions (approx.) = 1020 x 850 x 1700 mm. Weight: 200 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/QMS.pdf

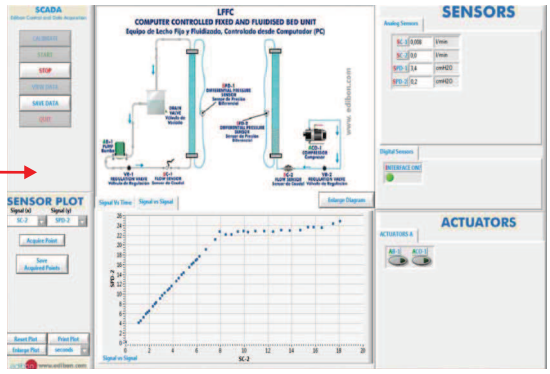
PRACTICAL POSSIBILITIES

1.- Sieving techniques.
2.- To determine the angle of repose.
3.- Study of size reduction.
4.- Classification study according to the size.
5.- To determine bulk solids parameters of density.
6.- To use the hopper to measure solids discharge rates and relate to initial load and hoper exit orifice size.
7.- Cyclone operation. Solids separation.
8.- Pneumatic conveying.
9.- To observe the comminution of granular solids processed through a ball mill.
10.- Study of solids mixing.
11.- Study of the solids properties.
12.- Solids weighing: Balance.
13.- Study of the apparent density.
Other possible practices:
14.- Mixer operation.
15.- Sieves operation.

LFFC. Computer Controlled **Fixed and Fluidised Bed Unit** ✱



① Unit: LFFC. Fixed and Fluidised Bed Unit



SPECIFICATIONS SUMMARY

Items supplied as standard

① LFFC. Unit:
Bench top unit for the study of fixed and fluidised beds of solid particles.
"LFFC" unit allows a full study about everything concerning the flow of a fluid through a bed, both packed and fluidised. The unit allows the simultaneous study of the water and air flow through the bed.
Anodized aluminum structure and panels of painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
2 Transparent cylindrical columns, one for air and one for water.
Two sizes of bed material (glass beads) are supplied, 170/300 and 250/420 micron ranges.
The columns can be dismantled in order to remove the particle bed.
Water tank.
Water pump, computer controlled.
Compressor, computer controlled.
Water regulation valve.
Water flow sensor.
Air regulation valve.
Air flow sensor.
2 Differential pressure sensors (one for water and other for air).

② LFFC/CIB. Control Interface Box :
With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the PC keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:
PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ LFFC/CCSOF. Computer Control + Data Acquisition + Data Management Software:
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 700 x 570 x 870 mm. Weight: 50 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/LFFC.pdf

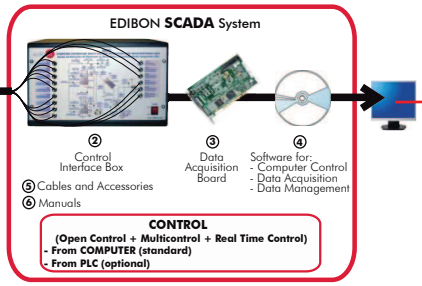
PRACTICAL POSSIBILITIES

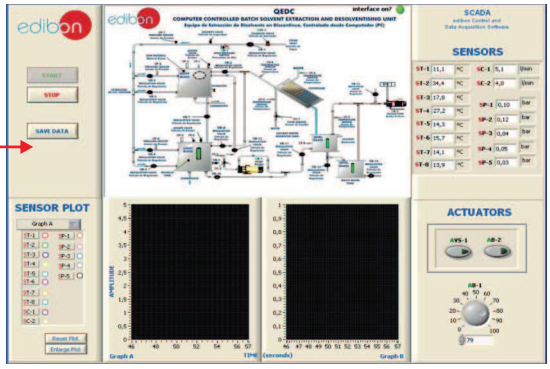
1.- Study of the basis of fixed bed fluidisation.
2.- Comparison of the fluidisation process in water and air currents.
3.- Study of the pressure drop through fixed and fluidised beds in function of:
The flow speed.
The size of the bed particles.
Type of fluid: air or water.
4.- Verification of Carman-Kozeny equation.
5.- Study and determination of the minimum fluidisation speed.
6.- Study and determination of the fluidisation speed and comparison with theoretical calculated values (Ergun equation).
7.- Study of differences between particulate and aggregative fluidisation.
8.- Observation of the "bubbling" fluidisation phenomenon.
Other possible practices:
9.- Sensors calibration.
10-28.- Practices with PLC.

✱ Non computer controlled version available too.

QEDC. Computer Controlled **Batch Solvent Extraction and Desolventising Unit**

① Unit: QEDC. Batch Solvent Extraction and Desolventising Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

① QEDC. Unit:

The Solvent Extraction and Desolventising Unit (QEDC) is a batch process unit able to perform different solid/liquid extractions. It is especially suitable for extracting oil from oily seeds and to remove the solvent both from the extracted solids and mixtures. Furthermore, several factors that influence the extraction process can be studied with this unit.

Metallic structure and panels of painted steel.

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

Extractor tank:

Cylindrical vessel of stainless steel, with a hinged lid and equipped with an indirect steam chest for process heating and a sight glass of neoceram.

The vessel has a base inclined slightly towards a port for discharging the extracted and desolventised meal and a perforated plate covered with a fine woven mesh so solvent may drain through to the miscella tank whilst retaining the solids.

Direct steam and solvent are injected through two distribution pipe.

Direct steam: 0 - 0.9 bar.

Indirect steam: 0-3.5 bar.

Miscella tank:

Cylindrical vessel of stainless steel, equipped with an indirect steam chest for process heating and a level viewer. The vessel has a base inclined slightly towards a port for discharging the extracted and solvent.

Direct steam is injected through a distribution pipe.

Direct steam: 0 - 0.9 bar.

Indirect steam: 0 -3.5 bar.

Solvent condenser:

Condensing capacity: 2.5kW.

Condensing area: 2.5m^2.

Cooling medium: water.

Cooling water flow range: 0 - 22 l./min.

Maximum working pressure: 1.0 bar.

Solvent water separator tank:

Cylindrical vessel of stainless steel equipped with a level viewer.

Volume of separator section: 16 l.

Volume of solvent store: 16 l.

Waste water tank:

Cylindrical vessel of stainless steel equipped with a level viewer. Volume: 15 l.

Solvent pump.

Vacuum pump.

8 Temperature sensors.

5 Pressure sensors.

2 Flow sensors.

The inlet of vapour incorporates a safety valve to limit the working pressure to 4.0 bar, and the extractor/desolventiser tank and the miscella tank incorporate two safety valves to limit the working pressure to 0.9 bar.

An electronic solenoid valve and a pressure switch (4 bar).

Modes of operation:

Extraction by washing with clean solvent.

Extraction by recirculating miscella.

Desolventising extracted material.

Desolventising miscella.

② QEDC/CIB. Control Interface Box

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the PC keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ QEDC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1750 x 1000 x 2000 mm. Weight: 850 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

PRACTICAL POSSIBILITIES

1.- Operation of small scale version of industrial processes.

2.- Effect of degree of pretreatment of solid material on extraction efficiency.

3.- Effect of extraction time.

4.- Effect of drain time.

5.- Effect of solvent type.

6.- Effect of solvent percolation rate.

7.- Effect of process temperature.

8.- Effect of process pressure.

9.- Method of solvent recovery.

10.- Degree of solvent recovery.

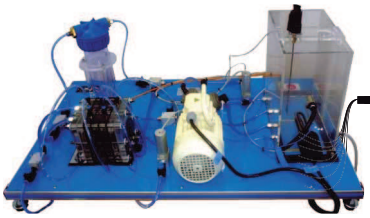
Other possible practices:

11.- Sensors calibration.

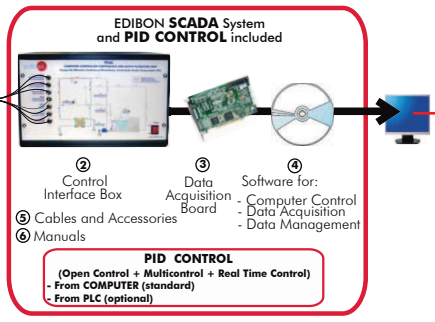
12- 30.- Practices with PLC.

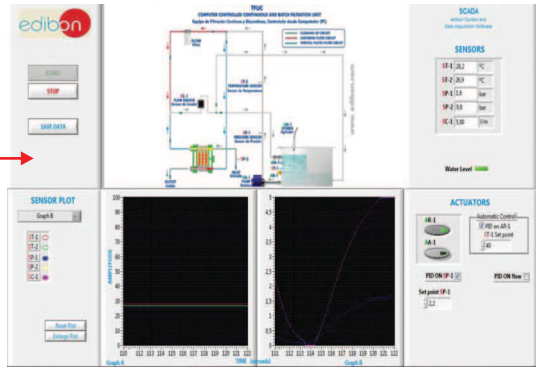
More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/QEDC.pdf

TFUC. Computer Controlled **Continuous and Batch Filtration Unit** ✱



①Unit TFUC. Continuous and Batch Filtration Unit





SPECIFICATIONS SUMMARY

Items supplied as standard

① TFUC. Unit:

The TFUC unit demonstrates the principles of continuous and batch filtration.

Anodized aluminum structure and panel of painted steel.

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

Double tank connected to a centrifugal pump which send the mixture to one of the filters according the valves position.

Centrifugal pump, computer controlled.

A PID control enables constant flow rate.

A PID control enables constant pressure operation by controlling the speed of the pump (from computer).

Heating element, computer controlled.

Level switch in the tank.

Vertical plates filter, composed of 4 nylon plates of 5 microns diameter, allowing us to filter the $CaCO_3$ suspension of known concentration.

Cartridge filter will filter and "clean" a water sample with small pieces of paper.

Stirrer, computer controlled.

2 Temperature sensors, "J" type.

2 Pressure sensors.

1 Flow sensor.

② TFUC/CIB. Control Interface Box :

With process diagram in the front panel.

The unit control elements are permanently computer controlled.

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

Calibration of all sensors involved in the process.

Real time curves representation.

All the actuators' values can be changed at any time from the keyboard.

Shield and filtered signals to avoid external interferences.

Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process.

Open control allowing modifications, at any moment and in real time, of parameters involved in the process.

3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

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

16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ TFUC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software.

Management, processing, comparison and storage of data.

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

It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 1100 x 750 x 400 mm. Weight: 30 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/TFUC.pdf

PRACTICAL POSSIBILITIES

1.- Understanding the principles of continuous and batch filtration using both constant pressure and constant flow operating modes (vertical plates and cartridge filters).

2.- Study of the plates filter at a constant pressure.

3.- Study of the plates filter at a constant flow.

4.- Study of the cartridge filter at constant pressure.

5.- Study of the cartridge filter at constant flow.

6.- Demonstrating filtration through membrane technology.

7.- Precoat and body aid filtration.

8.- Optimisation of filtration performance using body aid.

9.- Determination of medium and cake resistances.

10.- Effect of body aid on medium and cake resistances.

Additional practical possibilities:

11.- Sensors calibration.

12.- Mass balancing.

13.- Demonstration of Darcy's Law.

14.- Filter cake washing and dewatering.

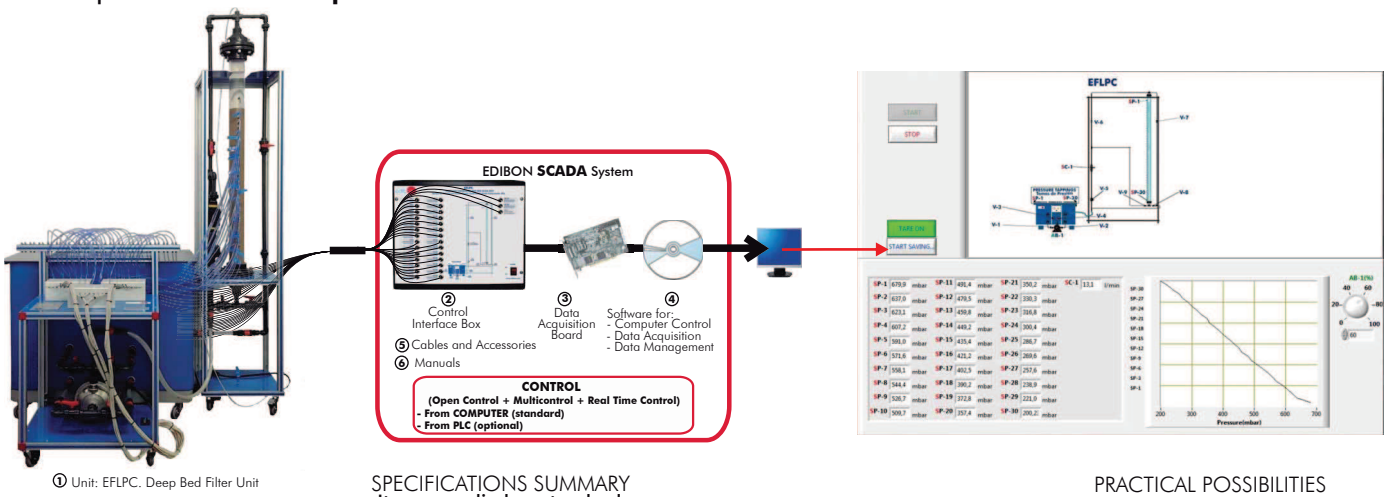
15.- Study of commercial aspects of filtration and optimisation of filtration operations.

Other possible practices:

16-34.- Practices with PLC.

✱ Non computer controlled version available too.

EFLPC. Computer Controlled **Deep Bed Filter Unit** ✱



① Unit: EFLPC. Deep Bed Filter Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① EFLPC. Unit:

The Computer Controlled Deep Bed Filter Unit (EFLPC) enables to study filtration in open and closed circuit, as well as to visualize the bed washing process. This unit allows us to filter a fluid in order to eliminate particles in suspension, to have it in more adequate conditions for its subsequent use or consumption.

Anodized aluminum structure and panels of painted steel.

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

Filter column, where the porous media is formed:

It includes the following elements:

Transparent PMMA tube of circular section (column height: 1300 mm), with removable top and bottom covers. Support filter of the porous bed. Filtering bed. 30 Sample capturing takings. 30 Pressure sensors.

Tank:

Its objective is to prepare the suspension for being filtered. There is a tank with two reservoirs:

Reservoir 1 = 350 l. Reservoir 2 = 350 l. Total capacity: 700 l. Both reservoirs have water heigh level.

Pump:

Centrifugal pump, computer controlled.

In order to take the fluid to the upper part of the filter column (filtering operations), or the bottom part of the column (washing operation of the porous bed).

Pipes and valves system to establish several circuits and regulate the flows.

Flow sensor.

② EFLPC/CIB. 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. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ EFLPC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)=Unit: 1600 x 1500 x 2500 mm. Weight: 250 Kg. Control Interface Box: 490 x 450 x 470 mm. Weight: 20 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/EFLPC.pdf

PRACTICAL POSSIBILITIES

1.- Determination of the initial head loss of a deep bed.

2.- Evolution through time of the head loss of the deep bed.

3.- Measuring pressure drop profiles through the bed.

4.- Demonstration of reversed flow and backwashing fluidisation.

5.- Filtering in open and closed circuit.

Additional practical possibilities:

6.- Sensors calibration.

7.- The column may be readily adapted for absorption and ion exchange studies.

8.- Measuring suspension concentration profiles through the filter bed.

9.- Filtration efficiency. Clarification.

Other possible practices:

10-28.- Practices with PLC.

EII. **Ion Exchange Unit**

SPECIFICATIONS SUMMARY

Self-contained unit either single bed water softening or double bed system for demineralisation.

Anodized aluminum structure and panel of painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Exchange capacity of the different materials, as resins and used reagents, as well as the problem water.

Use of simple or double bed for demineralisation.

4 Tanks (treated water, demineralized water, hydrochloric acid and sodium hydroxide).

Pump diaphragm type.

Flow meter,resistant to hydrochloric acid.

2 Transparent vertical columns for the anionic and cationic resins. 1 spare column.

Valves and pipes circuit.

Conductivity meter (with conductivity cell).

Typical commercial anionic and cationic resins.

Switch board.

Cables and accessories, for normal operation.

Manuals: This unit is supplied 8 Manuals.

Dimensions (approx.) = 1200 x 500 x 1000 mm. Weight: 50 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocess/EII.pdf

PRACTICAL POSSIBILITIES

1.- Study of general techniques of ion exchange.

2.- Familiarization with the operation modes of column ionic exchange.

3.- The exchange capabilities of different resins materials.

4.- Water softening using a cationic resin.

5.- Hard water softening (H^+).

6.- Hard water softening (OH^-).

7.- Resin regeneration efficiency (H^+).

8.- Demineralisation.

9.- Demineralisation efficiency.

10.- Determination of saline ions concentration.

11.- Separation of Ni^{2+}, Zn^{2+}.

12.- Hard water softening (sodic resin).

13.- Resin regeneration efficiency (Na^+).

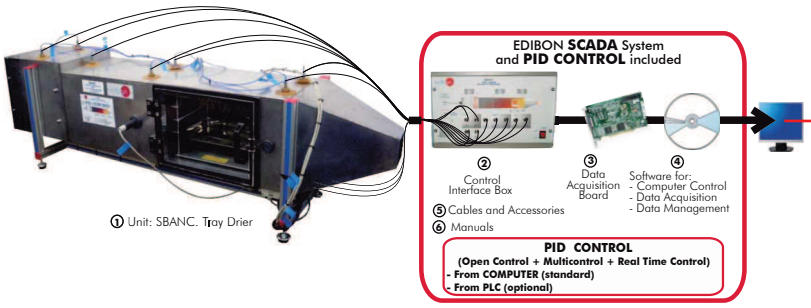
14.- How to operate the conductivity meter.

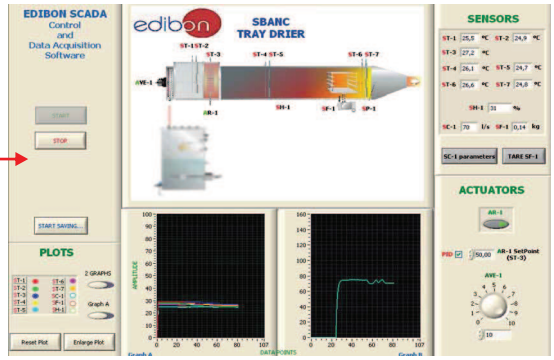
15.- Regeneration efficiency of a softening system.

16.- Demineralisation using two-bed exchange.

✱ Non computer controlled version available too.

SBANC. Computer Controlled **Tray Drier**





SPECIFICATIONS SUMMARY

Items supplied as standard

① SBANC. Unit:

This unit has been designed to study fluid mechanics, surfaces chemistry, solid structures and substances and energy balances, related to the drying processes. Anodized aluminum and main metallic elements of stainless steel. Diagram in the front panel. Stainless steel rectangular conduct (1000 x 320 x 320 mm), which includes a support, a drying chamber with a door with transparent window and a tray holder for 4 trays, a square nozzle 300 mm long, whose side goes from 315 to 100 mm progressively. Fan, with speed control from computer (PC). Weighing system for following the changes in weight of the solid due the evaporation or vaporisation of moisture during operation. Load Cell-force sensor. 7 Temperature sensors: 2 temperature sensors of Dry and Wet Bulb before the heating element, 1 temperature sensor in the heating element, 2 temperature sensors of Dry and Wet Bulb after the heating element, 2 temperature sensors of Dry and Wet Bulb after the drying chamber. Air flow sensor. Humidity sensor. Electrical heater (heating element), computer controlled.

② SBANC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ SBANC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 2000 x 400 x 450 mm. Weight: 190 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/agronomicalindustry/SBANC.pdf

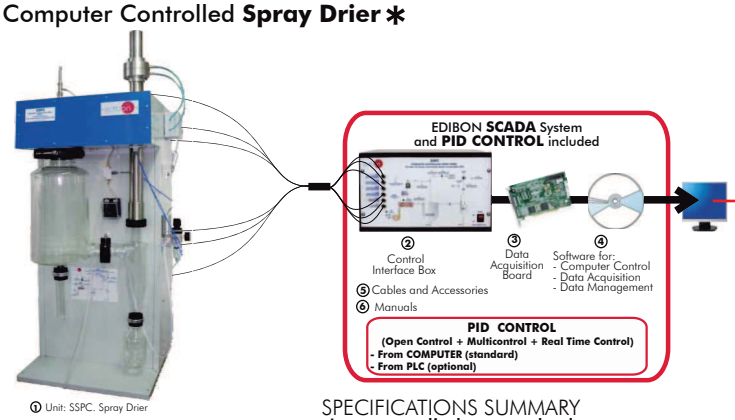
PRACTICAL POSSIBILITIES

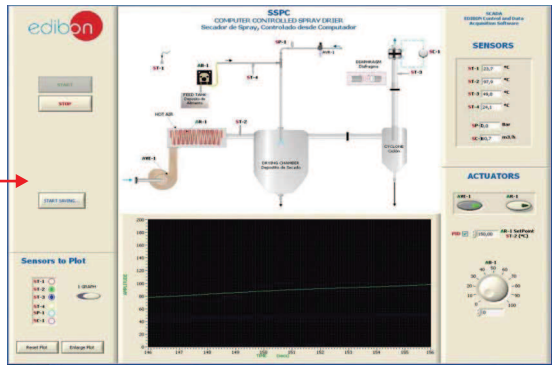
1.- Demonstration of drying rate regimens.
2.- Determination of the efficiency of the warm-up resistance.
3.- Effect of the warm-up in a drying installation.
4.- Heat and mass transfer analogies.
5.- Obtaining of drying curves.
6.- Influence of the particle size.
7.- Influence of the air speed.
8.- Influence of the air temperature.
9.- Application of the psychometry in the drying.

Other possible practices:

10.- Example of the determination of the properties of the air.
11.- Use of a psychometric map.
12.- Determination of the air flow.
13.- Dynamic simulation of the control systems.
14.- Sensors calibration.
15-33.- Practices with PLC.

SSPC. Computer Controlled **Spray Drier** ✱





SPECIFICATIONS SUMMARY

Items supplied as standard

① SSPC. Unit:

Spray drier for processing aqueous emulsions, solutions, suspensions and colloids. This unit is suitable for aqueous solutions only. Downward co-current operation (a fine jet of the product is brought into contact with a hot air stream). The unit components are made of glass with gasket free ground glass flanges. Characteristics: max. drying capacity: 1000 ml/h. approx., temperature range: 40-200°C (temperature at inlet), dry air volume range: 0.2-0.65 m^3/min., feed pump volume range: 102-1800 ml/h. approx. Fan, computer controlled. Heating element, computer controlled. Temperature sensor, located at the inlet of the drying chamber, works with the PID controller to maintain the desired air temperature at the inlet of the drying chamber. Drying chamber. Feed peristaltic pump, with variable speed, computer controlled. Cyclone. Sample collection bottle. Exhaust tube. Filter/air regulator located between the compressor (not included) and the unit to ensure that the drying air does not include contaminants. 4 Sensors to measure: environmental temperature, air inlet temperature in the drying chamber, exhaust air temperature, feeding temperature. Differential pressure sensor to measure, together with the diaphragm with orifice plate, the flow of exhaust air. Pressure sensor at the compressed air inlet. 1 glass vessel.

② SSPC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ SSPC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.) = Unit: 500 x 500 x 1500 mm. Weight: 80 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/agronomicalindustry/SSPC.pdf

PRACTICAL POSSIBILITIES

1.- Operation principle of a spray drier.
2.- Effect of the drop size on the drying process.
3.- Effect of the air input temperature on the drying process.
4.- Effect of the feed flow of the product on the drying process.
5.- Mass balance of a spray drier.
6.- Spray drier efficiency.

Additional practical possibilities:

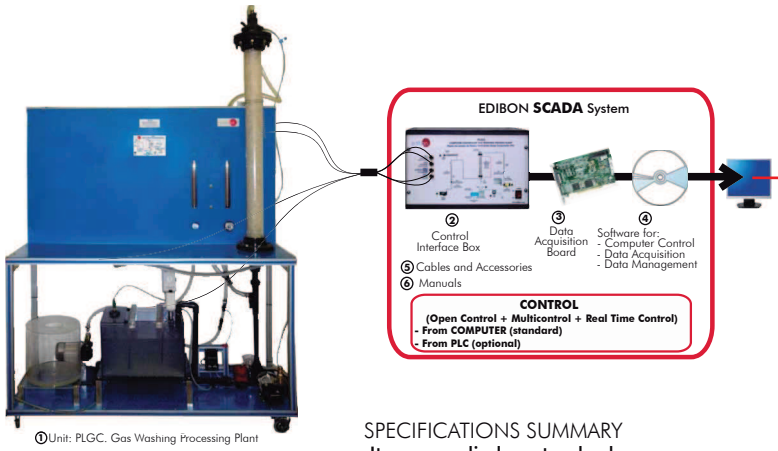
7.- Sensors calibration.
8.- Energy balance of a spray drier.

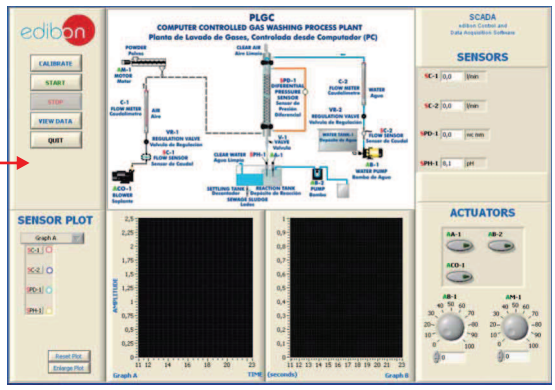
Other possible practices:

9-27.- Practices with PLC.

✱ Non computer controlled version available too.

PLGC. Computer Controlled **Gas Washing Processing Plant**





①Unit: PLGC. Gas Washing Processing Plant

SPECIFICATIONS SUMMARY

Items supplied as standard

① PLGC. Unit:

The Gas Washing Processing Plants are used to eliminate the presence of gases such as carbon dioxide or sulfur dioxide, among others. They also contribute to eliminate fogs or dusts for the environment. Besides, they have other applications such as the products recuperation from process gases, gases desorption and gases condensation and cooling. PLGC unit allows to evaluate the operation of a gas washing plant, analyzing its efficiency.

Anodized aluminum structure and panels of painted steel. Diagram in the front panel.

Packed Column: formed by a glass cylindrical tube of 1200 mm. of length and an internal diameter of 100 mm. The column is filled with Raschig rings with a 8 mm. diameter.

Rectangular tank formed by the reaction system and the settler, with a methacrylate structure. Cylindrical feed water tank. Pump, computer controlled, to supply water to the column. Pump, computer controlled, to supply the flocculant to the reaction tank. Solids dosing system to introduce the powders in the air line. Compressor, computer controlled. Stirrer, computer controlled, to mix the water going out the column with the flocculant. Valves to regulate the flow. Ball valve for extracting the sludges.

Sensors: flow sensor to determine the air flow, flow sensor to measure the water flow, two flowmeters, differential pressure sensor. pH sensor.

② PLGC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the PC keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PLGC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

Dimensions (approx.)= Unit: 1500 x 600 x 2400 mm. Weight: 150 Kg. Control Interface Box: 490 x 330 x 310 mm. Weight: 10 Kg.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocessspecial/PLGC.pdf

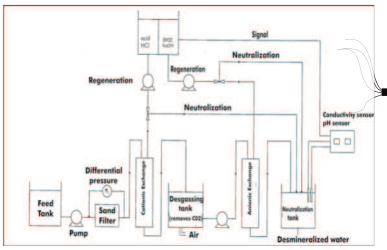
PRACTICAL POSSIBILITIES

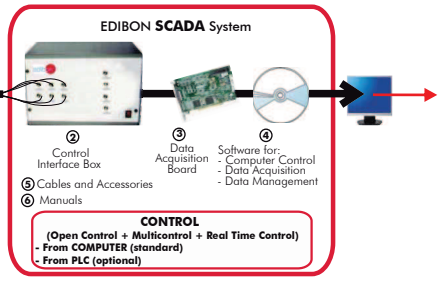
1.- Familiarization with a gas washing plant.
2.- Study of the water flow influence on the gas washing plant efficiency.
3.- Study of the air flow influence on the gas washing plant efficiency.
4.- Study of the introduced dust mass influence on the gas washing plant efficiency.
5.- Determination of the gas washing plant efficiency related to the quantity of solids introduced into the air current with the quantity of sedimented solids.
6.- Best quantity of floculant to produce the dust particles precipitation.
7.- Determination of the best pH for the solid particles sedimentation which go together with the water.
8.- Study of the best pH to obtain biggest purity in settled water.
9.- Study of the floculant presence influence on the pH variation in the reaction-settling tank.
10.- Pressure losses in the gas washing plant.

Other possible practices:

11.- Sensors calibration.
12-30- Practices with PLC.

PPDAC. Computer Controlled **Water Demineralization and Processing Plant**





①Unit: PPDAC. Water Demineralization and Processing Plant

SPECIFICATIONS SUMMARY

Items supplied as standard

① PPDAC. Unit:

Main metallic elements in stainless steel. Diagram in the front panel with similar distribution to the elements in the real unit.

Basically formed by the following main elements: feed tank, feed tank pumping group computer controlled, mechanical filter for particles bigger than 30µ, cationic resins exchanger, water degasifier tank, degasifier pumping group computer controlled, cationic exchanger, anionic exchanger, tank for acid, tank for base.

Sensors: pH sensor, conductivity sensor, pressure sensors, flow sensors, temperature sensor.

② PPDAC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time control with flexibility of modifications from the PC keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ PPDAC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

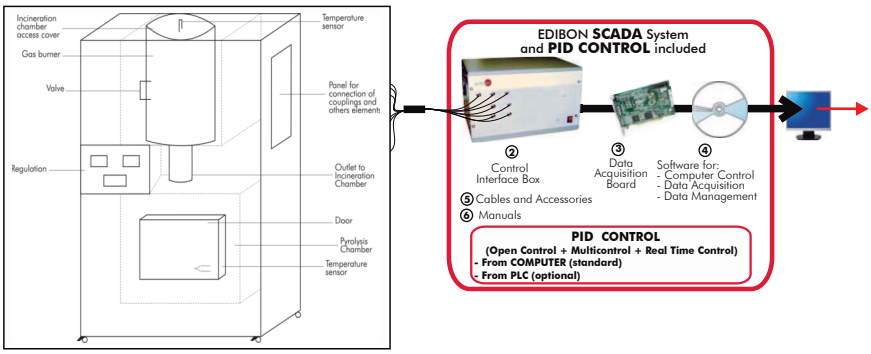
Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocessspecial/PPDAC.pdf

EPIRC. **Computer Controlled Pyrolysis Unit**



①Unit: EPIRC. Pyrolysis Unit

SPECIFICATIONS SUMMARY

Items supplied as standard

① EPIRC. Unit:

For chemical separation of the elements of a compound through temperature and a tight chamber, heated by an electric resistance with temperature control.

Metallic structure and main metallic elements in stainless steel. Diagram in the front panel with similar distribution to the elements in the real unit.

The unit includes a combustion chamber, which arrives gases produced in the pyrolysis chamber. This one has a temperature controller which operates the burner.

Furnace safety has a pressure sensor.

The furnace has a gas automatic analyser at the gas line and there are sample points and gas input in both chambers.

This unit is supplied with the instrumentation and the suitable sensors for the control and measurement of the most representative parameters.

② EPIRC/CIB. Control Interface Box :

With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneous visualization in the PC of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation. All the actuators' values can be changed at any time from the keyboard. Shield and filtered signals to avoid external interferences. Real time PID control with flexibility of modifications from the PC keyboard of the PID parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface, and the third one in the control software.

③ DAB. Data Acquisition Board:

PCI Express Data acquisition National Instruments board to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 KS/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

④ EPIRC/CCSOF. PID Computer Control+Data Acquisition+Data Management Software:

Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 KS/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals.

More information in: www.edibon.com/products/catalogues/en/units/chemicalengineering/chemicalprocessspecial/EPIRC.pdf