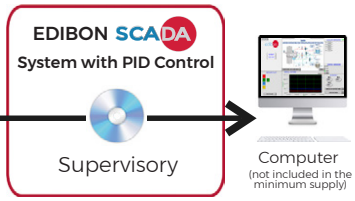
SLE00

Computer Controlled and Touch Screen Solid-Liquid Extraction Pilot Plant

11.- CHEMICAL ENGINEERING



- Research unit.
- Custom designs and own manufacture.
- Food grade materials.
- Possibility of production for commercialization.

EXPANSIONS

The main reference could be expanded adding:

ESN
EDIBON Scada-Net Systems

ECL
EDIBON Cloud Learning

INNOVATE SYSTEMS

- Advanced Real-Time SCADA and PID Control.
- Open Control + Multicontrol + Real-Time Control.
- Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.
- Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.
- Capable of doing applied research, real industrial simulation, training courses, etc.
- Remote operation and control by the user and remote control for EDIBON technical support, are always included.
- Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).
- Designed and manufactured under several quality standards.
- This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

WARRANTIES

SPARE PARTS AVAILABILITY 15-YEAR

WARRANTY 5-YEAR

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For detailed product information, visit:
www.edibon.com

INTRODUCTION

Solid-liquid extraction is a unitary operation consisting of the separation of one or more components from a solid phase using a suitable liquid solvent. This method is effective when the component to be separated from the solid phase is highly soluble in the solvent used. The extraction process has three main components: the solid carrier substance, the solute to be extracted and the liquid solvent. By bringing the carrier substance containing the solute into contact with a related solvent, the solute will diffuse into the liquid phase until equilibrium is reached.

This process has been perfected for the production of different substances of economic interest such as: extraction of oils from seeds using organic solvents, separation of sugars from sugar beet using hot water, extraction of dyes using alcohols or in metallurgy for the extraction of different metals such as gold or silver from their ore.

The Computer Controlled and Touch Screen Solid-Liquid Extraction Pilot Plant, "SLE00", consists of a pilot scale installation that allows the extraction of solutes from a solid matrix using different types of solvents and with variable operating conditions, which gives the unit great versatility. This pilot plant includes a large number of sensors and actuators that allow the operating temperature, the type of solvent, the solvent flow rate and the residence time to be varied.

GENERAL DESCRIPTION

The Computer Controlled and Touch Screen Solid-Liquid Extraction Pilot Plant, "SLE00", allows the separation of a solute from its solid matrix by direct contact with a suitable solvent.

The pilot plant incorporates five columns that can store up to 18 vessels of about 200 ml capacity, which allows loading up to 15 – 18 liters of solids. The PTFE and stainless steel vessels are loaded with the solid prior to the operation, and then the columns are filled by stacking the vessels on top of each other.

Once the pilot plant has been preloaded and correctly assembled, the servomotors that drive the different carousels are started. The feeding carousel doses the sieves into the extraction zone, one by one.

In the extraction zone, the solid from each sieve undergoes six different stages, with three consecutive extraction and draining cycles.

After each extraction stage there is a resting stage that allows the solvent to drain, optimizing the recovery of the solute. This pilot plant allows for a countercurrent solid-liquid extraction process, which is the most commonly used in the industry because it is the most efficient. The solid is depleted from the first to the last stage, while the solvent is concentrated in solute from the last to the first stage.

When the extraction stage is finished, the depleted solid passes to the emptying carousel, where the vessels are dosed into five columns similar to the feed columns. The sieves fall into these columns by gravity and will remain there until the process is finished.

The liquid used as solvent for the extraction starts from the storage tank or fresh solvent tank. This solvent is pumped by a dosing pump to the last stage of extraction of the solid (which corresponds to the first stage of solvent extraction), the solvent passes through a heating hose that raises the temperature of the liquid and is injected into the container with the solid through a spray nozzle. The bottom of the vessels on which the solid is placed is made of stainless steel mesh which allows the solvent together with the solute to pass through, but retains the solid material. The solvent is collected at the bottom of the unit body in a compartment with an outlet leading to another dosing pump, the solvent is reheated and fed to the second extraction stage. The same process then takes place until the solvent is fed to the first extraction stage.

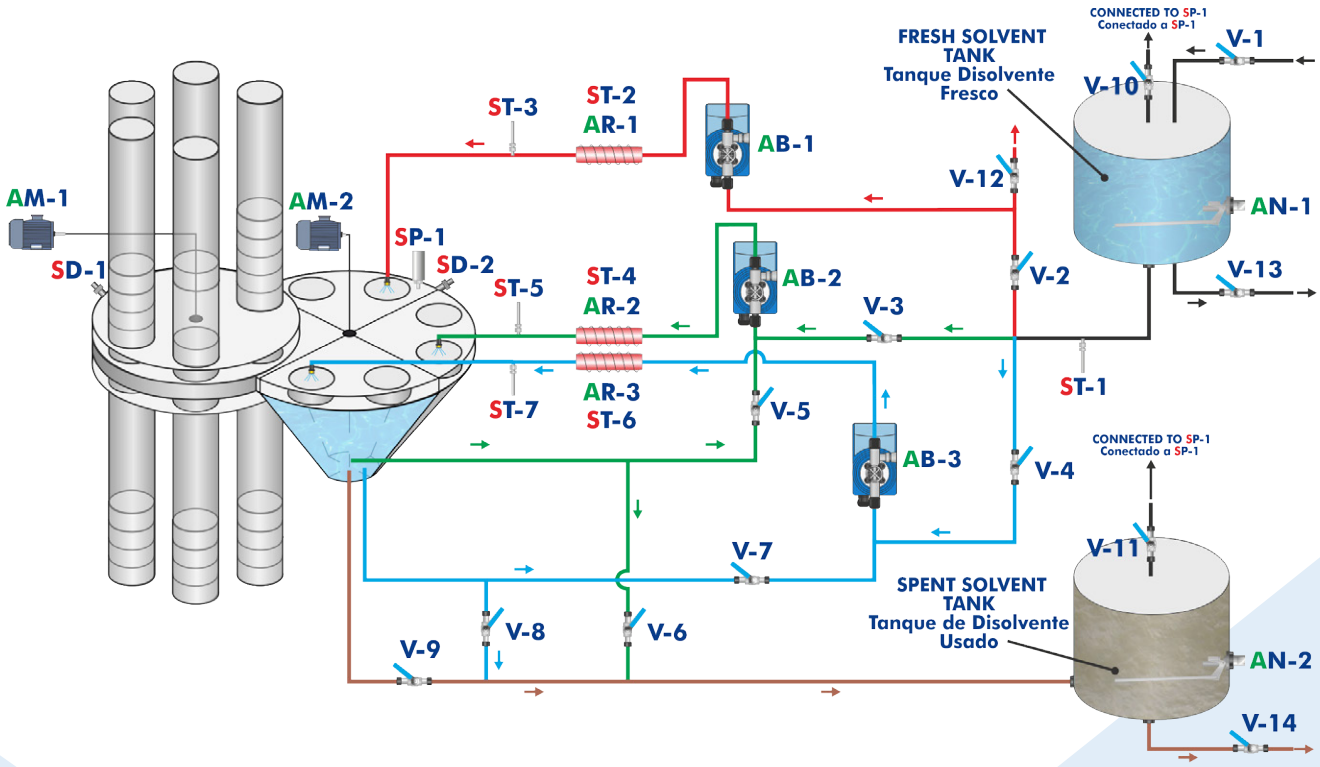
When the solvent from the first extraction stage is collected (from the point of view of the solid) it is completely exhausted, having the maximum concentration of solute, therefore, it is led to the spent solvent storage tank.

This Computer Controlled and Touch Screen Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

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

- OPEN CONTROL
+
- MULTICONTROL
+
- REAL TIME CONTROL



ST- TEMPERATURE SENSOR Sensor de Temperatura	SP- PRESSURE SENSOR Sensor de Presión	SD- DISPLACEMENT SENSOR Sensor de Desplazamiento	AB- PUMP Bomba	AN- LEVEL SWITCH Interruptor de Nivel	AM- MOTOR Motor	AR- HEATING ELEMENT Resistencia	V- VALVE Válvula
PRIMARY CIRCUIT Circuito Primario	SECONDARY CIRCUIT Circuito Secundario	TERTIARY CIRCUIT Circuito Terciario	FRESH SOLVENT CIRCUIT Circuito de Disolvente Fresco		SPENT SOLVENT CIRCUIT Circuito de Disolvente Usado		

EXERCISES AND PRACTICAL POSSIBILITIES

Guided practical exercises included in this pilot plant:

1.- Study of the unit operation of solid-liquid extraction.
2.- Study of the influence of the type of solvent.
3.- Study of the influence of the particle size of the solid.
4.- Study of the influence of the solvent temperature.
5.- Study of the influence of the solvent flow rate.
6.- Study of the influence of the number of extraction stages.
7.- Study of the influence of the residence time.
8.- Comparison between series and parallel operation in solid-liquid extraction.
9.- Performance of material balances in extraction operations.
10.- Calculation of partition coefficients.
11.- Solid-liquid extraction with organic and aqueous solvents.

Additional practical possibilities:

12.- Sensors calibration.

Other possibilities to be done with this pilot plant:

13.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
14.- Open Control, Multicontrol and Real Time Control.
This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters, etc. in real time.
15.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
16.- This unit can be used for doing applied research.
17.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
18.- Visualization of all the sensors values used in the SLE00 pilot plant process.
19.- Several other exercises can be done and designed by the user.

Additional practical possibilities with the expansions:

ESN. EDIBON Scada-Net Systems

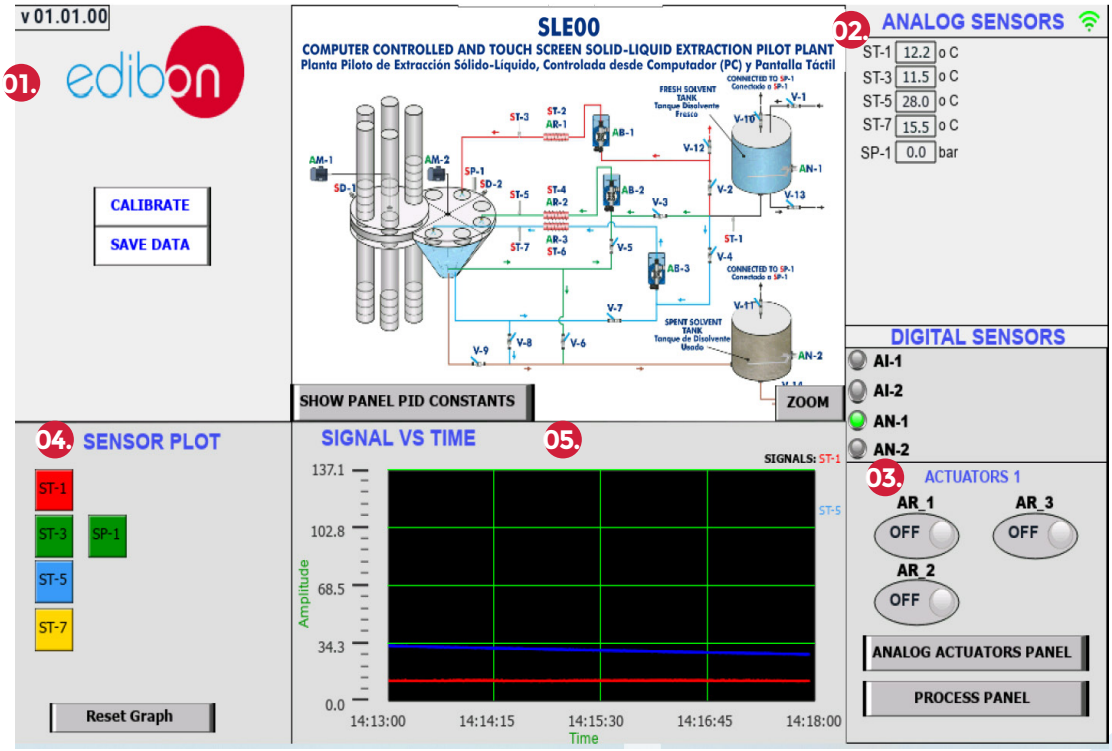
20.- Control any unit from any post located in the laboratory.
21.- Supervise different experiments about data acquisition and representation, from the units, in real time.
22.- Visualize any experiment from any laboratory post.
23.- Supervise as many experiments as desired, performed in different units at the same time.
24.- Generate reports with the results obtained with the units.
25.- Perform different experiments at the same time.
26.- Show to the laboratory members the appropriate manual or automatic operations to perform with each laboratory unit.
27.- Create more elaborate practical exercises using more than one unit from the laboratory.
28.- Suggest multidisciplinary experiments, in other words, mix in the same experiment units from different study fields.
29.- Modify any parameter of any unit included in the system from any workstation in the laboratory.
30.- Cause an abnormal functioning in a unit for the students to practice fault finding exercises.
31.- Assess the knowledge of a student or group of students about a particular unit (any unit included in the "ESN" system).
32.- Develop guided practical exercises for a better understanding of each unit.
33.- Individual training practical exercises.
34.- Group exams or practical exercises.
35.- Perform interactive exercises (using the chat between manager-users).
36.- Exchange of obtained results among the members of the "ESN" system.
37.- Any exercise directly related to the SCADA software of each unit.
38.- Some of the practical possibilities may be done only with the "ESN" complete system.

ECL. EDIBON Cloud Learning

**Ask us for information about the practices that you could perform remotely with each of our units.*

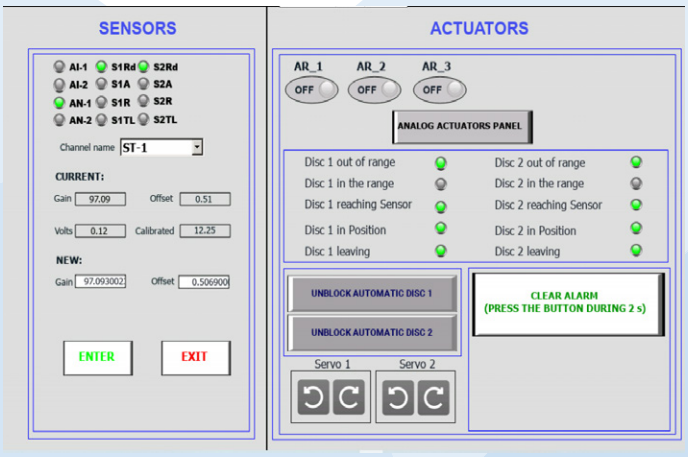
RESULTS

SOFTWARE MAIN SCREEN



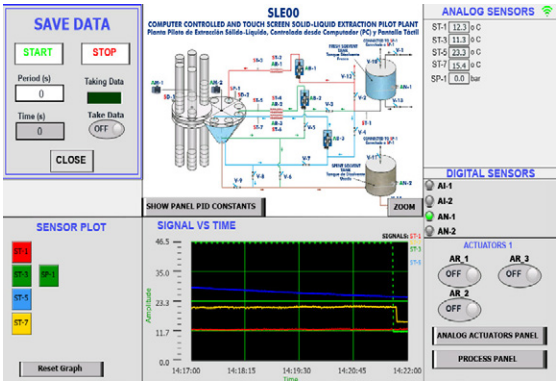
1. Main software operation possibilities.
2. **Sensors displays, real time values, and extra output parameters. Sensors:** ST=Temperature sensor. SP=Pressure sensor. SD=Displacement sensor.
3. **Actuators controls. Actuators:** AB=Pump. AN=Level switch. AM=Motor. AR=Heating element.
4. Channel selection and other plot parameters.
5. Real time graphics displays.

SOFTWARE FOR SENSORS CALIBRATION (Example of screen)



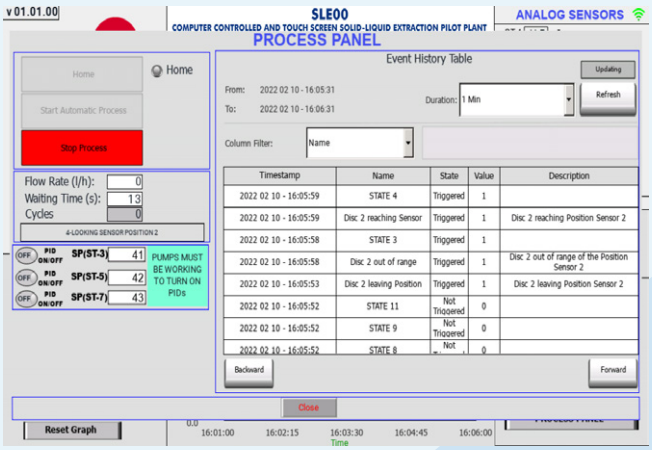
The researcher, the teacher and the students can calibrate the unit with a password provided by EDIBON. Factory calibration can be restored at any time.

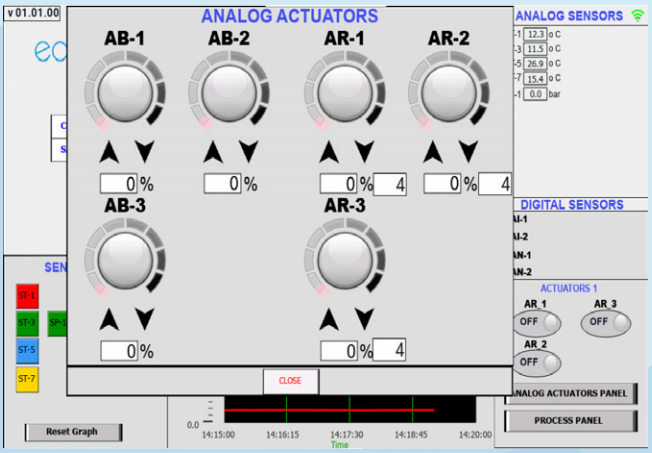
RESULTS:



Real time representation of any measured variable of the SLE00 pilot plant.

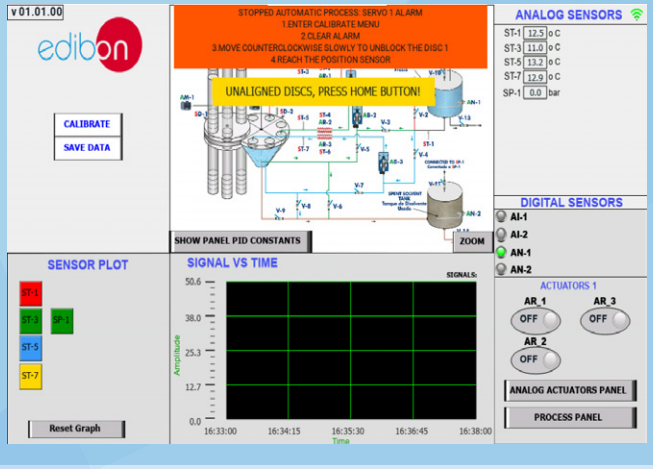
The SLE00 pilot plant allows the variation of the solvent flow rate, residence time and solvent feed temperature in each of the extraction stages. In addition, there is an event display that indicates the different actions performed by the unit in automatic operation.





The SLE00 pilot plant allows manual control of the process flow rate and the performance of the heating

The SLE00 pilot plant has different safety measures and interlocks that stop the operation in case of any risk, in addition, an alarm message will be displayed on the main screen.



COMPLETE TECHNICAL SPECIFICATIONS

1. SLE00 Pilot Plant:

- Anodized aluminum frame and panels made of painted steel.
- The pilot plant includes wheels to facilitate its mobility.
- Main metallic elements made of stainless steel.
- Diagram in the front panel with distribution of the elements similar to the real one.
- All the elements of the pilot plant that may come into contact with the solvent during the process are made of stainless steel AISI 316 and AISI 304, and PTFE.

SOLID FEED SYSTEM

- 90 vessels with 50 µm mesh bottom:
  - Made of AISI 316 stainless steel.
  - Maximum capacity per sieve: 200 cm^3 approx.
  - PTFE outer casing to avoid metal-to-metal contact.
- Feeding columns with a capacity of up to 90 vessels.
  - Five columns.
  - Viewers in each column to visualize if the system is working correctly.

BODY OF THE UNIT

- Feeding carousel:
  - Doses the sieves to the extraction carousel from the feed columns.
  - Made of stainless steel and PTFE.
  - Consists of a rotating drum with six holes.
  - Movement in 60° steps.
  - Includes an inductive sensor which ensures that the carousel is in the correct position after each rotation.
- Extraction carousel:
  - Drives the containers with the solid through different extraction phases.
  - Made of stainless steel and PTFE.
  - Consists of a rotating drum with eight holes.
  - Movement in 45° steps.
  - Includes an inductive sensor that ensures that the carousel is in the right position after each rotation.
- Emptying carousel:
  - Drives the containers with the exhausted solid from the extraction carousel to the storage columns.
  - Made of stainless steel and PTFE.
  - It consists of a rotating drum with six holes.
  - Movement in 60° steps.
  - This carousel rotates in conjunction with the feed carousel.
- Solvent reception area:
  - Hopper with three differentiated sections that allows a countercurrent extraction process to be carried out.

FRESH SOLVENT FEED TANK

- Capacity: 50 l.
- Made of stainless steel.
- Low level switch.

SPENT SOLVENT RECEPTION TANK

- Capacity: 50 l.
- Made of stainless steel.
- High level switch.

THREE LIQUID DOSING PUMPS

- Electromagnetic pumps with digital frequency regulation.
- Maximum flow rate: 18 l/h.
- Maximum pressure: 16 bar.
- Stainless steel head and PTFE seals.

THREE HEATING HOSES

- Length: 1000 mm.
- Power: 400 W.
- Built-in “J” type thermocouple.
- Maximum heating temperature: 80 ˚C.

SPRAY NOZZLES

- Low capacity ultra-fine spray nozzles.
- Spray flow rate: 10.6 l/h (at 7 bar).
- Made of AISI 303 stainless steel and ceramic material.

DRIVE SYSTEM

- Two servomotors:
  - Power: 200 W.
  - Protection IP67.
  - Nominal torque: 0.64 Nm.
  - Nominal speed: 3000 rpm.
- Two gearboxes:
  - Two worm-crown reduction stages in series.
  - Reduction ratio: 1/980.
- Two mechanical seals:
  - They allow the transmission of torque avoiding gas leaks from inside the unit.
  - Maximum torque: 40 Nm.
  - Made of AISI 304 stainless steel and PTFE.

INSTRUMENTATION

- Set of 14 valves allowing series and parallel operation.
- Seven "J" type thermocouples.
- Two level switches.
- Pressure sensor.
- Two optical detectors.

The complete pilot plant includes as well:

- **Advanced Real-Time SCADA and PID Control.**
- **Open Control + Multicontrol + Real-Time Control.**
- **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**
- **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**
- **Capable of doing applied research, real industrial simulation, training courses, etc.**
- **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**
- **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**
- **Designed and manufactured under several quality standards.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

2. SLE00/CCSOF. Supervision Software + Control Software + Data Acquisition Software + Data Management Software:

SCADA System is composed of four software package with the following features:

- **The Supervision Software** is in charge of monitoring in real time start and stop elements, unexpected conditions and process evolution. In case of being necessary, it actuates on the system and notifies the user the incorrect operations.
- **The Control Software** allows to manage multiple process and variables in real time either a manual way or automatic way. Several type of algorithms of control such PID CONTROL are implemented depending on the field of study.
- **The Data Acquisition Software** focus on measuring and processing signals from the process with very high accuracy getting a synchronized and fast response of the system. A calibration system is part of this software to adjust the sensor measurements.
- **The Data Management Software** stores and represents, alarms, variables and process evolution in real time both in a graphic format and in a numeric format such time charts or process diagram. Printable reports can be generated or historian data can be loaded to study the experiments in detail.

The Software is open and flexible architecture that facilities to access different work levels both instructors and students. It is supported by current Windows operating system and industrial standards. The graphical user interface is intuitive and user- friendly.

3. Cables and Accessories, for normal operation.

4. Manuals:

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

References 1 to 4 are always included in the minimum supply:
- SLE00.
- SLE00/CCSOF.
- Cables and Accessories.
- 8 Manuals for enabling normal and full operation.

REQUIRED SERVICES

- Electrical supply:
  - Single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.
- Water supply and drain.

DIMENSIONS AND WEIGHTS

- **SLE00:**
  - Dimensions: 1600 x 1200 x 2300 mm approx. (62.99 x 47.24 x 90.55 inches approx.)
  - Weight: 300 Kg approx. (661 pounds approx.)

ADDITIONAL RECOMMENDED ELEMENTS (Not included)

- Computer.

SIMILAR UNITS AVAILABLE

Offered in this catalog:

- SLE00. Computer Controlled and Touch Screen Solid-Liquid Extraction Pilot Plant.

Offered in other catalogs:

- UESLC. Computer Controlled Solid-Liquid Extraction Unit.
- UESLB. Solid-Liquid Extraction Unit.

Additionally to the main items (1 to 4) described, we can offer, as optional, other items form 5 to 6. All these items try to give more possibilities for:

ESN. EDIBON SCADA-Net System.

ECL. EDIBON Cloud Learning.

EXPANSIONS

5. ESN. EDIBON Scada-Net Systems

The EDIBON Scada-Net Systems, "ESN", consists on the integration of EDIBON computer controlled units into the SCADA system in a local network.
The main feature of this system is the remote control of any EDIBON unit belonging to it from any control station included in the local network. In addition, any of these units can be visualized from any workstation.
Consequently, the efficiency of a laboratory with the "ESN" system is higher than the efficiency of a conventional laboratory.

- Higher laboratory performance since several students can work simultaneously. Several users can operate various units at the same time.
- Possibility of dividing the classroom into workgroups.
- Several experiments can be performed at the same time.
- Collaborative experiments performance.
- There are different user levels (manager, basic, intermediate and advanced) with different permissions.
- The manager has the absolute control of the system.
- The manager/teacher can supervise from his/her computer the operations every user is performing in any unit of the laboratory.
- Users and manager are connected at all times.
- Real time display and control of the whole system from an interactive whiteboard (touchscreen).
- CENTRALIZED AND SECURE SYSTEM, it can be totally controlled from the central computer (manager).
- The "ESN" system is MODULAR, OPEN and EXPANDIBLE.
- A vision system for real time monitoring of experiments is supplied.
- Visualization of the changes in a unit from any computer of the laboratory.
- All units can work simultaneously.
- The system is made up of as many units as required.
- The required infrastructure, both hardware and software is provided.

For more information see ESN catalog. Click on the following link: www.edibon.com/en/edibon-scada-net

6. ECL. EDIBON Cloud Learning

EDIBON Cloud Learning expansion, "ECL", is a solution designed to control EDIBON Technology based laboratories remotely in a simple and easy way.

EDIBON Cloud Learning, "ECL", is divided in two platforms:

Users Online Platform:
The main advantages of the Users Online Platform are:

- The **administrators** have full control over their laboratories thanks to the powerful class-administrator tool that allows the users management, logs visualization and progression monitoring. It also enables to assign users permissions to let them control EDIBON units or just display them. Furthermore, the administrator can upload and download measurements, data and multimedia resources.
- The **users** can learn interactively in a flexible environment as if they were in the laboratory, accessing through the remote app to work with EDIBON units. Several users can work with one unit or one user with several units. The users can also upload and download measurements, data and graphs, multimedia resources and reports.

Remote App Platform:
Thanks to the Remote App Platform, the users can control EDIBON units and EDIBON SCADA software as if they were in the laboratory and share their expertise with the users community.

For more information see ECR catalog. Click on the following link: www.edibon.com/en/edibon-cloud-learning

ORDER INFORMATION

Main Items (always included in the supply):

1. **SLE00. Computer Controlled and Touch Screen Solid-Liquid Extraction Pilot Plant.**
2. **SLE00/CCSOF. PID Computer Control + Data Acquisition + Data Management Software.**
3. **Cables and Accessories,** for normal operation.
4. **Manuals.**

*IMPORTANT: Under SLE00 we always supply all the elements for immediate running as 1, 2, 3 and 4.

Optional items (supplied under specific order):

- **EXPANSIONS:**
  5. ESN. EDIBON Scada-Net Systems.
  6. ECL. EDIBON Cloud Learning.

QUALITY CERTIFICATES

WARRANTIES

SPARE PARTS AVAILABILITY 15-YEAR

WARRANTY 5-YEAR

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REPRESENTATIVE: