# Gas Absorption Column

**CAG**

## PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION
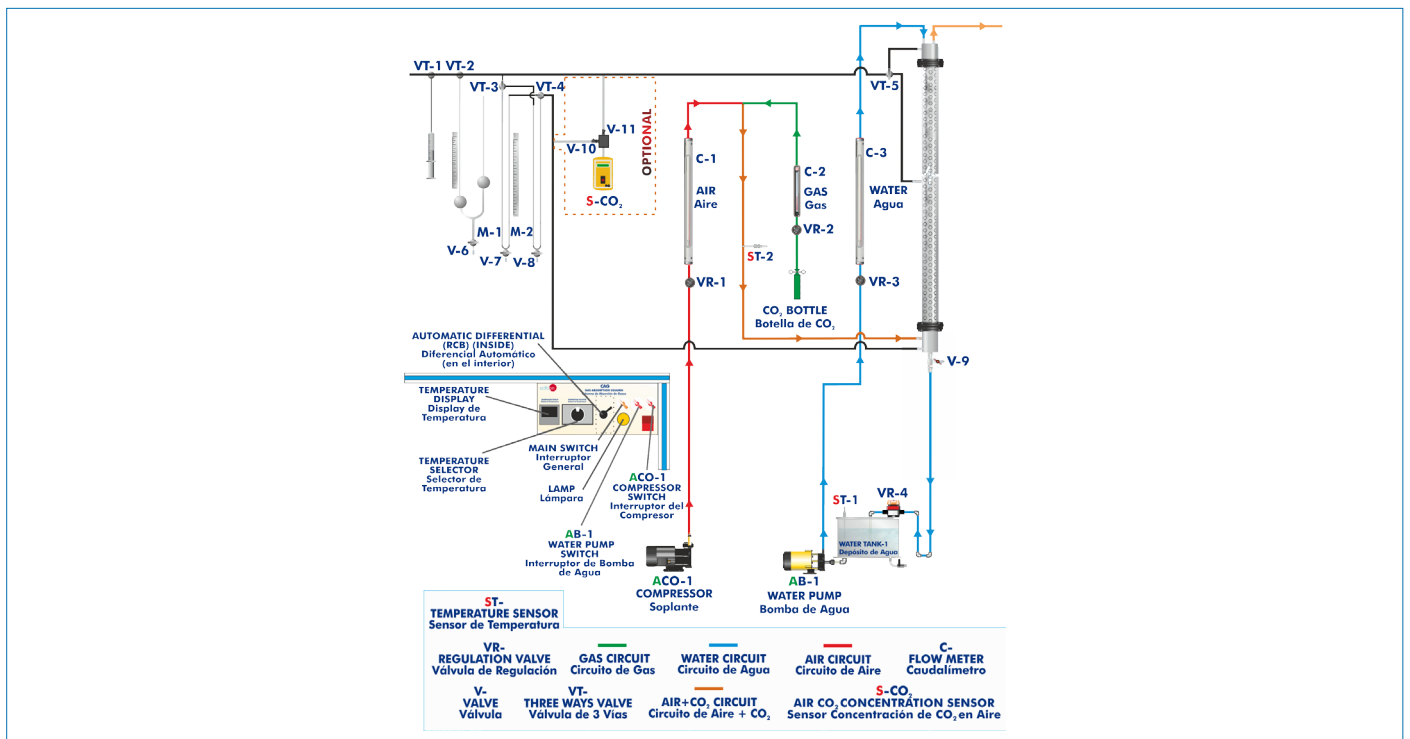


VT-1 VT-2
VT-3 VT-4
VT-5
V-11
OPTIONAL
V-10
C-1
AIR
Aire
C-2
GAS
Gas
C-3
WATER
Agua
S-CO₂
VR-2
M-1 M-2
V-6
V-7 V-8
ST-2
VR-1
VR-3
CO₂ BOTTLE
Botella de CO₂
V-9

AUTOMATIC DIFFERENTIAL
(RCB) (INSIDE)
Diferencial Automático
(en el interior)

TEMPERATURE
DISPLAY
Display de
Temperatura

TEMPERATURE
SELECTOR
Selector de
Temperatura

MAIN SWITCH
Interruptor
General

LAMP
Lámpara

ACO-1
COMPRESSOR
SWITCH
Interruptor del
Compresor

AB-1
WATER PUMP
SWITCH
Interruptor de Bomba
de Agua

ACO-1
COMPRESSOR
Soplante

ST-1  VR-4

WATER TANK-1
Depósito de Agua

AB-1
WATER PUMP
Bomba de Agua

| ST-TEMPERATURE SENSOR Sensor de Temperatura | | | | |
|---|---|---|---|---|
| VR-REGULATION VALVE Válvula de Regulación | GAS CIRCUIT Circuito de Gas | WATER CIRCUIT Circuito de Agua | AIR CIRCUIT Circuito de Aire | C-FLOW METER Caudalímetro |
| V-VALVE Válvula | VT-THREE WAYS VALVE Válvula de 3 Vías | AIR+CO₂ CIRCUIT Circuito de Aire + CO₂ | S-CO₂ AIR CO₂ CONCENTRATION SENSOR Sensor Concentración de CO₂ en Aire | |

# INTRODUCTION

Absorption is a basic operation of mass transfer that consists on the separation of some components of a gaseous miscture by contact with an adequate solvent.

Mass transfer separation operations imply the contact of two immiscible phases. This contact can be intermittent, as it happens in plate columns, or continuous, as it happens in packed columns.

Some processes that demonstrate the importance of absorption are:

   The recovery of solvent vapors or natural gasoline from gaseous currents.

   The treatment of gases in refineries.

   The decontamination of industrial gases.

The Gas Absorption Column, "CAG", is a laboratory scale unit designed to study hydrodynamic and absorption processes in a packed column.

# GENERAL DESCRIPTION

The Gas Absorption Column, "CAG", 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 descends along the column.

The main parts of the unit are:

   Packed column: it consists of a glass cylindrical column filled with Raschig rings.

   Liquid circuit (water): the liquid, that is stored in a PVC tank, is impelled towards the column by a pump. It feeds the column through its upper end using a glass diffusion shower. After crossing the column, the liquid is returned to the storage tank. The liquid flow that arrives to the column is measured with a flowmeter. In the storage tank, through aeration, the $CO_2$ can be desorbed from the liquid previously filled in the column.

   Gas circuit (air and $CO_2$): it consists of a $CO_2$ and air (supplied by a blower) mixture current. Both gaseous currents are mixed, and later they enter the base of the column through a side inlet located below the bed level, so that the gaseous mixture is an homogeneous as possible. Both gas flows are measured by flowmeters.

   $CO_2$ measuring system: it allows to determine the concentration of this gas in the currents originated from the upper and central parts of the column.

# SPECIFICATIONS

Anodized aluminum frame and panels made of painted steel.

The unit 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.

**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 of 10 mm diameter.

   It includes glass ends for inlet and outlet of gases and liquids and for sample point.

**Liquid circuit (water):**

   PVC glass storage tank, capacity: 40 l.

   Centrifugal pump, maximum flow rate: 540 l/h.

   The liquid flow that arrives at each moment to the column is measured with a flowmeter.

   Glass diffusion shower.

   PVC conduit for the effluent liquid with a control flow valve and one sampler.

**Gas circuit (air and $CO_2$):**

   Compressor (blower) provides a maximum flow of 6 m³/h and a maximum pressure of 1 bar.

   The gas ($CO_2$ or ammonia) is supplied by a cylinder, type bottle. (Not supplied with the unit)

   Mixing system for the two gases streams.

   Both gas flows are measured by two flowmeters installed in the panel.

   Two control flow valves.



CAG detail

**Instrumentation for the analytical measurement of $CO_2$:**

   Glass syringe of 100 ml capacity, dedicated to extract the specific quantities of a sample to be analysed.

   Two glass tanks located at different heights and interconnected. They contain an aqueous solution of KOH, in which the contained $CO_2$ will be absorbed in the sample of gas to analyze.

   Three way-valves to direct the gaseous currents during the analysis process.

   There are transparent elements allowing a better visualization of the process.

**Control panel:**

   Lamp. Automatic differential (RCB). Compressor switch. Pump switch.

   Selector for temperature sensors. Digital display for temperature sensors.

Cables and Accessories, for normal operation.

Manuals: This unit is supplied with the following manuals: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

Additional recommended elements (Not included):

   - CAG/M. Manual Meter to Measure the Concentration of CO in a Gaseous Current Directly.

   - TERA. Refrigeration Water Recirculation Unit.

## EXERCISES AND 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 efficiency of the absorption.

Additional practical possibilities:

9.- Determination of the water, $CO_2$ and air flow.

10.- Head loss in the column.

11.- Study of the simple desorption process.

12.- Measurement of the $CO_2$ concentration in gaseous currents using a $CO_2$ meter (It requires the additional recommended element CAG/M).

13.- Influence of temperature on the adsorption efficiency. (It requires the additional recommended element TERA).

## REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.
- Water supply and drain.
- Vent piping to outside laboratory.

## DIMENSIONS AND WEIGHTS

CAG:

-Dimensions: 1000 x 740 x 2600 mm approx.

(39.37 x 29.13 x 102.3 inches approx.)

-Weight: 100 Kg approx.

(220 pounds approx.)

## ADDITIONAL RECOMMENDED ELEMENTS (Not included)

- CAG/M. Manual Meter to Measure the Concentration of CO in a Gaseous Current Directly.
- TERA. Refrigeration Water Recirculation Unit.
- General instrument for liquid titration.
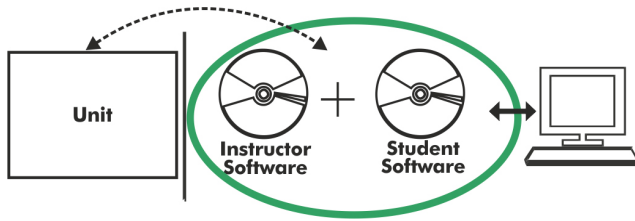- Draining tank for treatment of effluents.

## REQUIRED CONSUMABLES (Not included)

- Gas bottle $CO_2$ or ammonia.

## SIMILAR UNITS AVAILABLE

Offered in this catalog:

- CAG. Gas Absorption Column.

Offered in other catalogs:

- CAGC. Computer Controlled Gas Absorption Column.
- CAG-CD. Double Column Gas Absorption Unit.

## CAG/ICAI. Interactive Computer Aided Instruction Software:



With no physical connection between unit and computer, **this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF).** Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.
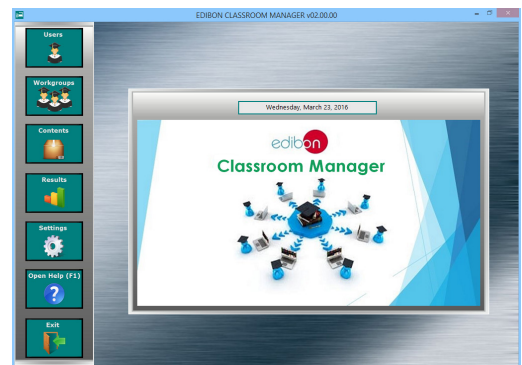
Instructor Software

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

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

Innovative features:

- User Data Base Management.

- Administration and assignment of Workgroup, Task and Training sessions.

- Creation and Integration of Practical Exercises and Multimedia Resources.

- Custom Design of Evaluation Methods.

- Creation and assignment of Formulas & Equations.

- Equation System Solver Engine.

- Updatable Contents.

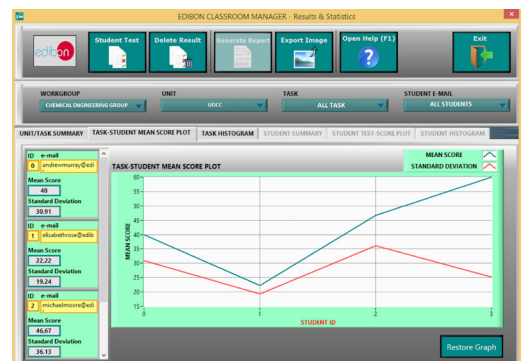- Report generation, User Progression Monitoring and Statistics.



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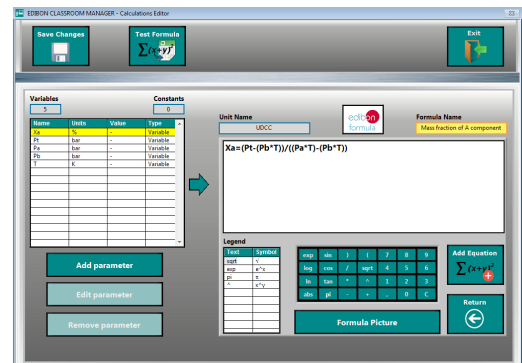


ECAL. EDIBON Calculations Program Package - Formula Editor Screen
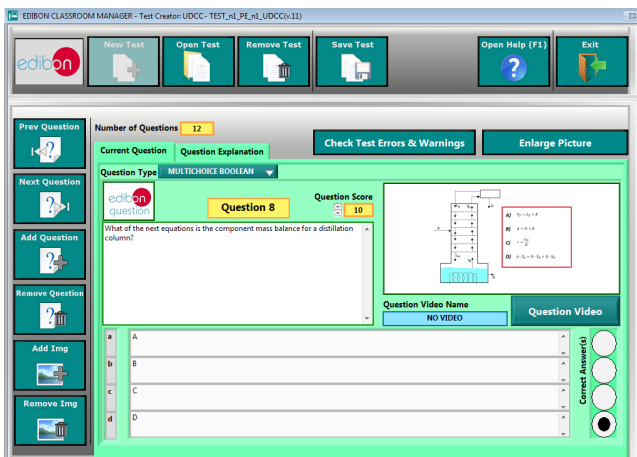


ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question



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

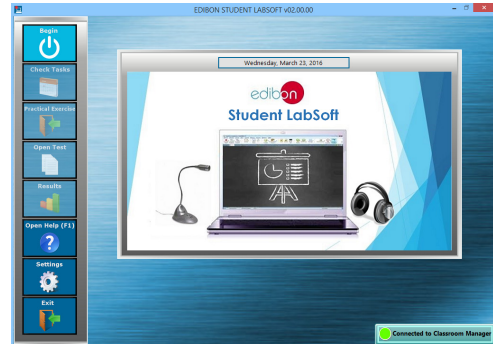## - ESL-SOF. EDIBON Student Labsoft (Student Software).

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

Innovative features:

• **Student Log-In & Self-Registration.**

• **Existing Tasks checking & Monitoring.**

• **Default contents & scheduled tasks available to be used from the first session.**

• **Practical Exercises accomplishment by following the Manual provided by EDIBON.**

• **Evaluation Methods to prove your knowledge and progression.**

• **Test self-correction.**

• **Calculations computing and plotting.**

• **Equation System Solver Engine.**

• **User Monitoring Learning & Printable Reports.**

• **Multimedia-Supported auxiliary resources.**

For more information see **ICAI** catalogue. Click on the following link:
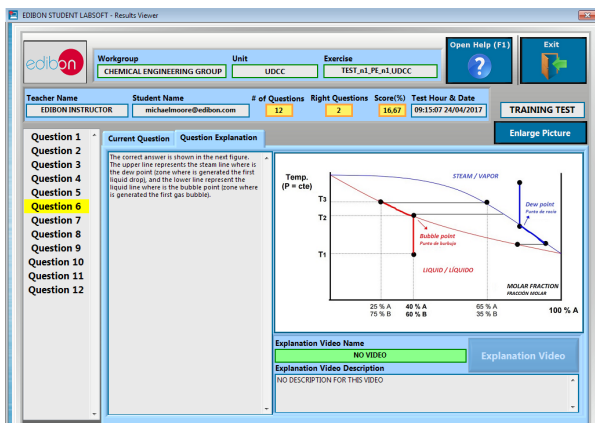
www.edibon.com/en/files/expansion/ICAI/catalog



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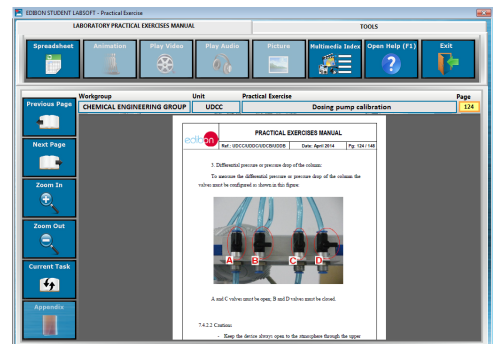


EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

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



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REPRESENTATIVE: