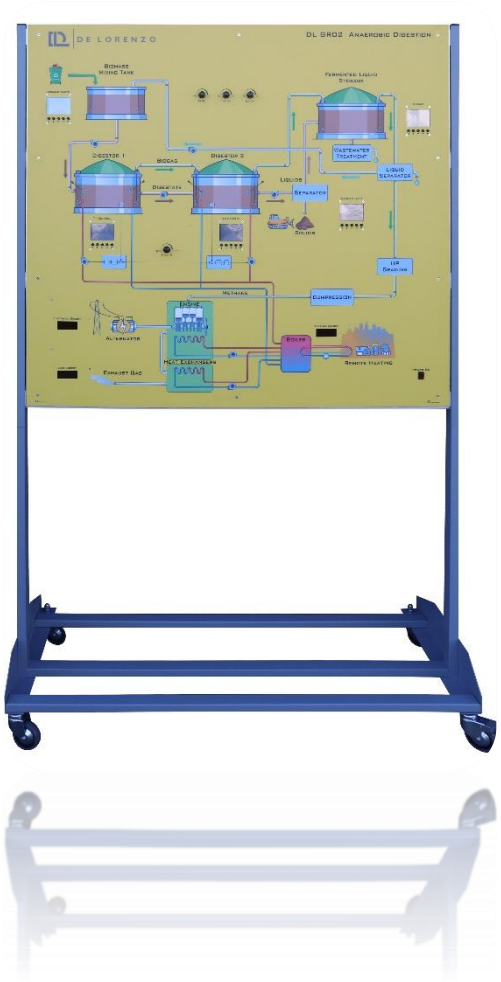
ANAEROBIC DIGESTION PLANT



DL GR02

The **DL GR02** Simulator allows you to study the operation and analyze the characteristics of an Anaerobic Digestion Plant.

It consists of a panel displaying the complete schematic of the entire plant, which houses a series of mini consoles displaying the values of the quantities that characterize the simulator's operation: masses, temperatures, energies, etc.

The simulator also features potentiometers for setting operating parameters and displays for viewing additional quantities.

The Simulator can be connected to a PC for supervision, graphical display of the quantities of interest, etc., via a dedicated USB interface..

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WASTE MANAGEMENT

The Simulator is accompanied by the Windows **DLworkspace** application which provides an integrated teaching environment for using the Simulator itself.

This previous application brings together, in a single graphical user interface, all the tools required to use the Simulator:

- the Training Software (i.e., the teaching materials) with the theoretical guide to the study topics, the exercise guide, and the questionnaires,
- the tools for graphically displaying the quantities acquired by the Simulator.

It is also possible to connect the Simulator to an **MQTT Broker** to publish all the information using Internet of Things techniques and view it remotely on other computers.

It has the following technical characteristics:

- Synoptic panel with color system diagram,
- 5 mini consoles with 2.8" TFT displays, 240 x 320 resolution, and 5-key keypad,
- USB interface,
- DLworkspace Windows application,
- Management and graphics processing software,
- Training software with text, images, videos, and questionnaires,
- Power supply: 220 Vac ± 10%, 50 Hz.

The curriculum includes the following topics:

- **Anaerobic digestion.**
  - Introduction,
  - The stages of digestion,
  - Biogas production.
- **Type of system.**
  - Operating parameters,
  - Process types: wet, dry, etc.
  - Plant types,
  - Cogenerator.
- **Sizing a reactor.**
  - Input parameters,
  - Dimensional calculations,
  - Mass and energy balances.
- **Operation simulation.**
  - Operational analysis,
  - Performance analysis,
  - Mass and energy balances.

The system is provided with technical manuals for theory and exercises.

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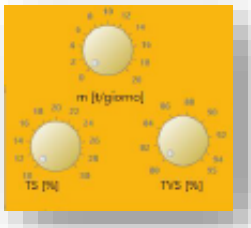
DL GR02 Simulator

For the Simulator to function, the data characterizing the system must be provided as input.

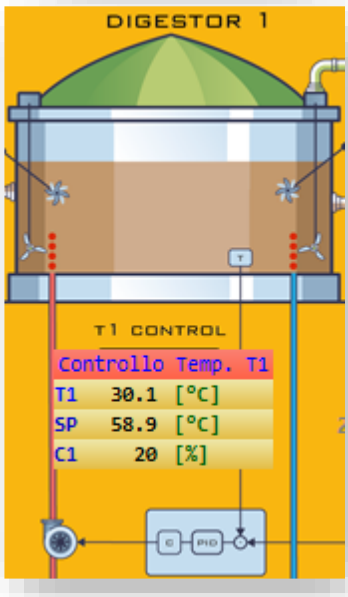
This data is:

- the mass of organic matter,
- the percentage of total solids,
- the percentage of volatile solids,
- the operating temperature.

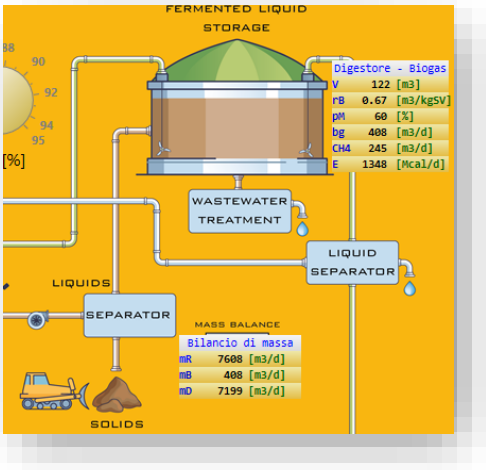


For optimal operation of the system, the temperature in the digesters must be regulated to optimal values and kept constant.

For this purpose, the simulator contains a PID controller for temperature control.



All the reactor operating variables are displayed on appropriate mini-consoles together with the mass balance data.



The methane that is produced, after successive cleaning and compression phases, can be used to be fed into the distribution network, or it can be used to generate electricity and heat through a cogenerator.

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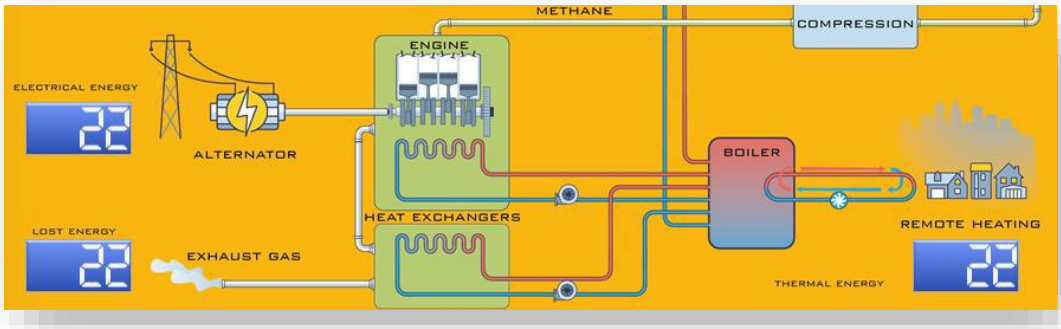
The DL GR02 simulator uses a cogenerator, according to the diagram in the figure:



Special displays show: the electrical energy produced, the thermal energy produced, and the energy lost.

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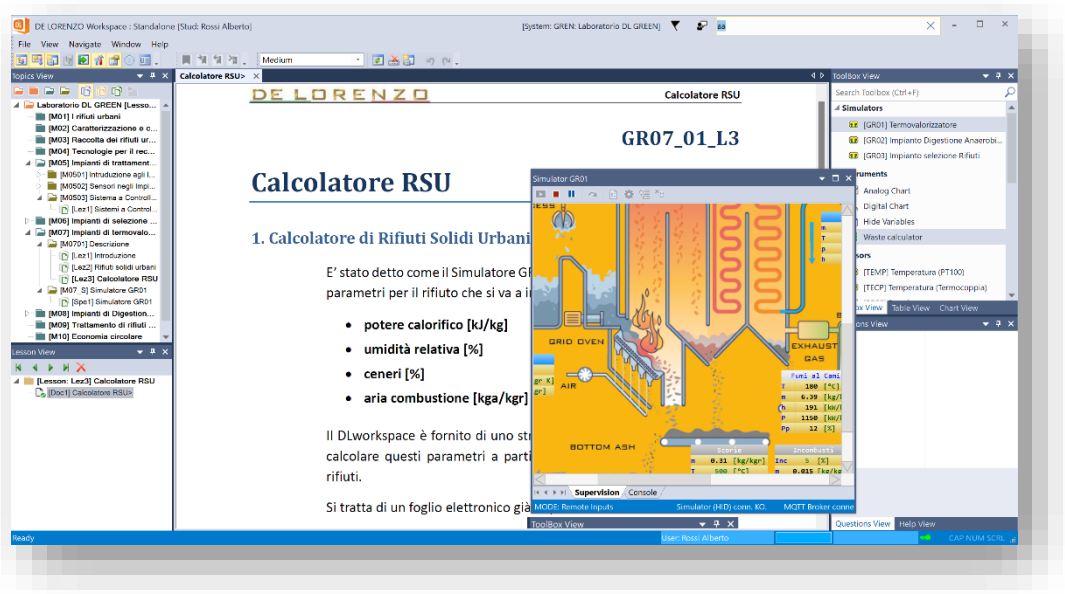
WASTE MANAGEMENT

DLworkspace IDE

De Lorenzo Workspace is a Windows application that provides an Integrated Learning Environment (**IDE**) for training. It brings together, in a single graphical user interface, all the tools useful for Students to study and experiment, and for Teachers to teach and verify learning.

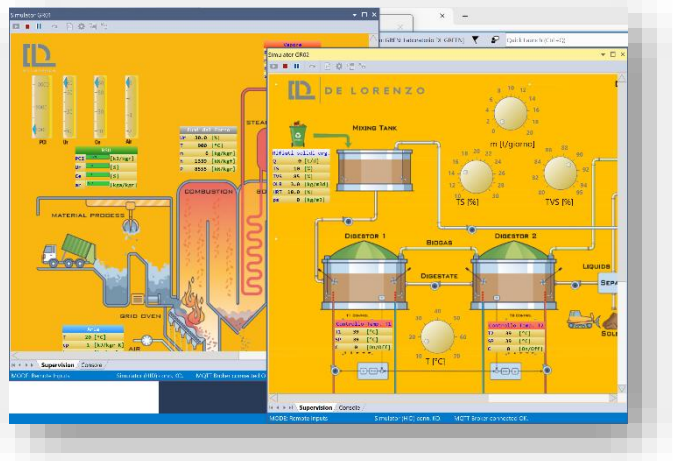
The figure shows an example.



You may notice:

- the list of topics and lessons on the left,
- the lesson pages in the centre,
- the supervision tools, videos and management of answers to questions on the right.

The same environment also houses the Simulator's tools for supervision and graphic processing.



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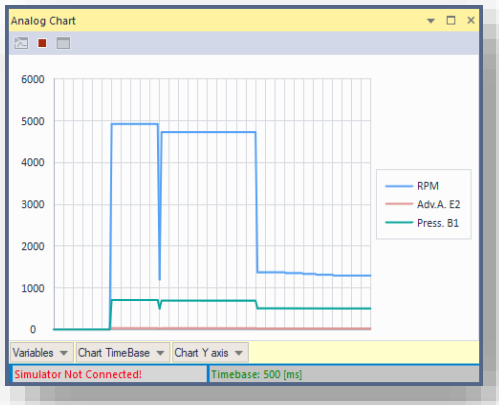
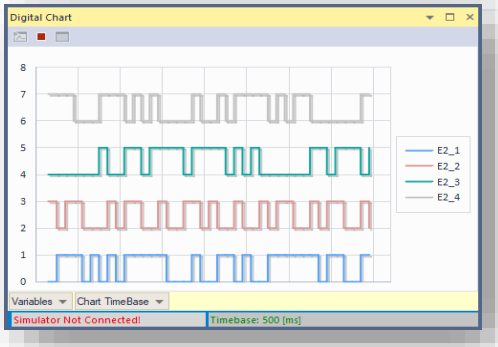
WASTE MANAGEMENT

The **Analog Chart** allows you to view the real-time trend of analog quantities during the simulation. It is possible to select multiple quantities at the same time.



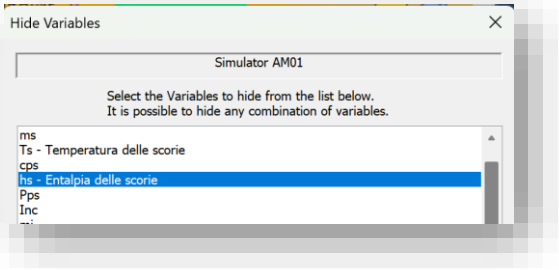
The **Digital Chart** allows you to view the real-time trend of ON-OFF quantities during the simulation.



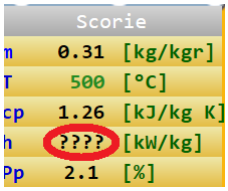
Interactive questions

The **DLworkspace** environment allows the Teacher to ask interactive questions to the Students during the simulation. It is in fact possible to 'hide' the values of the variables displayed by the Simulator and request their calculation by the Student.

A special window allows the teacher to select the variables to hide.



The value of the variable no longer appears to the Student on the Simulator. He must calculate its value using mass balances, energy balances, or other methods depending on the type of variable.



In this way it is possible to directly verify the student's level of learning.

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Implementation of DL GR02 simulator in the DL GREENLAB laboratory

The **DL GR02** simulator, here proposed in individual mode complete with its management software, can be integrated into the laboratory **DL GREENLAB (COURSE FOR THE STUDY OF URBAIN WASTE DISPOSAL)** which also includes two other simulators **DL GR01 (Waste to Energy Plant)** and **DL GR03 (Solid Waste Selection Plant)** with the aim of having an in-depth and complete course on the processes of urban waste disposal.

Specifically, the student acquires comprehensive training on all the following topics:

- **The product composition of urban waste.**
- **The main processes and flows of urban waste management.**
- **The main urban waste treatment processes.**

And thanks to the three simulators mentioned above, the **DL GREENLAB** laboratory allows for the faithful reproduction of urban waste disposal plants with the aid of a **DL WORKSPACE** learning tool which consists of a multimedia teaching platform.

For more detailed information, please refer to the catalogue **DL GREENLAB**.

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