1. General

The activated sludge pilot allows the study and the comprehension of sewage treatment by activated sludge. This treatment is an intermediate stage between the physical treatments or gridiron, deoilation and primary sedimentation and the final sterilization and chlorination stage, in a sewage treatment station. Its purpose is to eliminate the contaminated organic substances which are present in the sewage water after the above mentioned physical treatment. The organic load is measured in BOD (Biological Oxygen Demand) unit and it also causes a partial elimination of COD (Chemical Oxygen Demand). The conditioning process takes place in a tank where the organic load is removed by micro-organism (bacteria, rotifera, vorticellae, etc.) which are cultivated under aerobic conditions by blowing in air or sometimes also pure oxygen. The micro-organisms utilize the contaminated substances as necessary food for their production and their preservation. The aspect for this mass of micro-organisms is that of sludge, from which we have taken the name of the process. After the pollutant elimination phase it is necessary to divide the clarified water from the sludge, operation which is carried out in the settling tank (stating separator). The clarified water flows down to the receiving body, or to a sterilization treatment, while the activated sludge is partially recycled within the oxidation tank in order to stabilize the elimination treatment. This pilot plant has been designed to enable the students to learn all the fluid-dynamic, chemical-physical problems arising from the realization of an activated sludge process. The unit is completely instrumented and arranged for the execution of tests that help to understand advanced problems which come from the modern conception of activated sludge plants such as:

- the agitation effect in the reaction tank;
- the energetic saving and the reliability of the sludge recirculating system by “air-lift”;
- the effect of the work oxygen concentration on the sludge elimination and sedimentation.
2. Composition
The pilot plant is composed of:
- Basic plant (Code 944500)
- 6-place BOD (Biological Oxygen Demand) meter (Code 994510); OPTIONAL
- Frigothermostat for BOD apparatus (Code 949104); OPTIONAL
- Thermoreactor for COD analysis (Code 949103); OPTIONAL
- Electric compressor with 24 l tank (Code 971227); OPTIONAL
- OPTIONAL Automatic Data Acquisition System SAD/IC130D composed of:
  - Electronic transducers and signal conditioning kit (Code 914397)
  - Data analysis and acquisition software (Code 914398).

3. Description

Air line
It is composed of:
- a pressure stabilizing reducer;
- two flowrate controllers: one for the oxidation tank and the other for the sludge recirculation;
- a set of service solenoid valves
- an air distributor/diffuser in the reactor
- an “air-lift” system for the sludge recirculation from the settling tank.
The circuit can be supplied either by means of a compressor, or by an oxygen cylinder.

Liquid line
This consists of:
- a feed preparation tank with stirrer;
- a volumetric feed pump to study dilution D (Q/V) influence;
- a cylindrical plexiglass reactor to allow the contact among the three phases: gas/liquid/solid;
- a plexiglass settling tank with “air-lift”.

Control and regulation systems
The activated sludge pilot plant IC130D provides:
- control of the concentration of O₂ dissolved in to the oxidation tank by a sensitive element
- measurer/indicator of O₂;
- regulator/actuator acting on the air flow sent to the tank;
- control to the feed mixture temperature;
- control of the sludge quantity in the oxidation tank by sludge recirculation driven by a timer;
- luminous mimic panel to follow the process in real time.

Measuring instruments
The pilot plant is provided with instruments to measure the quantities indicated below:
- air flowrates sent to the oxidation tank and to the settling tank
- sewage feed flowrate and temperature;
- pH in the reaction tank;
- quantity of dissolved O₂.
Besides, by simple operations it is possible to measure the recycled sludge quantity and the purged sludge quantity.
The following equipment is also provided with the unit:
- a cone to determine the percentage of sludge preset;
- a set of chemical products to recreate a favorable environment for bacterial cultures;
- a quantity of lyophilized bacteria;
- nitrate percentage detection papers;
- pH detection papers
4. Range of experiments
- Determination of the purification effect according to the feed hydraulic stay time in the oxidation tank.
- Determination of the purification effect according to the mixing.
- Evaluation of the effect at different concentrations of dissolved O₂.
- Determination of the sludge sedimentation varying the concentration of work O₂.
- Influence of sludge age.
- Influence of pH.
- Efficiency of the purification according to the temperature.
- Influence of the activated carbon on the purification process.
- Tests using O₂ instead of air.

The basic plant can be integrated with some optional instruments and an Automatic Data Acquisition System.

6-place BOD (Biological Oxygen Demand) meter - Code 994510 - OPTIONAL
Manometric traditional solution for BOD determination up to 1000 mg/l (ppm). The apparatus can house 6 bottles at the same time; each position is fitted with bottle, manometer and 4 scales for the intervals up to 90, 250, 600, 1000 mg/l of BOD. The quantity of sample to be examined varies from 100 to 400 ml, the total capacity of the bottle is 500 ml. The samples are maintained in agitation by means of a 6-place magnetic stirrer.

The BOD meter has the following characteristics:
- Power: 2W
- Electric supply: 230V single phase, 50/60 Hz
- Dimensions: 360x210x350 mm
- Weight: 7 kg

Frigothermostat for BOD apparatus maintenance - Code 949104 - OPTIONAL
It allows to maintain the BOD meter apparatus at 20°C ± 0.5°C during the tests, when the ambient temperature is between 3 and +50°C.

It is a frigothermostat fitted with an innovative Auto-Tuning thermoregulation system. The peculiar electronic system regulated by a microprocessor, together with the forced air circulation, allows to obtain an excellent stability and homogeneity of the inner temperature (3-50°C) with selection of the tenth of the degree centigrade. The value of the actual temperature inside, homogeneous in all points, is constantly visualized on the display.

The frigothermostat has the following characteristics:
- Volume: 120 l
- Power: 120 W
- Electric supply: 230 V single-phase, 50/60 Hz
- Dimensions: 540x550x912 h mm
- Weight: 36 kg

Thermo-reactor for COD analysis - Code 949103 - OPTIONAL
It allows for 6-place COD (Chemical Oxygen Demand) analysis and is fitted with a temperature and test time control device. It is utilized for the contemporaneous COD analysis of 6 x 200 ml each samples (according to the IRSA – CNR n° 5130 method) and for the wet digestions of samples for the determination of metallic and non-metallic elements in organic and inorganic materials (metals, alloys, food-stuffs, grounds, sediments, clothes, etc.). It is possible to program the reaction time from 1 to 199 minutes or infinity and perform the electronic programming of the temperature up to 200°C, with high precision and repeatability. Through the digital display, which allows for the visualization of the reached temperature and of the remaining reaction time, it is possible to constantly monitor the course of the analysis.

The frigothermostat has the following characteristics:
- Power: 700 W
- Electric supply: 230 V single-phase, 50/60 Hz
- Dimensions: 198x319x132 h mm
- Weight: 5.6 kg

EC24D - Electric compressor, 24 l tank - Code 971227 - OPTIONAL
For the supply of the compressed air necessary to the circuit.

The compressor has the following characteristics:
- Tank capacity: 24 l
- Aluminum cylinder completely finned
- Aluminum head
- Intake air: 220 l/min
- Motor: 1.5 kW – 2.850 r.p.m.
- Max pressure.: 8 bars
- Electric supply: 230 V single-phase, 50 Hz
- Dimensions: 600x255x570 h mm
- Weight: 25 kg
5. Required services
- Electrical supply: 220V – 50/60 Hz – 3 kW
- Compressed air supply: 800 l/h – 6 bar
- Water supply: 200 l/h – 2 bar.

6. Dimensions and weights
- Dimensions: with feed tank 2450 X 700 X 1700 h mm
- Net weight: 270 Kg

Pilot plant components
With reference to figure 1 the activated sludge sewage treatment plant IC130D consist of:

1. – feed tank with capacity 150 l
2. – fixed speed stirrer – 100 RPM, 90 W
3. – low level indicator
4. – feed cut-off valve
5. – feed discharge valve
6. – feed filter
7. – metering pump – capacity 0-20 l/h
8. – 1.5 l damper
9. – breather valve
10. – feed flowmeter 60 l/h f.s.
11. – flowmeter activation valve
12. – flowmeter washing valve
13. – by-pass valve
14. – flowmeter washing
15. – flowmeter activation valve
16. – feed flowrate transducer (*)
17. – digital totalizer (*)
18. – 2000 W feed heater
19. – oxidation reaction tank – capacity approx 35 l
20. – 200 W variable speed stirrer
21. – pH measuring device
22. – reactor discharge valve
23. – digital temperature indicator-regulator
24. – digital dissolved oxygen indicator-regulator
25. – oxygenation flow meter 500 l/h f.s.
26. – oxygenation valve
27. – “air-lift” valve
28. – “air-lift” flow meter 500 l/h f.s.
29. – “air-lift” digital timer
30. – air/oxygen pressure reducer
31. – deactivated sludge discharge valve
32. – digital timer for deactivated sludge discharge
33. – sludge recovery with “air-lift”
34. – reactor discharge
35. – settling tank
36. – deactivated sludge collection tank
37. – clarified water discharge
38. – some computerized version components
39. – console and electric panel

(*) These components are part of the computerized version
1. General

The Data Acquisition System SAD/IC130D enables to collect and analyse, in real time, data from the Activated Sludge Sewage Treatment Educational Pilot Plant, through a Personal Computer. So it allows to monitor the plant and it is a useful tool to perform the necessary experiments.

The system is supplied with an instruction manual which describes the technical features of the system (hardware and software), explains how to set-up and calibrate the data acquisition system, suggests several exercises and gives sample experimental data and diagrams.

2. Composition

The system is composed of:
- Electronic Transducers Kit, complete with Feeding Unit and Signal Conditioning Electronics and A/D Conversion Unit (code 914397).
- Acquisition and Analysis Software for Windows (code 914398).

3. Description

Electronic Transducers Kit, complete with Feeding Unit and Signal Conditioning Electronics, and A/D Conversion Unit (code 914397)

The following industrial electronic transducers are supplied:
- Turbine type flowrate transducer with digital indicator.
- Galvanic separator for pH meter.

Besides, the digital temperature, pH and dissolved oxygen indicators of the standard version, are supplied with analog output.

The Feeding Unit and Signal Conditioning Electronics allow the conversion of the signals supplied to standard signals, suitable for the A/D Conversion card. The A/D Conversion card operates on 12 bit with a sampling frequency of about 10 kHz. The unit can be connected to an IBM or compatible Personal Computer through the serial RS-232 port.

Acquisition and Analysis Software (code 914398)

The Acquisition and Analysis Software operates under MS-Windows and allows to capture data from the transducers located on the plant.

The software allows to display on the screen or to print the diagrams of the acquired data as a function of time and the diagrams required in the exercises. Acquired and calculated data can be saved onto disk in ASCII format.

Besides it is possible to carry out simulations by introducing data through the keyboard.

4. Minimum PC Configuration Required

- PC minimum Pentium with Hard Disk (>10Gb) and CD drive, SVGA graphic card minimum, mouse, RAM 32 MB, USB port;
- XP Windows or later versions;
- Graphic Printer.

Cod. R00774/E 0713 Ed. 01 Rev. 03

In any time and without notice, Didacta Italia can carry out any appropriate modification on the product details, always maintaining their main features, according to the designing and teaching necessity.