



Expert remote control system at Villasimius

Anova Srl designs a remote control system based on the Movicon Scada system for wastewater treatment and purification in the town of Villasimius (CA).

The town of Villasimius is famous for its enchanting location on the picturesque Sardinian coast in the province of Cagliari. The constant onslaught of holidaymakers every year has forced the Villasimius council's environmental protection office to invest in more modern and sophisticated systems to clean and recover local wastewater.

A steep rise in tourism is expected within the next few years, which will lead to urban expansion involving the construction of new hotels in addition to the already existing Simius Playa and Cormoran seafront hotels and building allotments provisioned for residential holiday homes in popular tourist

spots starting from Campulongu to Cala Caterina, a two-sea oasis. This is going to be an intense period of territorial urbanization, with extended and expanded water distribution networks, and the construction of smaller water purification plants to provide water to the extra hotel structures and building allotments in order to comply to the current water pollution policy standards set by the 319 act (so-called legge Merli) passed in 1976 implementing the EC directives. This act stipulates that all municipals must be equipped and self sufficient to analyse sewer and water treatment systems in their territories.

Engineer Ugo Vittorio Cuccara was given the mission to study and design a central sewage and water purification and treatment system, based on variations in the number of users in the winter and summer months (holiday season). The month of October 1980 soon saw a new water purification plant and two wastewater canal systems put into use. This provoked the closing down of two old treatment plants built at the beginning of the 60s and several other purification plants setup to supply water to hotels and building allotments. This system, designed by Degremont, Italy, is comprised of screen filter systems, a settling basin, two oxidation ditches, a secondary 170 mc sedimentation tank, with chlorination at the final disinfection stage. The system has a 2500 user capacity equivalent to a oxidation total for the winter period to 7500 users for the summer period, the activated sludge treatment holds four desiccation beds. The increase in users connected to the sewage and purification system caused the first extension to happen in 1986, enlarging the plant to a potentiality of 15,000 u.e. This consents new users to connect and, in particular, those building allotments situated in the Riso Beach area, Public camping sites, Notteri, Serr'e Morus Cala Caterina, Porto Luna One and Two, Is Traias, leading to the closure of the old treatment plants which originally supplied water to these areas. This progressed further into centralizing wastewater systems, closing down small and medium sized plants (from 200 to 700 u.e.), which worked according to season and only on a few occasions where able to ensure acceptable performances in the 30-40 day activation periods and onslaught of holidaymakers in the high summer season.

In this same period two new sewage catchments were built; the East canal and the Capo Carbonara canal.

The increase in holidaymakers and holiday establishments to accommodate them (around 5000 beds), as well as upgrading municipal territory in the Regional tourist spots to meet public standards, required a more adequate structure to cope with extra community needs. This sparked off with the rebuilding of the city centre's water distribution network in the early 90s, with improvements made to the network in the tourist

areas, costing around three billion Euro. This led to further expansion of the water purification plant, increasing its potentiality to 40,000 u.e.



The wastewater treatment process monitored and remote controlled by a system designed by Anova Srl from Naples.

The system

The possibility to reuse biologically purified wastewater is conditioned by the correct running of the wastewater plant, which must guarantee a high standard of purified water according to the environmental protection and safe water standards.

In order to continuously guarantee correct plant working conditions where workloads vary considerably in the amount of water needed according to season, a computerized system was designed and tested during 1998-1999 to automatically control the purification processes and is now in full operation.

This system involves a very innovative remote control system, which integrates and features the best data acquisition and supervision technology available on today's market, with the diagnostic processing logic of Expert Systems designed by **ANOVA** - *knowledge based software solutions from Naples* (formerly SESPIM). The Expert remote control system is not only capable of using on-line data received from the field, but also the

knowledge and experience of process management experts.

The System installed at the Villasimius water purifying plant has been implemented with the following components:

Process tools (Endress+Hauser) selected and efficiently installed in the field; Remote data acquisition system, filtering of signals from the field and the **Movicon** supervision software, the Italian SCADA platform by Progea; **INTESYSensors** (ANOVA-kbss) Expert control system, capable of using all data deriving from the process tools (sensors) to the full and consents man machine interaction in the field (compressors, pumps, etc.), with process awareness. The System is equipped with a series of important utilities, such as being enabled to receive vocal alarm messages via GSM telephones, or the option to control and monitor condition statuses of the biological treatment section and so forth. The **MICRO expert** (ANOVA-kbss) System diagnostics laboratory *for diagnosing and managing the more serious anomalies* (bulking, foaming, rising, pinpoint, etc.) supports plant management and Analysis Laboratories. The Remote Control Center situated in the office building and in the plant's Laboratory, has been created with two PC/Pentium workstations: one has been installed with the INTESYSensors and Movicon/SCADA supervision system, while the other one has been installed with the MICROexpert for diagnosing any biological anomalies and managing microscopic laboratorial analysis. The Remote Control Centre users can browse through video screen pages to:

- check the working status of the process's equipment;
- view process variables;
- get diagnostics relating to the process's working conditions, by means of using indicators (clock hands) and relating explanatory messages on alphanumeric page graphics;
- display the trends of the most significant variables in X-Y charts;
- get maintenance intervention notifications;
- control parameters and activating commands-controls;
- display alarms with their chronological indications and status (acknowledge, reset, etc.)

The measuring and online controls executed by the system and orientated to improve the purification process efficiency and managing of the plant are mainly the following:

- a) Oxidation control during the Biological Purification Process
- b) Secondary Sedimentation process control
- c) Quality/Quantity control of influent treated
- d) Compressed Air management for the Oxidation stage
- e) Process Control Unit management
- f) Alerts/Alarms management using Teledring calls
- g) Plant Report/Log management

The interested plant sections result as follows:

Biological Active Sludge Reactors: the oxygen concentration is controlled and regulated dynamically both for energy saving reasons and activated sludge bulking conditions that may occur if the oxygen concentration is low (according to research carried out by D. Jenkins on the reaction between dissolved oxygen and sludge load). The oxygen is completely regulated with an



The main page of the remote control system at the Villasimius water purification plant created with the Movicon Scada from Progea.

automatic oxygen transfer system management (compressors).

The biological sludge concentration is controlled according to the real dynamic working conditions of the biological reactors, with the objective to guarantee high performance and continuous efficiency. Sludge and oxygen control is regulated according to sludge recycle output and/or surplus output.

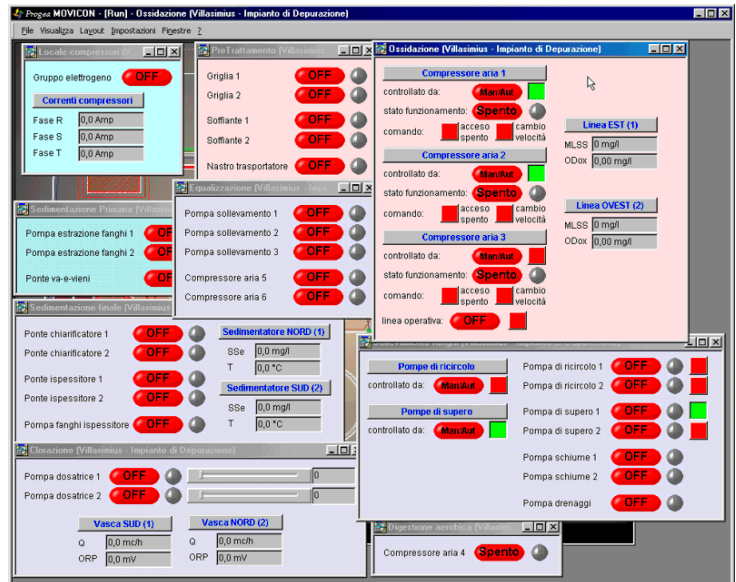
Secondary Sedimentation tank: the secondary sedimentation tank is controlled dynamically in function with its realtime working conditions and with the mission to notify and single out any temporary working conditions (ie. caused by weather such as rain falls), problems in separating solids from liquid due to possible active sludge pathogens or malfunctioning of the electro-mechanics of the plant's processing machines. An alarm alerts personnel when any part of the sedimentation tank machinery starts malfunctioning (sludge extraction, gantry, etc.) or when problems occur with the sludge.

Disinfection Station-Tertiary treatment: These stages are depended upon for establishing the quality of the purified effluent to be discharged to the receiving water supply systems and/or to used in farming. The on-line control is fundamentally based on symptomatic uses of conventional ORP (redox) and SST (turbidity) measuring tools, to which the expert diagnostic logic is associated. Not only can the chlorine residue be controlled but also the complete quality of the purified effluent while undergoing the tertiary treatment in order to optimize this process to reach and guarantee the required water quality standard according to the water's destination and usage.

The other plant sections (screening, settling basin – oil extractor, backwashing, primary sedimentation, equalization, active sludge treatment etc) are controlled in more conventional, namely acquiring the working status of the apparatus and alarm signals deriving from the local control system, which normally comes equipped with this type of apparatus. The consultation procedures of the Expert System's Remote control have been summarized as follows:

Data acquisition relating to preliminary investigations:

The System uses information relating to *visual controls, field measurements, etc.*, which are done daily by staff retrieving data from



Due to installing this expert system, the Villasilimus council can guarantee its inhabitants and numerous holiday guests clean water.

ASCII files and typing in information directly using keypads;

Monitoring with diagnostic explanations of possible malfunctioning. The System, based on information from data entries and/or from supervision modules is capable of tracking down any purification process anomaly and supplying a first level diagnostic chart, automatically contributing to more comprehensive assessment concerning the emergency priority type to apply to the plant section under inspection.

Consultation. Starting with emergency priority notifications on the monitoring panel, the System launches the Expert System's consultation procedures. This entails rendering all related archived data files available (inspections, working parameter field measures, laboratory measures and any microscopic active sludge analysis), which in addition to forming information on deferential quantities and qualities in each field, need to be retrieved frequently at different times.

Data acquisition on Lab tests and microscopic sludge analysis. Data acquisitions on Lab tests and microscopic sludge analysis are transferred to the system in files and/or as data entries.

Diagnosis. The diagnosis created by the expert system is in structured message form.

Solutions (corrective action). Following the diagnosis, the Expert System – based on the plant's

running status – provides the best solutions for removing the causes notified in the diagnosis. The Expert System is capable of providing report printouts on the control checks carried out on all or on specific parts of the plant.

Historical Data represented in Trend graphics. The Expert System is capable of creating trend graphics of preset variables, relating to historical data, to be kept monitored and controlled.

Emergency Notifications in alphanumeric-graphics from and via telephone using voice or SMS in GSM to staff on duty.

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Advantages obtained:

The system satisfies all the requirements put forward by the clients. In particular, the Villasimus plant's Remote Control solution contributes above all to:

1. *the continuity of the effluent quality*
2. *controlling and regulating complex systems.*
3. *monitoring safety risks*
4. *energy saving and optimizing processes;*
5. *providing notifications concerning the 'healthy state' of active sludge and "Early Warning" notifications*
6. *training staff on-the-job*