

Environmental Engineering Unit

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(June 2010)

PRESENTATION

The **Centro de Estudios e Investigaciones Técnicas de Gipuzkoa (CEIT)** is a Research Association created in 1982 and linked to the San Sebastián Engineering School, a part of the **University of Navarra**. The majority of its work is applied research and technological development under contract.

The **Environmental Engineering Unit** was formed in 1979, within the Engineering School, and at first based its research on the characterization and treatment of atmospheric pollution. Shortly after, in 1980, it received approval as Entidad Colaboradora del Ministerio de Industria – Approved Body from the Ministry of Industry – for Environmental protection.

With the founding of the CEIT in 1982, the unit became part of the recently created Centro de Estudios e Investigaciones Técnicas de Gipuzkoa, and its scientific and technological work began to be orientated towards applied research into **wastewater treatment technologies**.

During its first stage, up to the end of the 80's, the unit made great efforts to train personnel, this brought the first doctoral theses and the consolidation of the first multidisciplinary research team that was specialized in the design, operation and control of advanced technologies for the biological and physical-chemical treatment of waste waters.

From this date on, the Environmental Engineering Unit in the CEIT has been developing **R+D projects under contract**, in response to the demands from a large number of engineering companies and bodies responsible for water management. The wide experience accumulated over 25 years (more than 75 R+D projects carried out so far) means that any client is guaranteed high quality research by professionals when they contract the unit.

Nevertheless, and in agreement with the aims of the CEIT, this unavoidable commitment to client needs has not affected the department's **research excellence** in any way, as demonstrated by the doctoral theses and the publication of scientific papers in renowned international journals. The constant upgrade of the technological expertise within the unit is also confirmed by the participation of its researchers in prestigious International Congresses and Scientific Forums.

In the last few years the Environmental Engineering unit has significantly diversified its offer in response to the demands made by new technologies. For this reason new research has begun on technologies for the **treatment of sludges and organic wastes**, as well as **integrated water management**, at a wider scope than that regarding the treatment plants normally studied (urban supply and sewage networks, rivers, reservoirs, river basins, etc.).

The expertise and make up of the unit, the experience in R+D projects under contract, as well as the papers accepted in the most relevant scientific publications, are described below in greater detail.

TECHNOLOGICAL OFFER

Treatment and management of water and wastes

Research and technological development work offered by the Environmental Engineering Unit is based on the application of the most advanced methods in **mathematical modelling** and **experimental analysis** for the **design, operation** and **control** of **water and sludge** treatment technologies as well as for **integrated water management**.

EXPERTISE - CAPACITIES

Control, communication and systems engineering

Theoretical and applied knowledge of the most commonly used techniques for systems engineering and control.

- Mathematical modelling and simulation of complex systems
- Identification of systems and mathematical models for calibration
- Development of advanced monitoring equipment
- Telematic application for remote process control and supervision
- Control advanced strategies
- Development of computer applications for system simulation and optimization

Experimental analysis of environmental engineering processes

Theoretical and applied knowledge of the main experimental techniques for analysis.

- Aerobic biological processes
- Anaerobic biological processes
- Physico-chemical processes
- Pilot scale and full scale experimental research
- Analytical laboratory

APPLICATION FIELDS

Wastewater treatment technologies

Design and operation of wastewater treatment processes for urban and industrial water.

- Activated sludge (C, N, P removal)
- Biofilm systems: fixed and moving beds
- Anaerobic processes
- Primary and secondary settlers
- Membrane bioreactors
- Coagulation-flocculation
- Advanced oxidation
- Water reuse

Sludge and solid waste treatment

Design, operation and control of WWTP sludges, food industries, cattle livestock and other solid organic wastes.

- Thermophilic aerobic digestion
- Mesophilic and thermophilic biomethanisation
- Two stage anaerobic digestion
- Dry anaerobic co-digestion
- Compost
- Energetic valorisation of residues

Integrated water management

Optimization of water supply and management of sanitation systems.

- Integrated drainage and sanitation systems for urban waste water
- Quality models of water in rivers, lakes, dams and other aquatic mediums
- Industrial water management

MAIN CLIENTS

Some of the main clients and collaborators in the R+D projects made by the unit are shown below:

Engineering companies, consultants and equipment for the treatment and management of wastewaters:

- EPTISA
- ATM S.A.
- INFILCO S.A.
- DEGREMONT
- SPA S.A.
- CADAGUA S.A.
- AQUALIA Industrial
- SAITEC Ingenieros
- INITEK Ingenieros
- Porous Fiber S.A.
- Danish Hydraulic Institute (DHI)
- Mondragon S. Información(MSI S. Coop)
- GOIMENDI S.A.
- INTAGSA
- IKAUR S.L.
- PRAXAIR S.A.
- AIR LIQUIDE S.A.
- DoNewTech S.L.
- ACIDEKA
- NEURTEK M.A.

Water authorities:

- Consorcio de Aguas Bilbao-Bizkaia
- Aguas del Añarbe
- Consorcio de Aguas de Gipuzkoa
- Aguas Municipales de Vitoria (AMVISA)
- Mancomunidad de Sasieta
- Confederación Hidrográfica del Norte
- Confederación Hidrográfica del Ebro
- Diputación Foral de Gipuzkoa
- Navarra de Infraestructuras Locales S.A. (NILSA)
- Diputación Foral de Alava

Industrial wastewater treatment end users:

- PETRONOR
- PEPSICO S.A.
- Papelera ECHEZARRETA S.A.
- Papelera ZUBIALDE S.A.
- Mancomunidad de Sasieta
- IKUSI-ANGEL IGLESIAS S.A.
- Cementos REZOLA
- Papelera SAICA
- MAFRIDO S.A.
- Hijos de José Serrats S.A.
- Helados MIKO

STAFF

The environmental engineering section of CEIT has the human resources needed to carry out of its R&D activities. Taking into account the complexity of its technological offer the unit is provided with a multidisciplinary staff. Each of the researchers, technical and scientific collaborators contribute with their specific knowledge and experience in order to develop a high quality product together.

Researchers

RESEARCHERS (Project directors)

Name and qualification	Research fields	Collaboration with the University of Navarra
Dr. Eduardo Ayesa Iturrate Industrial Engineer (Head of Unit)	Modelling, simulation and process control	Asoc. Prof. of Engineering Systems (I and II)
Dr. Luis Sancho Seuma Biological Sciences	Wastewater treatment processes	Asoc. Prof. of Environmental Sciences
Dr. Luis Larrea Urcola Industrial Engineer	Wastewater treatment processes	Asoc. Prof. of Environmental Technologies
Dr. Jaime L. García de las Heras Industrial Engineer	Management and treatment of sludge and organic waste	Asoc. Prof. of Doctoral Studies
Dr. Antonio Salterain Ezquerro Computer Sciences	Computation and software development	Asoc. Prof. of Real Time Computer Systems and Digital Communications Systems
Dr. Ion Irizar Picón Industrial Engineer	Telecommunication and systems control	Asoc. Prof. of Electric Circuits Analysis
Dr. Paloma Grau Gumbau Chemical Engineer	Mathematical modelling of water and sludge treatment processes	Asoc. Prof. of Chemical Fundamentals of Engineering
Dr. Enrique Aymerich Soler Biological Sciences	Management and treatment of organic waste	Asoc. Prof. of Chemical Fundamentals of Engineering and Population, Ecology and Environment
Dr. Mikel Maiza Galparsoro Electronics and Automatics Engineer	Telecommunication and systems control	
Dr. Susana Rodríguez Couto PhD on Chemistry	Environmental biotechnology	

Cristina Martín Andonegui	Industrial Engineer	System Identification and Uncertainty Analysis
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JUNIOR RESEARCHERS

Name and qualification	Activity
Alain Castro Information Technologies Engineer	Responsible for Software and Hardware
Leire Otegi González Bachelor of Environmental Science	Biological gas treatment
Janelcy Alferes Castaño Electronics and Communications Engineer	Systems automation and control
M ^a Teresa López de Armentia Bachelor of Chemical Science	Biological wastewater treatment
Claudia Milena Cardona Jiménez Civil Engineer	Modeling and simulation of sewers
Jon Albizuri Izagirre Chemical Engineer	Biological wastewater treatment
Sergio Beltrán Calaff Electronics and Communications Engineer	Mathematical modelling of water and sludge treatment processes
Jesús Alberto Zambrano Electronics Engineer	Systems automation and control
Elena Meabe Pinedo Chemical Engineer	Biological wastewater treatment: Membrane bio-reactor
Alaitz Etxeberria Mendizabal Environmental Engineer	Management and treatment of sludge

Collaborators

TECHNICIANS

Name and qualifications	Working fields
Vicente del Barrio Martínez Technical Industrial Engineer	Responsible for instrumentation and equipment
Jaime González Martínez Laboratory Technical Operator.	Responsible for the laboratory analytics

ADMINISTRATION

Name and qualifications	Working fields
Carmen García Llorente Secretary	Secretariat and documentation

SCIENTIFIC COLLABORATORS – GRANT HOLDERS

Name and qualifications	Working fields
Paula Serras Malillos Chemical Engineer	Biological treatment of odours in WWTP
Myriam Esteban Gutierrez Bachelor of Biochemistry	Management of solid waste
Igotz Barrena Ruesga Chemical Engineer	Sludge treatment modelling
Izaro Lizarralde Aguirrezabal Industrial Engineer	Mathematical modelling of industrial wastewater treatments.
Ander Bengochea Cabonargi Chemical Engineer	Mathematical modelling of wastewater treatment

Mikel Morras Tercero Chemical Engineer	Design of digesters for sludge treatment
Tamara Fernandez Arévalo Chemical Engineer	Mathematical modelling of wastewater treatment
Carmen Gabaldón Castillo Environmental Engineer	Biological wastewater treatment
Juan Odriozola Control Engineer	Wastewater treatment optimization

R+D PROJECTS

Since the beginning of 1982, the Environmental Engineering Section in CEIT has increased its research activity more and more, as demonstrated by the more than 85 R+D projects completed for a wide variety of public and private firms. Some of the most representative works are given below.

- Survey and analysis of water wells for 67 areas in the County of Gipuzkoa. (1982-1983).
- Performance and control of the treatment of swine manure. Departamento Medio Ambiente, Gobierno Vasco. (1983-1984).
- Flocculation of pulp and paper mill waste water by polymers. Consejería de Industria. Gobierno Vasco. (1982 -1984).
- Dynamic Modelling and simulation of the main secondary treatment process for wastewater from Kraft pulp industries. Consejería de Industria. Gobierno Vasco. (1982-1984).
- Estimation of the optimum operational condition in a continuous laboratory scale plant for the flocculation of wastewater from Kraft pulp bleaching. Consejería de Industria, Gobierno Vasco. (1985-1986).
- Mathematical modelling of the activated sludge process working in transient state. Gobierno Vasco. (1985).
- Analysis of domestic wastewater of Zegama village and effluents from paper industries. Diputación Foral de Guipúzcoa. (1985).
- Physico-chemical treatability tests for paper mill wastewater. Diputación Foral de Guipúzcoa. (1986).
- Mathematical modelling and control of the activated sludge process. Consejería de Industria, Gobierno Vasco. (1987-1991).
- Mathematical modelling of the flocculation process for colour removal from pulp bleaching effluents. Consejería de Industria, Gobierno Vasco. (1987-1988).
- Relationship between bioflocculation and settling in an Activated Sludge process. Consejería de Industria, Gobierno Vasco. (1989)
- Operational strategies for the activated sludge process at the Vitoria city wastewater treatment plant. AMVISA. (1991-1995).
- Initial step of the research for the Eureka project EU-670. PITMA program, Ministerio de Industria Comercio y Turismo. (1991).
- Advanced methodologies to establish plant upgrading and operational rules, and real-time adaptive control of the AS process. Programa EUREKA, proyecto EU-670. (1992-1995)
- Optimising the Design and Operation of Biological wastewater treatment plants through the use of computer programs based on a dynamic modelling of the process. COST Programme, project 682. (1992-1995)
- Advanced methodologies to optimize the design and operation of the activated sludge process in the pulp and paper industries. (1992). Consejería de Industria. Gobierno Vasco.

- Pilot-plant assessment for the R-D-N process applied to wastewater from Bilbao city. EVE-Consorcio de Aguas-CE. (1992-1994).
- Advanced methodologies for plant design, operation and adaptive control of the activated sludge process. (1992-1993) Programa PITMA, Ministerio de Industria, Comercio y Turismo.
- Verification-calibration of mathematical models and the design of adaptive controllers for advanced activated sludge processes. Consejería de Industria. Gobierno Vasco (1993-1996).
- Nitrogen removal from the new Crispijana full scale WWTP. AMVISA. (1994-1995)
- Analysis of the performance of a rectangular secondary settler by means of a hydraulic model. Fase I. Consorcio de Aguas Bilbao-Bizkaia (1994).
- Development and lab-scale application of control strategies for advanced activated sludge processes with nutrient removal. Gobierno Vasco (1994-1995).
- Design optimization of activated sludge plants based on effluent requirements. CADAGUA, S.A. (1994-1995).
- A proposal for the agricultural reuse of secondary effluent from Crispijana (Vitoria). AMVISA, S.A. (1994-1995).
- Integrated Wastewater Management. Programa COST proyecto 682 b. (1996-1998).
- Physico-Chemical and biological treatment of San Sebastian city wastewater. Confederación Hidrográfica del Norte. (1995-1996).
- Biosensors for the control of the biological wastewater treatment processes. Proyecto Oferta-Demanda. Gobierno Vasco. (1996-1997).
- Performance and modelling of the nutrient removal process in a pilot plant located in Rejas village (Madrid). SPA (FCC). (1996).
- Methods to improve the key characteristics of sludge before its disposal. Gobierno Vasco. (1996-1997).
- Experimental plant to optimize the design and operation of secondary settlers. Cadagua S.A. – CENTA. (1996-1998).
- Optimization of the design and operation of aerobic and anoxic selectors in activated sludge processes. CADAGUA S.A. – CENTA. (1996-1998).
- Optimization of the integrated management of rivers based on mathematical modelling, identification and simulation techniques. Proyecto CICYT. (1996-1999).
- Development of advanced control strategies in wastewater treatment processes. Proyecto en cooperación: MSI S.Coop., CADAGUA S.A., Consorcio de Aguas Bilbao-Bizkaia, Gobierno Vasco. (1996-1998).
- Study of possible treatments for sewage sludge from Loiola WWTP and possible market for disposal of the treated sludge. Mancomunidad de Aguas del Añarbe. (1996).
- Pilot-plant verification of the configuration and the control laws for the future Crispijana WWTP (Vitoria city). AMVISA, Gobierno Vasco. (1996-1997).

- Design and operation of activated sludge processes with step-feed for nutrients removal. Application of mathematical methods. INFILCO. (1996-1998).
- Optimization of WWTP exploitation based on using operation simulators. CADAGUA, S.A. (1996-1998).
- Study of nitrification and denitrification of petrochemical wastewater (Petronor, Spain CADAGUA S.A. – Petronor. (1996).
- Characterisation test for urban wastewater in a pilot plant for the future WWTP in Gipuzkoa province. Departamento de Obras Hidráulicas; Diputación Foral de Guipúzcoa. (1996-1998).
- Introduction of a sustainable system to treat sludge and its application to soils. Seguros Zurich. (1998 – 2001).
- Experimental work on two-phase anaerobic digestion. CERDEG, DEGREMONT–Paris. (1997-1998).
- Design and operation of biofilters for carbon and nitrogen removal in wastewater. Gobierno Vasco. (1997-1999).
- Optimization of biological processes for stabilisation of sewage sludge to produce biosolids. Proyecto en cooperación. DEGREMONT, ATM, Gipuzkoako Urak, Diputación de Gipuzkoa, Cementos Rezola, Gobierno Vasco. (1997-1999).
- Design, operation and control of sewage networks for urban wastewater. Proyecto de Especialización de Centro. Gobierno Vasco. (1998- 1999)
- Development of the design and operation of the alternating activated sludge process for nitrogen and phosphorous removal. CADAGUA S.A. (1998 – 2002).
- Development of a dynamic simulator for the design of WWTP with nitrogen and phosphorous removal. CADAGUA S.A. (1998 – 2001).
- Development of a new intelligent sensor for the measurement and control of the oxygen supply in the biological reactors for wastewater treatment. Proyecto de Cooperación PRAXAIR S.L., ATM S.A., NEURTEK M.A., PEPSICO S.A., ZUBIALDE S.A., Gobierno Vasco. (1998 – 2001).
- Optimal Management of Waste Water Systems. COST Action Project 624. (1998 – 2004).
- Advanced water treatment technologies for kidney operation of zero effluent water systems for paper and board production. Proyecto BRITE-EURAM. (1998 – 2001).
- Development of expert systems in activated sludge processes. Proyecto de colaboración CEIT-TEKNIKER-ATM. (1999 – 2000).
- Experimental trials in a pilot plant with moving bed system in Tafalla-Olite towns WWTP NILSA. (1999 - 2000).
- Development of biofilters for carbon and nitrogen removal in industrial and urban wastewater. CADAGUA, ATM, S.A., NEURTEK, M.A., S.A., Papelera ECHEZARRETA, S.A., Aguas del Añarbe, S.A., Diputación Foral de Gipuzkoa (1999 – 2001)

- Treatability of industrial organic wastes with biological systems: Technical viability. An application to slaughterhouse liquid wastes. Proyecto Oferta/Demanda. Gobierno Vasco-ATM-MAFRIDO. (1999-2001)
- Experimental verification of automatic control strategies for the Galindo-Bilbao WWTP. Consorcio de Aguas Bilbao-Bizkaia, CADAGUA S.A., MSI S. Coop. (2000 – 2001).
- Design, operation and control of sewer networks based on the simulation of water quality models. Proyecto Cooperación INTEK. IKAUR, ATM, GOIMENDI, Aguas del Añarbe, Diputación Foral de Gipuzkoa. (2000 - 2003).
- Design and operation of a solar system for the heating of the wasted sludge. NILSA (2000)
- Optimising the design and operation of moving bed systems for the treatment of urban wastewater. Proyecto de Cooperación INTEK. ATM, GOIMENDI, Consorcio de Aguas de Gipuzkoa, Diputación Foral de Gipuzkoa. (2000 – 2003).
- Technical assistance in the functional optimization of the general sewage system of the Bilbao estuary and for the preliminary study of the Lamiako WWTP. Danish Hydraulic Institute (DHI), Consorcio de Aguas Bilbao-Bizkaia. (2001 – 2003).
- Integrated mathematical modelling and simulation of water quality in river catchments. Proyecto Especialización Gobierno Vasco. (2001- 2002).
- Development and verification of simulation tools for the optimization of the integrated water management. EPTISA. (2001 - 2003).
- Study of the centralized treatment of sewage sludge in the whole province of Navarre. NILSA (2001 – 2002).
- Plants for treatment and valorization of agro-food waste sludge by Anaerobic Digestion and Thermal Drying. Proyecto PROFIT de Cooperación GUASCOR - ATM S.A. (2001-2003).
- Management of organic wastes for the agro-food industry. Cátedra Zurich Medioambiente de la Universidad de Navarra. (2001-2004).
- Assessment of embedded Web-servers and communication with PLC systems. Gobierno Vasco, ATM S.A.. Proyecto INTEK O/D (2002 - 2003).
- Implementation of advanced control strategies at the Galindo-Bilbao city WWTP. MSI S. Coop., CADAGUA S.A. (2002 – 2003).
- Study of the centralized treatment of sewage sludge in the whole province of Navarre – Second Part -. NILSA (2002 – 2004).
- Anaerobic Hybrid Reactor to treat specific wastewaters. Mathematical modelling and evaluation of the technical feasibility. MCYT (2002 – 2003).
- Anaerobic Hybrid Reactor to treat wastewater. Development of their own technology. Proyecto de Cooperación INTEK. ATM, Hijos de José Serrats, MAFRIDO (2002 – 2004).
- Integrated solution for the remote monitoring process in environmental engineering. Proyecto de Cooperación INTEK. ATM, DoNewTech (2002 - 2004).

- Development of ozonization technology to reduce sludge generation. Proyecto de Cooperación INTEK. Air Liquide, INITEK, Helados MIKO, Consorcio de Aguas de Gipuzkoa, Diputación Foral de Gipuzkoa (2002 – 2004).
- Physico-Chemical and biological treatability of paper mill effluents in San Sebastian area. Confederación Hidrográfica del Norte. (2003)
- Biological and Physico-Chemical technologies to remove odours from WWTP. Proyecto O/D: Gobierno Vasco - PRIDESA (2003 - 2005).
- Advanced technologies for waste treatment. Mathematical modelling and simulation. Gobierno Vasco programa INTEK. (2003).
- Mathematical modelling and simulation of advanced processes for the treatment of wastewater and organic wastes. Proyecto O/D: Gobierno Vasco - HEMMIS. (2003 - 2004).
- Construction of pilot plant reproducing the biological treatment of the San Sebastian city WWTP. Aguas del Añarbe. (2003).
- Study of different activated sludge processes, with nitrogen and phosphorous removal from Lugo city wastewater. SAITEC. (2003 - 2004).
- Organic matter removal from the wastewater of Alava using sequential activated sludge processes. Agencia Alavesa del Agua. (2003-2005).
- Management system for the public access to Internet.. Proyecto de Cooperación INTEK. IKUSI, DonewTech. (2003- 2005).
- Automated control strategies for WWTP with secuencial operation. Proyecto de Cooperación INTEK. MSI S. Coop, CADAGUA S.A. (2003- 2005).
- Development and optimization of a submerged membrane module for sMBR. Proyecto de Cooperación INTEK. Porous Fiber, INITEK. (2003- 2005).
- Mathematical modelling, simulation and integrated analysis of uncertainty in the drainage and sewage water systems. MCYT. GVE. (2004- 2007).
- Advanced biological treatment and membrane technology for COD, nitrogen and pathogen removal from industrial wastewater with high COD and nitrogen. MCYT. GVE.(2004- 2007).
- Simulation of water quality in the Tajo river. EPTISA. (2004-2005).
- Development of a new integrated system for data management and WWTP simulation. EPTISA. (2004)
- Development of the new simulator for water quality in rivers – CalHidra 2.0. EPTISA. (2004).
- Optimization of the treatment of organic solid wastes. MCYT. (2004).
- Dynamic modelling and simulation of different case studies related to biological digestion of WWTP sludge. NILSA. (2004- 2006).
- Optimal management and modelling of industrial wastewater anaerobic treatment processes (ANACOM). MCYT. (2005 - 2007).

- Development of new hybrid processes for phosphorous removal of urban wastewater. Cooperation project INTEK. ATM, PRIDESA, Consorcio de Aguas de Gipuzkoa, Consorcio de Aguas Bilbao-Bizkaia, Diputación Foral de Gipuzkoa. (2005 – 2006)
- Experimental analysis of advanced technologies for the treatment of urban wastewaters and residues. SAIOTEK project. (2005- 2006).
- Mathematical modelling and simulation of the processes in wastewater and solid wastes treatment systems. SAIOTEK project. (2005- 2006).
- Optimization of the membrane bioreactor process for nitrogen and phosphorous removal SPA. (2005 – 2007).
- Course on mathematical modelling and simulation of activated sludge processes with nutrient removal. INFILCO. (2005).
- Performance optimisation of external membranes in MBR under different oxygen levels. ATM, PRAXAIR (2006 – 2008)
- Pilot-plant study for the biological process of the Lamiako WWTP. CHN. (2006)
- Development of the new river water quality simulator CalHidra 3.0. Quantitative Risk Assessment. EPTISA (2006 – 2008)
- Development of a new simulator for SBR technologies with membranes. AQUALIA Industrial. (2006 – 2007).
- Compact plants for wastewater reuse by MBR technology. ATM. (2006 – 2008)
- Trickling biofilter design for the removal of urban WWTP odors. Cooperation project INTEK. ATM, Acciona Agua, Aguas Añarbe, CABB y DFG. (2007- 2008)
- Design of automatic control strategies for solid wastes treatment plants based on modelling and systems simulation. MCYT in Cooperation with UPNA. (2007 – 2009)
- Robust control systems applied to optimum operation of membrana bioreactors. MCYT in Cooperation with the University of Girona. (2007 – 2009)
- Forecast models and management prediction of water resources. Evaluation for real cases related with Pyrenees basins. CTP Project. Gobierno Vasco. (2007 – 2008)
- Mathematical modeling of the mass and energy transport mechanisms of the waste and water treatment processes. SAIOTEK project (2007 – 2008).
- Wastewater treatment studies for the WWTP of Vigo. SAITEC (2007 – 2008)
- Development and implementation of automatic control strategies in WWTP. MSI S. Coop, ATM S.A. y CABB. (2006 - 2007)
- Tecnologías de estabilización biológica para aumentar la capacidad de carga orgánica de digestores anaerobios mesófilos de EDAR (2007 - 2009).
- Eliminación de nitrógeno vía nitrito en agua de retorno de EDAR (2007 - 2010).
- Concepción integral de la EDAR del siglo XXI. Desarrollo de tecnologías para el tratamiento y recuperación de recursos en aguas residuales (2008 - 2011).

- Polishing model design methods for nutrient removal in hybrid processes (2007 - 2009).
- Water in industry fit for use (2008 - 2011).
- Design of automatic control strategies for ATAD digesters (2007 - 2009).
- Mathematical control and modelling of membrane biological reactors and biofilm reactors in waste water treatments (2008).
- Membrane anaerobic reactors (2008 - 2010).
- Optimization of sludge digestion processes in WWTPs, with the aim of optimizing its performance, the quality of the produced biosolids and adapting to new regulations (2008 - 2011).
- Platform of emulation for industrialization of advanced controllers in WWTPs. (2008).
- Desarrollo de un simulador de operación para la EDAR de Galindo (2008 - 2010).
- Eliminación de nitrógeno vía nitrito y metanol. Acciona Agua (2007-2009).
- Use of simulation tools in the Optimum and sustainable water management in the industry (2008- 2009)
- Management and treatment of organic waste for restoration of soils and carbon sequestration. Caja Navarra (2009)
- Advanced Control Solutions for Waste Water Treatment. 7th Framework Programme, European Commission; (MSI, M4W, NASKEO, AQC, SCAD, Consorcio de Aguas de Gipuzkoa, CEIT, UGENT, INRA). (2009-2011)
- Eficiencia Energética en Plantas de Tratamiento de Aguas. Proyecto CDTI; (MSI, CABB, Mondragón Unibertsitatea, CEIT). (2009-2011)
- Operación Óptima Inteligente de los Sistemas de Saneamiento de Aguas Residuales Urbanas" - OPTIMAR; PSE (Proyecto Singular Estratégico) MCYT; (Univ. Girona, Univ. Pol. Cataluña, Univ. Valencia (Química), Univ. Valencia (Robótica), Univ. Pol. Valencia, Univ. Navarra, CEIT (Ingeniería Ambiental), CEIT (Simulación), ICRA, ESM, MSI S. Coop, ATM S.A., SISLTEC, CETAQUA, AQUATEC, IVEM, UTE PATERNA, C.A. Bilbao-Bizkaia, Consorcio Besos, PTEA). (2009- 2013)
- Eliminación de DQD y olores en papelera Zikuñaga. (2009-2011)

SCIENTIFIC ACTIVITY

Participation in International Congresses

Researchers in the Environmental Engineering unit actively participate in the most prestigious forums for the exchange of scientific knowledge. This is essential for keeping up to date and to compare scientific quality as well as the level of innovation achieved.

Among the various International Scientific Congresses where research and knowledge from the unit has been presented the most notable are the following:

- 74th Air Pollution Control Association Annual Meeting and Exhibition. 1987, Philadelphia (USA).
- The 14th IAWPRC Biennial International Conference. July 1988, Brighton (U.K.).
- 5th IAWPRC International Symposium on Anaerobic Digestion. 1988. Bologna (Italy).
- 2nd IAWQ International Conference on System Analysis in Water Quality Management – WATERMATEX'1991. June 1991, Durham (USA).
- Workshop of design and operational experience of treatment plants for nutrient removal from wastewater. June 1993, Perugia (Italy).
- IAWQ Specialized Seminar on Modelling and Control of Activated Sludge Processes. August 1994, Copenhagen (Denmark).
- 8th Forum for Applied Biotechnology (FAB). September 1994, Brugge (Belgium).
- ENVIROSOFT 94: Development and Application of Computer Techniques to Environmental Studies. November 1994, San Francisco (USA).
- ENVIROSOFT 97: Measurements and Modelling in Environmental Pollution. June 1997, Madrid (Spain).
- 7th IAWQ Workshop on Instrumentation, Control and Automation of Water and Wastewater Treatment and Transport Systems – ICA'97. July 1997, Brighton (UK).
- II International Symposium on anaerobic digestion on solid waste. 15-18 June 1999. Barcelona (Spain).
- 1st World Congress of the International Water Association (IWA). July 2000, Paris (France).
- 5th IWA International Symposium on Systems Analysis and Computing in Water Quality Management – WATERMATEX'2000. September 2000, Ghent (Belgium).
- 1st IWA Conference on Instrumentation, Control and Automation – ICA' 2001. June 2001, Malmo (Sweden).
- 5th IWA Specialised Conference on Small Water and Wastewater Treatment Systems. 24-26 September, 2002, Istanbul (Turkey).
- WATER POLLUTION VII - Modelling, measuring and prediction. June 2003, Cadiz (Spain).
- IWA Congress on Anaerobic Digestion (AD10-2004)). 29th August – 2nd September, 2004. Montreal (Canada).

- 5th International Symposium on Ecohydraulics. Aquatic Habitats: Analysis & Restoration. 182-186. 12 -17 September, 2004. Madrid (Spain).
- IWA World Water Congress and Exhibition. 19-24 September, 2004. Marrakech (Morocco).
- 6th International Symposium on Systems Analysis and Integration Assessment. November 3-5, 2004. Beijing (China).
- 2nd IWA Conference on Instrumentation, Control and Automation ICA2005. June 2005. Busan (Korea).
- 4th International Symposium on Anaerobic Digestion of Solid Waste. August 31 – September 2, 2005. Copenhagen (Denmark).
- 1st International Workshop on the IWA Anaerobic Digestion Model No.1 (ADM1). 2-4 September, 2005. Lyngby (Dinamarca).
- VIII Latin American Workshop and Symposium on Anaerobic Digestion. October 2-5, 2005. Montevideo (Uruguay).
- European Simulation and Modelling Conference EMS2005. October 24-26, 2005. Porto (Portugal).
- 7th IWA Specialised Conference on Small Water and Wastewater Systems. 7-10 March 2006. Mérida (Mexico).
- 2nd IEEE International Conference on Information & Communication Technologies: From Theory to Applications. 24-28 April, 2006. Damascus (Syria).
- WWWest 2006 User Group Meeting. 8-9 May 2006. Kortrijk (Belgium).
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- 7th International Conference on Hydroinformatics (HIC2006): Sep. 4-7, 2006. Nice (France).
- 5th IWA World Water Congress and Exhibition. 10-14 September, 2006. Beijing (China).
- 7th International IWA Symposium on Systems Analysis and Integrated Assessment in Water Management – WATERMATEX'2007. Mayo 2007. Washington USA.
- IWA Specialist Conference Moving Forward, Wastewater Biosolids Sustainability: Technical, Managerial, and Public Synergy. Moncton, New Brunswick, Canada, 24 - 27 June 2007.
- 4th Sequencing Batch Reactor Conference. 7-10 April, 2008. Rome (Italy).
- 1st IWA/WEF Wastewater Treatment Modelling Seminar WWTmod2008. Mont-Sainte-Anne, Québec, Canada, June 1-3, 2008.
- IX Latin-American Workshop and Symposium on Anaerobic Digestion. Waster Island, Chile. 19-24 October 2008.

Scientific Publications

The publication of the results obtained in the different R+D projects, while always respecting any possible confidentiality agreements with the client, are also one of the main objectives of the unit. The main scientific journals who have published project results are the following:

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ACADEMIC ACTIVITY

The close links between the CEIT and the University of Navarra is on the one hand reflected in the teaching carried out by researchers working in the Environmental Engineering unit and on the other by the numerous doctoral theses and undergraduate end of course projects produced.

Doctoral theses

- Dr. Eng. Jaime Luis García de las Heras, "*Removing colour from bleaching Kraft pulp wastewater by coagulation flocculation with iron (III), calcium and acrylamide co-polymers*". (1986).
- Dr. Eng. Luis Larrea Urcola, "*Contribution to the study of the treatment of black liquor from Kraft pulp industries by the activated sludge process using oxygen. Comparison with the aeration with air*". (1986).
- Dr. Eng. Eduardo Ayesa Iturrate, "*Design and development of an algorithm for the on-line identification of the activated sludge process*". (1992).
- Dr. in Sciences M^a Teresa Margeli Alcaide, "*Influence of stirring conditions on the treatment of bleaching effluents from Kraft pulping by FeCl₃: A flocculation model*". (1993).
- Dr. Eng. Libor Novak, "*Behaviour and modelling of advanced activated sludge wastewater treatment plants for nutrient removal*". (1994).
- Dr. in Biological Sciences Alejandro de la Sota Zubillaga, "*Evaluation of the performance and modelling of nitrification and denitrification processes for the Bilbao wastewater treatment*". (1995)
- Dr. in Biological Sciences Luis Sancho Seuma, "*Behaviour of aerobic selectors in activated sludge process*". (1995)
- Dr. Eng. Andoni Urruticoechea Ribate, "*Modelling thickening in secondary settlers of the Activated Sludge process*". (1995).
- Dr. in Chemical Sciences Asunción Larrea Urcola, "*Step-feed activated sludge process for nitrogen removal. Potentiality analysis and optimization of the design and operation*". (1998)
- Dr. Eng. M^a Elena Hidalgo Pérez, "*Development and verification of an identifiability test for state-space models. Application to the activated sludge process*". (1999)
- Dr. Eng. Joaquín Suescun Cruces, "*Identification of the oxygen supply and consumption in the activated sludge reactors at wastewater treatment plants*". (2000)
- Dr. Eng. Alejandro Rivas Nieto, "*Optimization of the design and operation of wastewater treatment plants based on total cost minimization*". (2000).
- Dr. Eng. Ainhoa Galarza Rodríguez, "*Design of operation and control strategies for biological wastewater treatment processes*". (2000).

- Dr. Eng. M^a Teresa Linaza Saldaña, "*Mathematical modelling for the management of integrated urban drainage systems*". (2001).
- Dr. in Biological Sciences Javier Lopetegi Garnica, "*Advanced technologies for treatment of paper mill wastewater*". (2002).
- Dr. Eng. Jon Irizar Picón, "*Optimizing the alternating activated Sludge Process for Nitrogen and Phosphorous Removal In Urban Wastewater*". (2003).
- Dr. in Chemical Sciences Iciar Marañón Ruíz: "*Treatment of landfill leachates by Advanced Oxidation Processes (AOP)*". (2004)
- Dr. Eng. Arantza Abad Alba: "*Optimization of predenitrification and nitrification process in urban wastewater using the moving bed biofilm reactor (MBBR)*". (2004)
- Dr. in Biological Sciences Saioa Soroa del Campo: "*Design optimization and modelling of an Anaerobic Hybrid Reactor for the treatment of wastewater rich in proteins and fats*".
- Dr. Eng. Mónica de Gracia Igelmo: "*Mathematical modelling of the digestion processes for waste sludge treatment*". (2007).
- Dr. Eng. Paloma Grau Gumbau: "*Operation and advanced control of the modern wastewater treatment plants making up water and sludge treatment lines*". (2007).
- Dr. in Biological Sciences Estibaliz Huete Palos: "*Design, operation and modelling of anaerobic digesters in a sludge stabilization dual system*". (2007).
- Dr. Eng. Valentina Zurcan Musseti: "*Mathematical modelling and simulation of the systems for the treatment and energetic valorisation of organic wastes*". (2007).
- Dr. in Biological Sciences Enrique Aymerich Soler: "*Dry Anaerobic Digestion and Composting of agroindustrial organic wastes*". (2007).
- Dr. Eng. Jairo Gómez Muñoz: "*Design, operation and modelling of an TAD process in a sludge stabilization DUAL process*". (2007).
- Dr. Eng. Saioa Arrizabalaga Juaristi "*Design, implementation and verification of a multi-service QoS architecture for a multi-dwelling gateway*". (2009)
- Dr. Cristina Martín Andonegui: "*Integrated Monte Carlo methodology for parameter estimation in biochemical models*". (2009)
- Dr. Garbiñe Manterola Agirrezabalaga "*Ozonation for sludge reduction in wastewater treatment plants: Process optimisation and mathematical modelling*" (2009)
- Dr. Maite Caminos "*Design optimization of the flat membrane bioreactor for nutrient removal from urban waste water*" (2010)

Current doctoral theses

- BSc. María Teresa López de Armentia: "*Optimization of advanced processes of biofilms and membrane techniques to recycle industrial wastewater with high COD and nitrogen loads*"
- BSc. Leire Otegi González "*Optimization of hydrogen sulphide and VOCs containing waste gas biotreatment in a biotrickling filter*"
- Eng. Claudia Cardona "*Mathematical modelling and simulation of biochemical processes in rivers*"
- Eng. Sergio Beltrán "*Design, operation and control of membrane bioreactors for wastewater treatment*"
- Eng. Elena Meabe Pinedo "*Operation and control of the MBR process for wastewater treatment*"
- Eng. Jon Albizuri "*Potential and modelling of hybrid processes for nutrient removal from urban wastewater*"
- Eng. Janelcy Alferes "*Design and experimental validation of an automatic control architecture for application to anaerobic digestion processes of industrial wastewater*"

Graduate projects and dissertations

- Carlos Espadas Peña, "*Laboratory pilot plant for the treatment of waste water coming from paper mill industry and sulphate pulp using the coagulation-flocculation-sedimentation process*". (July 1985).
- Eduardo Ayesa Iturrate, "*Calculation of aggregation and break-down constants in a mathematical model of flocculation*". (May 1988).
- J. Andoni Urruticoechea Ribate, "*Variables for the characterization of sedimentation process in an activated sludge process. Its influence on the operation of the secondary clarifier*". (February 1989).
- José I. Rodríguez Aldaco, "*Estimation of kinetic and stoichiometric coefficients in an activated sludge process*". (December 1989).
- Jorge Rodríguez Bilbao, "*Use of Galai CIS1 particle analyser to evaluate the bioflocculation in a activated sludge process*". (July 1991).
- Julián Arrillaga Costa, "*Experimental adjust and comprobation by simulation of a thickening model for the activated sludge process*". (November 1991).
- Alejandro Ganzarain Aguirrezabala, "*Desarrollo de un prototipo interactivo para un programa de diseño y simulación del comportamiento del proceso de fangos activos*". (December 1991).

- Julian Roteta Echave, "*Study of stationary and dynamic performance of different configurations with oxic reactors in an activated sludge system*". (December 1991).
- Asunción Fernández Sáez de Heredia, "*Development of a software for the graphical on-line representation of a simulation program of the activated sludge process*". (March 1992).
- Asunción Acuña Tallón, "*Comparative analysis of sensibility and observability of the activated sludge process under different operational conditions*". (March 1992).
- Adolfo Sucunza Alegre, "*Adaptation of a graphical commercial package to represent the transition state of an activated sludge process*". (September 1992).
- Iñaki Iraola Elcorobarrutia, "*Study of the dynamic development of an activated sludge plant with a selector*". (November 1992).
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- Andoni Etxegia Goñi, "*Experimentation and development of a Wazu respirometer*". (November 1993).
- Gorka Zalakain Bengoa, "*Contribution for the design and operation of an activated sludge process with step feed for the elimination of Nitrogen*". (December 1993).
- Gaizka Oyarbide Orbe, "*Observability reduced models for the predictive control of Alpha configuration*". (February 1994).
- Alejandro Rivas Nieto, "*Program developed to optimise wastewater treatment plant design*". (September 1994).
- Gerardo Tapia Otaegui, "*Design of dissolved oxygen control law, development and implementation at laboratory scale in an activated sludge process*". (February 1995).
- Eva M^a Vázquez Sánchez, "*Study and programme of an algorithm of optimization or activated sludge wastewater treatment plants*". (February 1995).
- Santiago Heredero, "*Verification and adaptation of the Wazu Respirometer to functional continuous real conditions of the plant*". (February 1995).
- Alex Hernandez, "*Assessment of the applicability of the commercial package FLUENT-VA to the hydraulic modelling of settlers*". (May 1995).
- Juan José de la Iglesia Ugartemendía, "*Development of a programme for the graphical representation of the variables in a wastewater treatment plant simulator*". (July 1995).
- Harm Klinworth, "*Design of a laboratory clarifier*". (July 1995).
- Andoni Beitia, "*Physical-Chemical treatment of the wastewater of San Sebastián*". (May 1996).
- Sonia Romero Outerelo. "*Identifiability analysis of the extended observability matrix in bioreactor experiments*". (December 1996).

- Jon García García. *"Development of a new simulator for a Wastewater Treatment Plant with nitrogen and phosphorous elimination"*. (October 1998).
- Jesús Calleja Palacios. *"Implementation in a microcontroller of an ON/OFF control system for dissolved oxygen and simultaneous estimation of OUR and KLA in an activated sludge process"*. (October 1998).
- Unai Antero Urrutikoetxea. *"Development of the Output user graphical interface for "Badiloegi" Operational Simulator"*. (September 1998).
- Beatriz Arenal Redondo. *"Development of the Input user graphical interface for "Badiloegi" Operational Simulator"*. (September 1998).
- Aitor Samaniego Vitores. *"Evaluation of the Performance of Alternating Activated Sludge Process for Nitrogen Removal in Urban Wastewater"*. (February 2000).
- Patricio Alemany López. *"Evaluation of the potential of Biofilter technology for nitrogen elimination from urban wastewaters"*. (April 2000).
- Arantza Abad Alba. *"Thermophilic Aerobic Biological Process for Treatment of Paper Mill effluents. Approximation and viability"*. (May 2000)
- Antonio Sempere Serrano. *"On-line estimation of oxygen consumption at the PEPSICO S.A waste water treatment plant: Analysis of different control strategies"*. (June 2000).
- José Antonio Unzue Barbier. *"Modelling and control of an industrial process. Real application to a paper manufacturing process for an engineering company"*. (July 2000).
- Eduardo Carrasco Alonso. *"Development and verification of a hydraulic sewer simulator based on Saint-Venant's equations"*. (November 2000).
- Joseba Martín Iriondo. *"Modelling and simulation of a river for global optimization of sewage networks: verification of results"*. (November 2000).
- Mónica de Gracia Igelmo. *"Development of a simulation tool for the activated sludge process in sequencing batch reactors (SBR). Comparison with the A2/O process for nitrogen and phosphorous removal"*. (January 2001).
- Paloma Grau Gumbau. *"Installations of sewage sludge digestion in Villafranca (Navarra). Simulation of solar system for sludge heating"* (February 2001).
- Jairo Gómez Muñoz. *"Experimental study in a laboratory plant of an hybrid anaerobic reactor treating slaughterhouse waste water. Design guidelines"*. (May 2001).
- Javier García Rodríguez. *"Application of object oriented techniques for the development of a Sewer Simulator"*. (June 2001).
- David Pérez Monje. *"Parametric modelling and pre-tuning for a DC engine with an ARM microcontroller"*. (June 2001).
- Gerardo Querejeta. *"Evaluation and application of Real Time alternatives for Windows NT"*. (September 2001).

- Carlos Tellería Peña. "*N removal optimization in urban wastewaters for biofilter processes in DN series*". (September 2001).
- José Antonio Ríal Nieto. "*Evaluation of the WEB-Server embeded in Dallas Semiconductor -TINI-*". (December 2001).
- Garbiñe Manterola Agirrezabalaga. "*Experimental studies in a SBR (sequencing batch reactor) pilot plant for the elimination of Nitrogen and Phosphorous from urban wastewater*". (February 2002).
- Jose María Iraizos Güemes. "*Optimization of Advanced Oxidation Processes by the Fenton reagent for Treatment of Lanfill Leachate*". (May 2002).
- Ricardo Gil Piñeirúa. "*Design method for the activated sludge zone in a UASB reactor with non-granulated sludge regarding the biodegradation process*". (July 2002).
- Armen Astour. "*Organic matter removal in a Biofilter from the Etxezarreta S.A. paper mill wastewater*". (July 2002).
- José Luis de Mier Vázquez. "*Evaluation of the inhibition grade by ammonium in the anaerobic treatment of swine manure. Continuous mixture tanks in continuos regime*". (October 2002).
- Leire Otegi González. "*Activity tests applied to evaluate the performance of an hybrid reactor and to help in the calibration of an anaerobic digestion model*". (January 2003).
- María Cano Núñez. "*Examining and evaluating the dynamic response of gas treatment within a by-products coke plant*". (May 2003).
- Arrate Olaiz Artola. "*Advanced Oxidation Processes for Treatment of Lanfill Leachate*". (May 2003).
- Iñigo Santos García. "*A pilot plant study with Moving Bed Biofilm System for nitrification and denitrification of San Sebastián urban wastewaters*". (July 2003).
- Juan Agudo González. "*Modelling a chemical reactor for producing sodium carbonate*". (September 2003).
- Jon Otaegui Ibarzabal. "*Remote Monitorization by GPRS of Industrial processes that used Programmable Logical Control*". (September 2003).
- Samuel Martín Angulo. "*Remote Supervision and Control of an Industrial Process through an Embedded Web-Server System*". (December 2003).
- Iñigo Arrúe Elorza. "*Experimental study of a batch reactor and design of a wastewater treatment plant at pilot scale for the icecream industry, using active sludge ozonation technology*". (December 2003).
- Aritz Zubizarreta Nafarrate. "*Mathematical modelling and sensitivity analysis of clarifying and thickening processes in storm tanks and clarifiers*". (June 2004).
- Irati Adin Iceta. "*Engineering improvements for MBBR (Moving bed biofilm reactor)designr*". (June 2004).

- David Ruiz. "*(Non)-occurrence of granulation in full-scale reactors*". (March 2005).
- Yoana de Simón Burstrom. "*Sewer system analysis with special emphasis on CSO performance evaluation*". (March 2005)
- Eneko Asarta Martín. "*Semi-industrial scale design of a biotrickling filter for odour removal from wastewater*". (May 2005).
- Imanol Busca Solanas. "*Developing a user interfacesoftware for OUR assays in discontinuous reactors*". (February 2006).
- Sergio Beltrán Calaff. "*Automatic characterisation of water and sludge based on mathematical optimisation algorithms*". (July 2006).
- Iñigo Martínez Canales. "Mathematical modeling and simulation analysis of a membrane SBR process" (September 2007)
- Miguel Soto de Prado Otero. "*Guidelines for design of membrane bioreactor processes with nitrogen removal*". (April 2009)
- Izaro Lizarralde Aguirrezabal. "*Mathematical Modelling and simulation of industrial wastewater treatment processes*". (March 2009)
- Isabel López Bajo. "*Evaluation of operational conditions for partial nitrification in biofilm systems*". (March 2009)
- Juan Odriozola. "Mathematical modelling and optimization of wastewater treatment plant digesters". (Enero 2010)

EQUIPMENT

Analytical laboratory

The Environmental Engineering unit at CEIT has the necessary analytical equipment to assist the R&D current projects.

A- Laboratory for conventional analysis

Conventional chemical analysis and preparation of samples. The laboratory is equipped with:

- 2 extractor fans for gas and toxic vapours.
- Distillation and deionization water equipment.
- Vacuum filtration system.
- Stoves, high temperature oven and plate heater.
- Analytical balance Mettler Toledo and granatory balances Sartorius and Mettler Toledo (PB 3002-S).
- PH-meter Crison 517 and Crison digit 501. Oxymeter WTW. Digital conductivity-meter Crison 525 and turbidity-meter 2100P.
- Flocculator for 'Jar Test'. Selecta floccumatic.
- 12 position digestion block and temperature control.
- TKN digester.
- N-NH₄ and Kjendal Nitrogen distillation equipment BÜCHI-315
- Automatic titration Crison TT 2050 for 15 samples
- Centrifugator with high frequency induction engine. Meditronic, BL7001084. Selecta.
- Centrifugator Centromix S549
- Controlled temperature store (20°C) for BOD₅ analysis.

B – Laboratory instrumental techniques

- Double-beam UV-visible spectrophotometer, Perkin Elmer, Lambda-3B.
- Trinocular optic microscope with phase contrast, NIKON OPTIPHOT XTR-CF with video and photographic output, video camera Hitachi KP-C500 and video monitor SONY, TRINITON KX-14-CP1.
- Continuous flux injection analysis (FIA) meter for simultaneous measurement of Ammonia, nitrates and phosphates, F.I.A., ISMATEC, ASIA, with six sampling ports.
- Gas chromatograph with mass detector Hewlett-Packard GCD (G1800 B).
- Gas chromatograph with thermal conductivity detector Hewlett-Packard HP6890.
- Gas chromatograph with FID Hewlett-Packard HP6890N.

Laboratory for pilot plant experimentation

The Environmental Engineering unit possesses a wide experience in the design, construction and operation of pilot plants which, depending on the requirements of each specific experiment, can be located in different places:

- The Analytical Laboratory of CEIT has an annex containing small pilot plants which were designed and built by our own unit.
- In a nearby area, provided by "Aguas del Añarbe" and next to an Urban Wastewater Pump Station medium sized pilot plants using real wastewater are in operation.
- Alongside WWTPs and using real wastewater.

Other resources

The Environmental Engineering unit has all the computing resources (hardware and software) necessary to carry out R+D projects.

It is worth mentioning that the unit has a wide variety of computer applications for the modelling and simulation of environmental engineering systems (Eg: treatment plants, sewage networks, rivers, etc.) developed on standard commercial programmes or pro-

duced by the unit and made to measure for different users.

Also, CEIT is the Spanish support centre for the environmental systems simulation platform WEST.