

Environmental technologies

research lines



The Instituto de Tecnología Cerámica (ITC) is a concerted mixed Institute, established by agreement between the Ceramic Industry Research Association (AICE) and Universitat Jaume I of Castellón, which originated in 1969 in response to the needs of companies from the Spanish ceramic cluster. During its more than 40-year history, ITC has articulated a successful university–business cooperation system that has borne its fruits, witness the significant development of the Spanish ceramic tile manufacturing industry.

ITC is committed to providing solid support for Spanish ceramic companies in the defence and enhancement of their strategic positioning in the current global context, principally through innovation-enabling research and development actions, but also through whatever activities might serve to foster the competitiveness and growth of the sector, always based on sustainability criteria and commitment to societal well-being.

ITC's mission is focused on spearheading technology innovation and design processes in the Spanish ceramic sector, anticipating market and consumer needs regarding the uses and applications of ceramic materials, through professionalised management of a qualified human team committed to excellence in the sector.

The competence attained through ITC's wide-ranging research activity enables ITC today to extend its field of action to other types of processes and materials. Particularly noteworthy have been ITC's actions in the field of energy efficiency and the minimisation of industry's environmental impact, as well as in the functionalisation of ceramic surfaces and the achievement of new technical performance and aesthetic features of products related to the habitat hyper-sector and to other industries, such as the high-tech tool, advanced ceramics, automotive, petrochemical sectors, etc.

Eco-management: services and training

From the outset, as technology partner of the ceramic sector, ITC has undertaken activities with regard to environmental issues in the ceramic and related industries, through projects funded by outside organisations and by ceramic sector companies, essentially with a view to improving and/or reducing the environmental impact of industry, while concurrently optimising the use of available resources.

In pursuit of this aim, the main lines of action of the Environmental Unit address the following issues: air, water, waste, and noise, as well as other, more horizontal subjects, such as life cycle analysis, environmental product declarations, consultancy in implementing Best Available Techniques, etc.

OVER 1000 R&D PROJECTS DEVELOPED THROUGHOUT THE HISTORY OF ITC, AMOUNTING TO ALMOST 40 MILLION EUROS.

Eco-management and Applicable legislation

In the environmental context, companies first need to identify their eco-situation in regard to both eco-management and compliance with applicable legislation. In this sense, ITC conducts the following activities for companies from the ceramic and related sectors:

- › Reports compiling and updating information on the environmental regulations applicable to companies.
- › Reports assessing possible environmental impacts of a technical and normative character.
- › Preparation of compulsory documentation: plans for minimising waste and/or packaging.
- › Compliance and verification of the EPER-PRTR emissions declaration.
- › Consultancy on the implementation of the necessary techniques for compliance of the requirements laid down in the Integrated Environmental Authorisation.

Analysis tools and environmental communication

With a view to identifying, enhancing, and demonstrating environmental sustainability, in both a given industrial process and the actual products made, the Environmental Unit offers companies a series of services that, in addition to others, enable assessment of the related environmental impacts, possibilities of improvement, and preparation of internationally recognised eco-communication documents, etc. These activities include:

- › Environmental Assessments.
- › Consultancy on the implementation of eco-management systems, according to ISO 14001 and/or the EMAS eco-management and audit scheme
- › Environmental analysis of products and/or services: Life Cycle Analysis, Carbon footprint, etc.
- › Evaluation of compliance with the environmental requirements in order to obtain the 'Eco-label for coverings'.
- › Consultancy on the development of Type II eco-labels (Self-declared Environmental Claims) and Type III eco-labels (Environmental Product Declarations), in accordance with UNE EN ISO 14020:2002.
- › Consultancy on the implementation of Eco-design.
- › Consulting on the obtainment of credits in Sustainable Building Construction (LEED, GREEN).

ITC IS A **REFERENCE PARTNER** IN DIFFERENT NATIONAL AND INTERNATIONAL NETWORKS AND TECHNOLOGY PLATFORMS.

Air emissions

A key environmental issue in the ceramic industry is the emission of pollutants into the atmosphere, from channelled as well as from diffuse or fugitive sources.



Panoramic view of the ceramic sector located in the L'Alcora-Moró districts.

Channelled emissions

In recent years, in regard to air pollution, the Environmental Unit has focused much of its work on studying dust emissions, particularly the PM_{10} and $PM_{2.5}$ fractions, and on the fluorine generated during the ceramic materials firing stage, undertaking activities aimed at detection, at-source prevention, and elimination of these pollutants.

The Environmental Unit has methodologies for the control of the following pollutants at channelled sources:

- › Determination of particle concentrations (TSP, PM_{10} , $PM_{2.5}$).
- › Determination of the particle size distribution of emitted particles.
- › Chemical, morphological, and mineralogical characterisation of emitted particles.
- › Determination of flow rates and analysis of combustion gases.
- › Determination of acid pollutant emissions: HF, HCl, and SO_2 (chemical method).
- › Determination of total heavy metal emissions.
- › Determination of volatile organic compound emissions (VOCs).
- › Continuous monitoring of the pollutants present in gas emissions: HF, HCl, NO_x ($NO+NO_2$), SO_2 , CO_2 , CO, and VOCs.
- › Collaboration in the start-up, optimisation, and monitoring of the efficiency of pollutant treatment systems.

For these tests, ITC has the following accreditation:

“Nº 2/LE565 for the performance of tests of air emissions through fixed emission sources”, from the Spanish National Accreditation Body (ENAC), first awarded in 1996. The scope of the accreditation includes the determination of the emissions of total particles, fluorides (as HF), chlorides (as HCl), and sulphur (SO_2).

Fugitive particle emissions

Fugitive particle emissions in the ceramic industry are mainly generated as a result of the storage and management of raw materials of a dusty nature, their occurrence being most significant during loading, unloading, and transport operations.

In order to evaluate, control, and identify possible actions for reducing these types of emissions, the Environmental Unit has fine-tuned the following services:

- › Determination of settleable particle concentrations, TSP, PM_{10} , and $PM_{2.5}$, at the company perimeter.
- › Continuous monitoring of TSP, PM_{10} , and $PM_{2.5}$ in ambient air.
- › Chemical, morphological, and mineralogical characterisation of emitted particles.
- › Evaluation and monitoring of the efficiency of corrective measures implemented to minimise fugitive dust emissions.
- › Calculation and determination of TSP, PM_{10} , and $PM_{2.5}$ emission factors from fugitive sources by experimental and analytical methods.

Water consumption and wastewater discharges

The Environmental Unit performs various activities aimed at minimising water consumption and improving management of the wastewater arising in the manufacturing process. The following services may be noted:

- › Industrial wastewater sampling and analysis.
- › Drawing up water saving plans.
- › Design and consultancy on physical and chemical water treatment.
- › Application of advanced separation techniques with membranes (micro-, ultra- and nanofiltration) for the removal of substances present in wastewater.

Gestión de residuos

The production of waste is a major environmental concern in any industrial production process, in relation to both the quantity and diversity of the arising types of waste and to the ensuing regulatory obligations. ITC therefore collaborates with companies in order to enable them to assure appropriate waste management, from the start of their production processes to the final destination, and conducts the following activities:

- › Sampling and characterisation of wastes and leachates.
- › Evaluation of waste processing and handling.
- › Waste minimisation plans.
- › Feasibility studies for waste recycling in the own process or in other alternative processes.

Custom training

› The application of technologies developed for the prevention, reduction, and control of the different environmental issues, together with the need to be fully acquainted with the legal requirements relating to ceramic tile manufacture, has led to the creation of a series of custom courses aimed at addressing the possible shortcomings of ceramic technicians in environmental matters. The main thematic lines dealt with are as follows:

- › Management and environmental technologies in the ceramic and related industries.
- › Techniques for controlling and characterising air pollutants.
- › Integrated pollution prevention and control (IPPC).
- › Environmental communication tools: Life cycle analysis, implementation and application of eco-design, eco-labelling, etc.

available equipment

ITC has a fully equipped mobile unit for the performance of field measurement campaigns, which also allows transport of all the necessary scientific and technical equipment detailed below:



ITC CURRENTLY HAS TECHNICAL AND SCIENTIFIC EQUIPMENT FOR CONDUCTING R&D VALUED AT OVER 9 MILLION EUROS.

Air

- › Electrochemical cell-based discontinuous combustion gas analyser (O_2 , CO_2 , CO , SO_2 , NOx).
- › Continuous HF analyser by tuneable diode laser (TDL) technology.
- › Continuous measurement system of gaseous pollutants based on standard methods adapted to the quality assurance procedures laid down in standard UNE-EN 14181:
 - UV fluorescence: SO_2
 - Non-dispersive IR absorption: HCl , CO , CO_2
 - Chemiluminescence: NO , NO_2 , NOx
 - Paramagnetism: O_2
- › Isokinetic sampling equipment: Adapted for measuring particles and acid pollutants (HF , HCl , and SO_2).
- › Cascade impactor and cyclone: For studying the particle size of emitted particles and PM_{10} and $PM_{2.5}$ fractions in channelled sources.
- › Sound level meter for noise mapping.
- › Volatile organic compound (VOC) analyser by flame ionisation detection (FID) technology.
- › Meteorological station (wind speed and direction, rainfall measurement, relative humidity, and temperature).
- › Gravimetric particle samplers (TSP , PM_{10} , and $PM_{2.5}$) for ambient air.
- › Continuous TSP , PM_{10} , and $PM_{2.5}$ measurement instrument for ambient air.

Water

- › Multi-parameter water quality probe – Continuous measurement of dissolved oxygen, pH, conductivity, temperature, and salinity.
- › Biological reactor.
- › System of liquid effluent filtration through laboratory membranes.

technical references

ITC has the capability to transfer the knowledge acquired through the ongoing training of its team of qualified human resources, who keep their knowledge up to date by conducting various R&D&I actions and studies, in addition to participating in numerous science and technology forums worldwide and in different international platforms and consortia. This knowledge, together with that acquired or assimilated from other production sectors, serves to generate the innovation that is transmitted to the companies, which need this to maintain or to enhance their competitiveness.

THE DISSEMINATION OF THE RESULTS OF THE STUDIES CONDUCTED BY ITC FROM THE OUTSET HAS LED TO **600 PUBLICATIONS** OF SCIENTIFIC ARTICLES IN SPECIALISED JOURNALS, **700 COMMUNICATIONS AT NATIONAL AND INTERNATIONAL CONFERENCES**, AS WELL AS THE DEVELOPMENT OF **31 PATENTS**.

R&D&I projects with private companies

In the course of the years, over 50 projects have been conducted into the application of environmental technologies at ceramic sector companies, based mainly on the following research lines:

Control and treatment of channelled emissions into the atmosphere originating from spray dryers, dryers, and kilns for firing ceramic products, frit fusion furnaces, etc.

Control and treatment of fugitive emissions produced in spray-drying plants.

Control and treatment of discharges originating in the ceramic industry and in the related chemical industry.

Application of best available techniques.

These research projects have been carried out in the following companies and Associations:

ARCILLA BLANCA, S.A.,
ARCILLAS ATOMIZADAS, S.A.
ASCER
AEFFECC
ATOMIZADAS DE ALCORA, S.A.,
ATOMIZADORA, S.A.
AZULEJERA TÉCNICA, S.A.,
AZULEV, S.A.,
AZULIBER 1, S.L.,
BIONATUR BIOTECHNOLOGIES, S.L.
CERACASA, S.A.
CERÁMICAS BELCAIRE, S.A.,
ESMALGLASS, S.A.,
DUAL GRES, S.A.,
ENDEKA CERAMICS, S.A.,
EUROATOMIZADO, S.A.,
EXAGRES, S.A.,
FERRO SPAIN, S.A.
FRITTA, S.L.,
ITACA, S.A.,

KEROS CERÁMICA, S.A.
MAS VICENT INGENIEROS,S.L.
PAMESA CERÁMICA, S.L.
TALLERES JOIS, S.A.,
TALLERES MOVIGI, S.L.
TAULELL, S.A.
TEJAS Y LADRILLOS DEL MEDITERRÁNEO, S.A.
TIERRA ATOMIZADA, S.A.
VIVES AZULEJOS Y GRES, S.A.,
ZIRCONIO, S.A.

R&D&I projects co-financed with public funding

European Commission

2009-1-PT1-LEO05-03237 Innovation and Ecodesign in the Ceramic Industry (2009-2011).

E14121 - Advanced membrane technologies for boron removal from ceramic wastewaters to enhance water reusability (2008-2009).

COLL-CT-2003-500896/2 - Studies aimed at assisting legislation and encouraging continual improvement strategies in the field of respirable crystalline. (2004-2007).

Ministry of Science and Innovation

CGL2009-14680-CO2-01 – Quantification and characterisation of fugitive particle emissions in the management and transport of dusty materials (2010-2012).

PSS-380000-2009-24 - Analysis of the environmental impact of buildings throughout their life cycle in quantifiable terms of energy consumption and related GHG emissions (2009-2012).

CGL2006-07956/CLI - Physical and chemical characterisation of channelled and fugitive emissions of particulate matter (TSP, PM10, and PM2.5) in the ceramic industry. (2006-2009).

CTM2004-06619-CO2-02 - Valorisation of ceramic wastes in cement manufacture (2004-2007).

PPQ2003-00869 - Minimisation of fluorine emissions in the ceramic industry by development of clean technologies (at-source abatement techniques). (2003-2006).

REN2003-08916-CO2-01 - Emissions of particulate matter at channelled and fugitive sources in the ceramic industry. Characterisation and modelling. (2003-2006).

GV01-97 - Reuse of marble-working wastes in the manufacture of ceramic tiles, frits, and fired-clay products (roof tiles and bricks). (2001-2002).

Autonomous Government of Valencia

Monitoring in areas affected by Air Quality Improvement Plans of the Valencia Region and consultancy for non-IPPC activities. (2009).

IMDIC/2009/3 - Environmental sustainability of the ceramic industry (2007-2010).

Preparation of the ‘Air quality Improvement Plan of the Alicante area: Western Alacanti’ (2008).

IMCITA/2007/5 - Removal of organic compounds in ceramics industrial waters by means of advanced filtration techniques (Ultra-nanofiltration) (2007-2008).

Preparation of the ‘Air quality improvement plan of the area ES 1003: Mijares-Penyagolosa (A. Costera) and Agglomeration ES 1015: Castelló’ (2007).

IMIDIC/2004/4 IMIDIC/2005/10 - Study of Chlorine and Sulphur compound emissions during the firing of ceramic tiles. (2004-2007).

IIARC0/2004/301 - Recycling of marble cutting and polishing sludge as by-products in structural ceramics, cement derivatives, and composites. (2004-2005).

IMDIC/2001/6 - Study of acoustic pollution and PM10 particle emissions in the ceramic industry (2001).

IMTEFB/2000/22 IMDIC/2001/8 - Study of fluorine emissions in the ceramic materials firing process. (2000-2002).

Ministry of Education and Science

CIT-310200-2007-86 - Design of a zero waste process for boron removal from ceramic company wastewater. (2007-2009).

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Articles in technical and scientific journals

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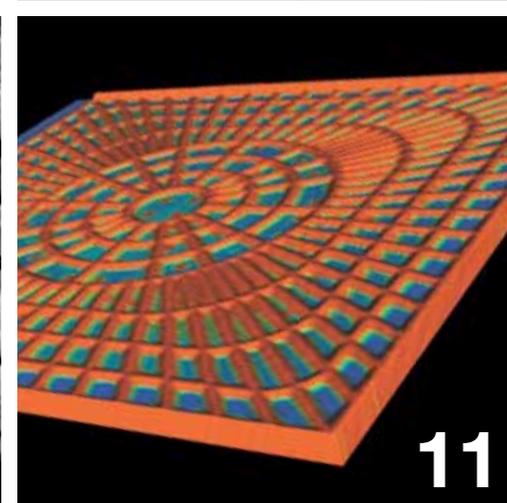
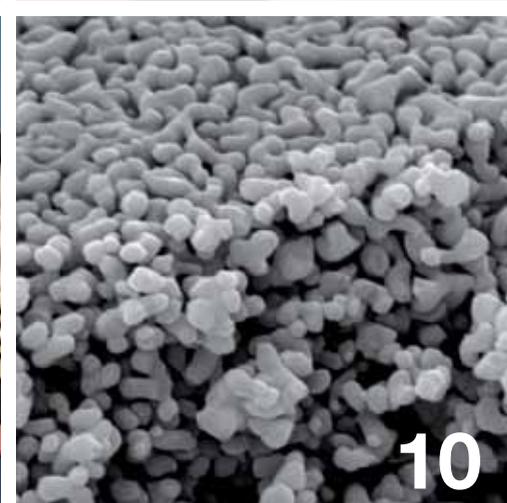
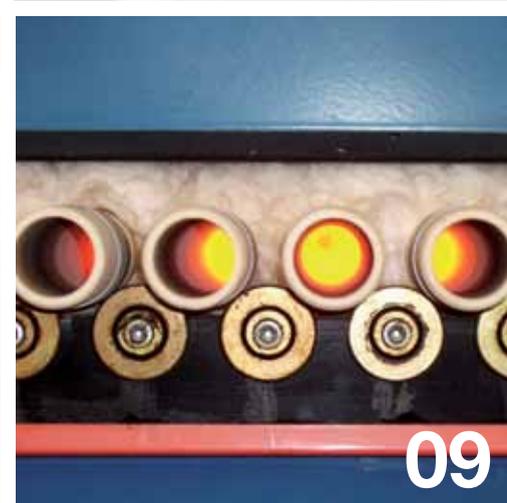
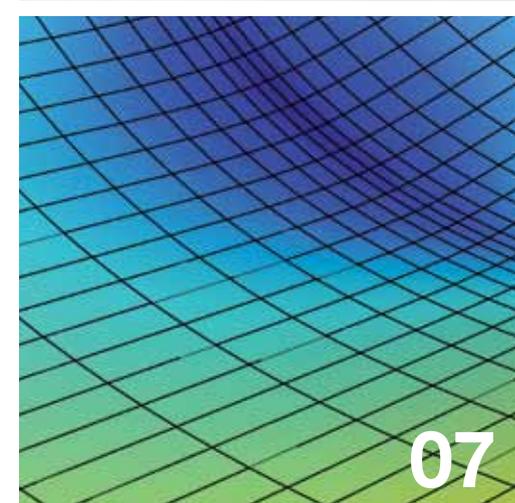
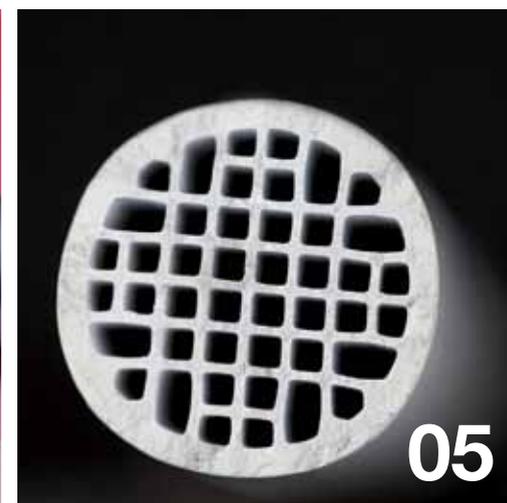
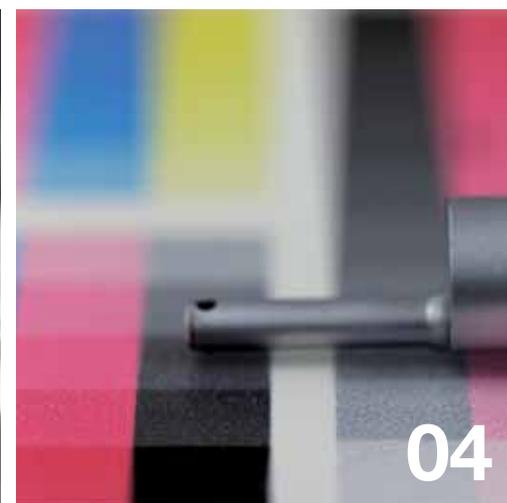
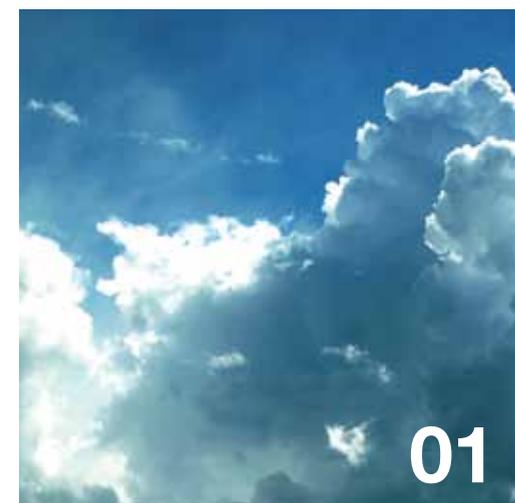
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8000m² SURFACE AREA DEVOTED
TO RESEARCH AND DESIGN SPREAD
OVER TWO HEADQUARTERS.



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