Construction systems and energy efficiency for architecture

research lines

Instituto de
Tecnología Cerámica

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.

Construction systems and energy efficiency for architecture

The Instituto de Tecnología Cerámica, through ALICER, the ITC area for design and architecture, began conducting projects on installation systems, urban furniture, and domotic systems in the 1990s. At present, this activity is being further explored in view of the ceramic sector's growing interest in construction systems and energy efficiency in architecture.

ITC is a member of the 'Energy Efficient Buildings Association' (E2B A), which was created in January 2009. An international non-profit-making association is involved, made up of private companies, and public as well as private Research Centres, whose mission is to foster research, development, and innovation in the field of energy efficiency in buildings. The Association's key objective is to contribute to achieving the goals set for 2020 by the European Commission in March 2007, namely to reduce energy consumption and greenhouse gas emissions by 20% and 30%, respectively, taking the year 1990 as a reference, and for 20% of the energy consumed in 2020 to come from renewable energies.

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

Construction systems

Traditionally, ceramic systems and materials have been almost exclusively used for hygienic purposes in kitchens and bathrooms. Nowadays, however, these products are being increasingly used outdoors and in urban applications, while new functionalities are concurrently starting to be demanded of these systems and materials.

In this sense, ITC carries out projects on the design, development, and evaluation of systems for ventilated façades, technical and raised floors, dry tile installation systems, and custom-designed floors for public spaces. These projects generally have in common the following phases:

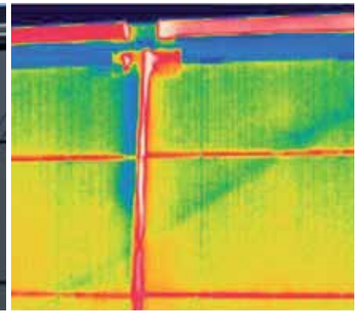
Determination of the state of the art. This involves the search for and analysis of patents, utility models, etc. in relation to construction systems and system materials, as well as a review of the characteristics of those available in the market.

Definition of requirements and evaluation of performance. The requirements applicable to construction systems and their constituent materials are identified: that is, their mechanical, physical, installation, or maintenance features. These requirements are judiciously evaluated according to their nature, either by testing in the case of physical properties or by panels of experts in the case of requirements relating to installation or use.

System design and development. A series of proposals are drawn up, based on the requirements to be met by the new system, which are thoroughly discussed with a view to soundly reasoning the chosen solutions. Finally, the detail design provides the necessary documentation for appropriate system manufacture.

Energy-efficient architecture





Sustainable development policies, aimed at reducing the environmental impact of industrialisation, have contributed to fostering research into enhancing energy efficiency in buildings and constructions, a field of action to which ITC is fully committed.

ITC pursues its activity in this field by using the full spectrum of ITC capabilities, ranging from sensor and measurement system design (in order accurately and precisely to determine materials thermal performance) and energy studies (either in situ or by developing prototypes of scale construction systems) to modelling construction systems (by computer simulations), as a design optimisation tool and instrument for predicting system performance under different season and climate conditions.

Research projects are, thus, being undertaken to reduce energy consumption in buildings by optimising building heating and cooling demands, choosing the most appropriate materials for reducing the related environmental impact, developing construction systems for building renovation and, in general, by implementing whatever actions may contribute to enhancing the efficiency and sustainability of the construction sector.

The most noteworthy projects currently being conducted by ITC in this field address the following issues:

Optimisation of the properties of ceramic materials and construction systems, for example, in order to obtain materials with low thermal conductivity and high mechanical strength.

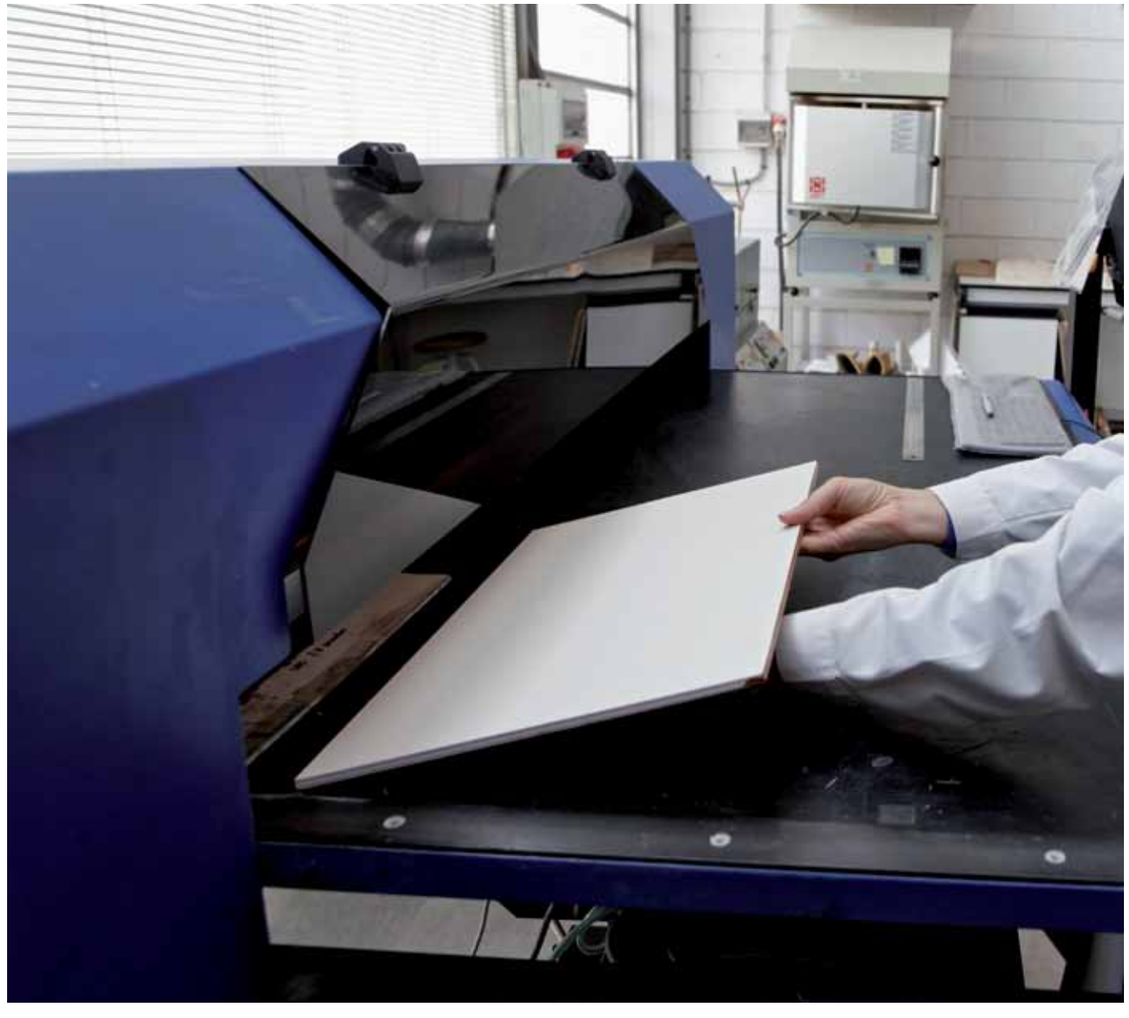
Integration of ceramic products in passive construction systems, such as those used to enhance the ability to capture and collect thermal solar energy.

Analysis of construction system energy efficiency by scale experimental studies, in order to optimise construction system design and thus enhance the contribution of these systems, such as ventilated façades, to building energy efficiency.

available equipment

ITC sets at the disposal of companies a great technological infrastructure of technical competence endorsed by both ITC's high number of external accreditations and its highly qualified human and instrumental resources, which assure total reliability with regard to the results obtained in the characterisation of raw materials and end products, and in the determination of their behaviour during the production process.



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

Energy efficiency equipment

- Experimental module for studying atmospheric exposure under actual conditions.
- Pyranometers for measuring total and diffuse solar radiation.
- Heat flux sensors.
- Anemometer for measuring outside air speed and direction.
- Meteorological station.
- Devices for the determination of gas stream flow rates and flow conditions.
- Contact and non-contact temperature measurement sensors.
- Equipment for measuring materials conductivity and thermal effusivity.
- Data logging systems by direct or remote connection for in situ measurements.
- Reflectometer for measuring solar absorbance.
- Equipment for measuring surface emissivity.
- Thermographic camera.

Architecture equipment

- Systems for custom mechanical tests (ventilated façades, technical floors, etc.).
- Means for performance assessment by simulating actual service conditions.
- Z-Corp Z-printer 310 plus three-dimensional printer.
- GALILEO RI Nº1/2 three-dimensional laser digitiser.
- CNC GALILEO R31Nº212 metal-milling machine.
- KERAJET 40P inkjet printer.

IN THE COURSE OF ITS 40-YEAR HISTORY, ITC HAS CARRIED OUT ABOUT 150,000 ANALYSES AND TESTS OF THE 475 DIFFERENT TYPES THAT IT CURRENTLY OFFERS.

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 co-financed with public funding

Energy efficiency

IMPCNC/2008/42 – Study of the energy efficiency of ventilated ceramic tile façades (2008-2009).

IMIDIC/2008/12 – Passive systems with ceramic materials. Study of the contribution to building energy efficiency (2008).

FIT-38000-2007-12 – Development of a composite building envelope managed by an active control system for the use of solar thermal energy (2007-2009).

FIT-380000-2005-159 – Design of a bioclimatic ceramic outer building envelope with high thermal energy efficiency (2005-2006).

IMIDIC/2004/5 – Measurement of the thermal conductivity of ceramic materials used in manufacturing ceramic tiles, bricks and roofing tiles (2004).

Construction systems

DEX-530000-2008-108 – Design and development of new ceramic tile installation systems (2008-2009).

IMCITA/2005/3-IMCOCA/2006/2 – Analysis of the problems relating to the constraints of current ceramic tile installation methods (2003-2004)

IMPYPA/2003/37-IMPYGD/2004/16 – Ceramics in urban furniture: design, development, and innovation (2003-2004).

FIT- 020100-2003-316 – Prospective analysis of design regarding the feasibility of ceramic products in architecture and urban development (2003).

IMPYPA/2003/76 – Design of new presence sensors and electric plugs (Part 2) (2002-2003).

IMPYPD/2002/13 - Design of new presence sensors and electric plugs (2001-2002).

Publications

Energy efficiency

SILVA, G.; CANTAVELLA, V.; GARCÍA, A.R.; BOU, E.; MIRALLES, A.; UVIEDO, E. Estudio de la eficiencia energética de fachadas ventiladas cerámicas. En: *Qualicer 2010: XI Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, 2010.

CANTAVELLA, V.; BANNIER, E.; SILVA, G.; MÚÑOZ, A.; PORTOLÉS, J.; ALGORA, E.; GARCÍA, M.A. Dinámica del comportamiento térmico de un suelo radiante eléctrico con recubrimiento cerámico desmontable. En: *Qualicer 2010: XI Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, 2010.

BARTOLOMÉ, M.; CORRALES, J.; MIRA, J.; RAMÓN, J. Introducción del producto cerámico en los sistemas climáticos de la casa pasiva. En: *Qualicer 2010: XI Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, 2010.

SILVA, G.; CANTAVELLA, V.; BOIX, J.; MIRA, F.J.; JULIÁ, J.E. Análisis de la eficiencia energética de un cerramiento bioclimático cerámico. *Ceram. Inf.,* 357, 82-94, 2008.

MIRA, J. Fachadas cerámicas ventiladas. Ventajas y sistemas de anclaje. *Ediceram,* 40, 31-39, 2006.

GARCÍA-TEN, J.; SILVA, G.; CANTAVELLA, V.; LORENTE, M. Utilización de materiales aligerantes en la fabricación de bloques de Termoarcilla. Influencia sobre la conductividad térmica y el comportamiento en el proceso. *Conarquitectura*, 16, 89-96, 2005.

Construction systems

BARTOLOMÉ, M.; CORRALES, J.; LLORENS, M.; MIRA, J. Nuevas aplicaciones cerámicas en arquitectura. Filtros y pieles. En: *Qualicer 2010: XI Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, 2010.

LLORENS, M.; CLAUSELL, J.; LLORENS, D.; RAMÓN, J. Cerámica, electrónica y arquitectura. En: *Qualicer 2010: XI Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, 2010.

COLOMER, J.; NIETO, J.; PARKINSON, S.; PÉREZ-SEGUI, M.; SANDKUEHLER, P.; MORENO, A.; SÁNCHEZ, E.; SANZ, V.; SILVA, G. Desarrollo de materiales compuestos laminados cerámica-polímero para fachadas ventiladas. En: *Qualicer 2008: X Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, vol. III, 2008, p. BC275-BC284.

PORTOLÉS, J.; ALGORA. E.; MIRA, J.; SILVA, G.; BARTOLOMÉ, M.; ALCÁNTARA, E.; ZAMORA, T. Recubrimientos cerámicos que mejoran la seguridad y el confort en espacios públicos. En: *Qualicer 2008: X Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, vol. III, 2008, p. Pos273-Pos277.

MIRA. J. Productos innovadores en el sector de la cerámica. En: *Público, privado, efímero. La cerámica en la arquitectura.* Castellón: Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos, 2008, p. 46-50.

MIRA. J. Procesos para la personalización de productos. En: *Moldear, ensamblar, proyectar. La cerámica en la arquitectura.* Castellón: Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos, 2006, p. 82-85.

RAMÓN, J.J.; MIRA, F.J.; SILVA, G.; QUIJANO, A.; MAYORGA, P.M. Diseño de nuevos interruptores integrados en recubrimientos cerámicos. En: *Qualicer 2004: VIII Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, vol. III, 2004, p. GII137-GII154.

MUSEROS, LL.; MIRA, J.; SANZ, V.; MONZÓ, M.; BERNDT, D.; SCHMIDT, N.; BRÜCHER, M. Digimould. Moldeo digital para la industria cerámica. Una contribución a la fabricación en serie personalizada. En: Qualicer *2004: VIII Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara Oficial de Comercio, Industria y Navegación, vol. I, 2004, p. GI213-GI228.

MIRA, J.; PAYÁ, M.; LÁZARO, V.; DIÉGUEZ, A.; JOLI, C.; GARCÍA, M. Rehabilitación de mobiliario cerámico urbano del parque Ribalta de Castellón. En: *Qualicer 2002: VII Congreso Mundial de la Calidad del Azulejo y del Pavimento Cerámico.* Castellón: Cámara oficial de Comercio, Industria y Navegación, vol. III, 2002, p. GII191-GII210.

MIRA, J.; PAYÁ, J. Combinaciones de formatos. En: GARCÍA VERDUCH, A. (coord.). *Colocación de pavimentos y revestimientos cerámicos.* Castellón: Instituto de Tecnología Cerámica, 1993, p. 73-89.

Related patents

ALICER, ASOCIACIÓN PARA LA PROMOCIÓN DEL DISEÑO INDUSTRIAL CERÁMICO. Permeable paver for external floors. ES1055856U, 2004-05-16.

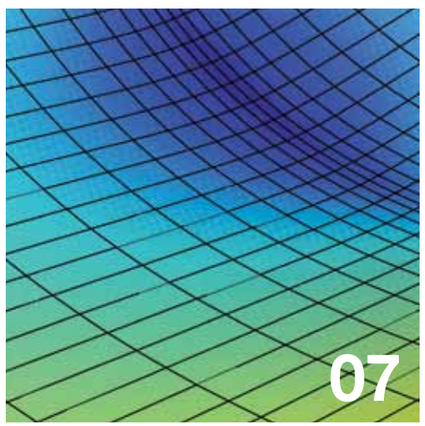
ALICER, ASOCIACIÓN PARA LA PROMOCIÓN DEL DISEÑO INDUSTRIAL CERÁMICO. Ceramic tile fastening device for internal mechanical wall tile installation. ES1055857U, 2004-05-16.

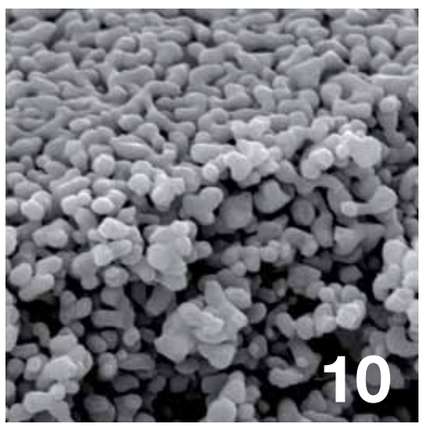
ALICER, ASOCIACIÓN PARA LA PROMOCIÓN DEL DISEÑO INDUSTRIAL CERÁMICO. Back-lit lighting device fitted in wall and floor tiles. ES1058629U, 2005-01-16.

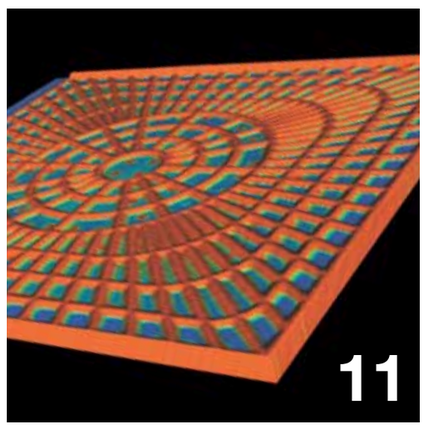
ALICER, ASOCIACIÓN PARA LA PROMOCIÓN DEL DISEÑO INDUSTRIAL CERÁMICO. Ceramic cladding with concealed joints for vertical facings. ES1058992U, 2005-06-16.

ALICER, ASOCIACIÓN PARA LA PROMOCIÓN DEL DISEÑO INDUSTRIAL CERÁMICO. Waterproof cladding with concealed joints for sloping facings. ES1059416U, 2005-08-01.

ALICER, ASOCIACIÓN PARA LA PROMOCIÓN DEL DISEÑO INDUSTRIAL CERÁMICO. Cladding with covered joint for curved facings. ES1059415U, 2005-08-01.







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