



University of Thessaly  
School of Technology  
Department of Environmental Sciences  
Chemical and Construction Materials Technology Laboratory  
Gazette of Establishment: No. B' 2630/29-6-2020  
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#### Laboratory Description:

Since 1991 the Laboratory has had sufficient equipment for research. With the E5/53461/12-2-91 and E5/1355/13/12/91 administrative decisions of the Ministry of Education, the implementation of a research programme of the Laboratory in cooperation with local ceramic industries is approved in order to assess the quality of the ceramic products produced. Since 1993, research efforts have been implemented on environmental issues, based on the laboratory's instrument chemical analysis equipment. In the following period, research was carried out on the recovery of solid or liquid waste by incorporating it into ceramics for the creation of composite materials with an advanced structure and recovery of waste produced by various processes, so that both its safe disposal and its residual value could be assessed. The Laboratory focuses on issues of circular economy and in particular on the detection of terms and conditions for the recovery of by-products and/or waste, through their incorporation into ceramic clay soils for the production of structural ceramic materials with advanced structure and low environmental footprint. In addition, its activity extends to the characterisation, quality control and evaluation of properties of new innovative materials such as structural ceramics, composite materials, nanomaterials and biomaterials as well as the development of geopolymers from demolition wastes, ashes and residues of metallurgical industries. In recent years the Lab specializes in the cultivation of algae for the production of biofuels.

The Laboratory aims to develop partnerships at national and European – international level, while linking it with both productive actors and society.

#### Research areas:

The “Laboratory of Chemical Technology of Materials Science and Mechanical Behavior” specializes in the following fields/cells, which develop the relevant research activity, covering the following:

##### **SECTION A: BUILDING AND COMPLEX CERAMIC MATERIALS**

Research in Section A focuses on circular economy issues, in particular on the detection of terms and conditions for the recovery of by-products and/or waste, through their incorporation into ceramic clay soils for the production of building ceramic materials with advanced structure and low environmental

footprint. In addition, its activity extends to the development of geopolymers from demolition wastes, ashes and residues of metallurgical industries.

#### SECTION B: MECHANICAL CHARACTERISTICS AND BEHAVIOUR OF MATERIALS

Research in Section B focuses on the characterization, quality control and evaluation of properties of structural and new innovative materials such as building ceramics, composite materials, nanomaterials and biomaterials.

#### SECTION C: ENVIRONMENTAL PROTECTION TECHNOLOGIES – BIOFUELS

Section C focuses on the research and development of new environmental protection technologies, the biofuel production from algae, as well as the waste recycling produced in the primary sector, through developed technologies in the Lab.

The main research laboratory activities are:

- Strengthening improvement of ceramic material structure.
- Advanced ceramic materials.
- Exploitation – incorporation of industrial waste and by-products into ceramic products.
- Energy recovery of industrial waste and by-products.
- Secondary raw materials development – exploitation derived from waste
- Biofuels.
- Polymeric and metal matrix composite materials.
- Applications of biomaterials in orthopedics and dentistry.
- Polymeric materials with nano-inclusions.
- Biofuels (biogas, biodiesel from the cultivation of microalgae).

#### Research Projects:

- “Strengthening ceramic materials by dispersing mortars from industrial solid waste” (ARCHIMIDIS II, 01-01-2005 to 31-12-2007).
- “Remazol dye discoloration experiments and correlation of experimental data” (ARCHIMIDIS I, 12-5-2004 to 31-12-2007).
- “Study of kaolin systems+graphite fibres, cement+flying ash, characters+mechanical properties + statistical analysis” (ARCHIMIDIS II, 01-01-2005 to 31-12-2007).
- “Study on the Development of Appropriate Technologies for Disposal-Management: Solid and Liquid By-products of Olive Oil Mills, Sewage Sludge, Alternative Solid Fuel (ASF) & Petroleum Coal (PETCOKE)”, 2011 – 2016 (Private financing).
- “Innovative Ceramic Materials” (Cooperation 2011 – Partnerships of productive and research bodies in focused research and technological fields, in the Operational Programme “Competitiveness and Entrepreneurship” (RE-II), Priority Axis (A.P.) 1 “Creation and Exploitation of Innovation Supported by Research and Technological Development”, 1-1-2013 to 30-6-2015).
- “Production of algae biofuels” (SYNERGASIA 2011, 1-1-2013 to 30-6-2015).
- “Innovation and Entrepreneurship Unit of TEI Larissa”, 2011-2013. EPEDBM, 2010-2013.
- “Nanostructured Geopolymers and Calcium Phosphate based Biocements and Implants (NANO. GEO. S.CA. PHO. L.)”, THALIS, EPEDBM, 2011-2015.
- “Study of the exploitation of deported refinery sludge and its bio-cleaning product in the construction ceramics industry” (16/12/2016 – 16/3/2017).

- “QUALITY CONTROL OF GAS, LIQUID AND SOLID EFFLUENTS OF THE BIOGAS UNIT SEITI BROS S.A. AND CERTIFICATION OF THE USE OF LIQUIDS AND SOLIDS EFFLUENTS IN AGRICULTURE”, 2015 – 2019 (Private financing).
- “ASSESSMENT OF LIQUID WASTE FOR MICROALGAE CULTIVATION AND THEIR USE TO PRODUCTION OF BIODIESEL AND FISH FEED SUPPLEMENTS” (code 5944), University of Thessaly.
- Coordination or Participation in various research projects in cooperation with enterprises and private bodies (INASCO SA, EXALCO SA, MAKH SA, “CHALKIS SA”, STUFFCOLOUR ENERGY SA, AIGAION SA, VIOKERAL SA, METALOCK, “ARGILOS” etc.).

#### Equipment:

The basic laboratory equipment available is as follows:

- Electronic microscopy system.
- SPRaman-NIR Spectroscopy.
- System (Anter) for the determination of specific thermal conductivity of materials.
- Series of standard sieves for granular analysis.
- Blaine device.
- Vicat.
- Automatic granular analysis system using Laser rays to determine grain size of the order of  $\mu\text{m}$ , medium diameter, % diameter, special surface area, etc.
- Los Angeles.
- Infrared Thermo Balance apparatus for the determination of working plastic mass.
- Electronic penetrometers of various types to check the homogeneity of the materials produced.
- Pilot plant for the production of heavy clay ceramic materials with extrusion (milling, mixing-homogenization, formatting).
- Production of compressed ceramics.
- Atmospheric Dryer.
- Dryer using inert atmosphere.
- Ball mill system for material pulverization.
- Electronically programmable oven for the firing of ceramics.
- High temperature Oven for thermal treatments (up to  $1700^{\circ}\text{C}$ ).
- Water absorption measurement system.
- Automatic system for determining the resistance of materials to frost.
- Three-point bending.
- Complete system for studying mechanical properties.
- Hardness measurement (Rockwell).
- Determination of surface hardness for ceramic materials (Vickers).
- Ultrasound material failure control system.
- Measurement of a dynamic measure of elasticity using ultrasound.
- Acoustic wave device for determining defects.
- Surface grinding device.
- Density determination system.
- Balances.
- Raw material mixer.
- Ceramic test cutter.
- GC.

- TOC.
- Ionic chromatography.
- Bioreactors.
- Spectrophotometers.
- Dynamic Mechanical Analysis Device.
- Impact device.
- BOD.
- COD.
- Deionized water production apparatus.
- Leaching tests

#### Research Results:

- Production of new advanced ceramic materials
- Valorization of solid and liquid industrial wastes.
- Study on the neutralization of the hazardous elements by its incorporation in the ceramic matrix.
- End of waste criteria in heavy clay ceramics production. Good practices developed in the Lab, accepted and published in the European Circular Economy Platform (<https://circulareconomy.europa.eu/platform/en/good-practices/close-loop-ceramic-industry>).
- Characterisation of polymers, metals and composite materials
- Algae cultivation – biofuels production

#### Services:

- Services provided by the laboratory to third parties:
- Complete tests on clay soils.
- Assessment of the quality of building materials.
- Environmental protection technologies – Biofuels.
- Characterization of metal, polymeric and composite materials.
- Applied Research with the development of cutting-edge technologies in ceramic materials.
- Industrial Research with emphasis on the development and pilot production of innovative products.
- Health assessment of building materials.
- Product Certification and Quality Control Services.
- Integrated solutions in the areas of Environmental Control and Protection.
- End of waste criteria – valorization studies.
- Circular economy in industrial sectors.
- Detection of industrial symbiosis conditions.
- Building Materials control services for CE marking.
- Leaching tests on raw materials, aggregates and building materials.
- Advisory activity in the application of Quality Management Systems (ISO 9001), Environmental Management Systems (ISO 14001, EMAS), Drafting technical dossiers for CE marking, improving the quality of the products produced.
- Collaboration with organizations, local authorities, research institutes and related bodies.
- Specialized Workshops and Seminars.
- Training of Industry Personnel.
- Training of Scientists at Undergraduate and Postgraduate Level.

## Personnel

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## Laboratory Photos



