# **Research Team**

# Raw Materials Exploitation & Sustainable Energy Solutions



Hosted@Lab.of Metallurgy

National Technical University Of Athens Main Infrastructure/Services







## & Technical Services Scientific Research



Laboratory of Metallurgy (LabMet) National Technical University of Athens

### INFRASTRUCTURE

### RESEARCH ACTIVITIES

The activities of Labmet are mainly focused on research and technology development in the field of extractive industries, including development of energy efficient processes, processing technologies for ores and industrial minerals, design, simulation and techno-economical evaluation of new production processes, design of environmental protection processes, synthesis of high added-value materials from ores and industrial minerals.

### EXPERTISE

LabMet has gained considerable experience and reputation through the number of research projects it undertakes, and the number of publications in the above mentioned fields. Over the last 10 years LabMet has coordinated or participated in more than 30 EC and 20 National funded research projects with partners from many industrial companies, academic and research institutes in Europe and worldwide.



**characterisation** and has the necessary infrastructure to support its research and development activities.



#### CHEMICAL ANALYSIS & PHYSICAL PROPERTIES

Scanning Electron Microscope with X-ray microanalysis and Electron backscattered diffraction, Transmission Electron Microscope, Atomic absorption spectrophotometer, ICP spectrometer, XRF spectrometer, UV spectrometer, Differential thermogravimetric analyzer (DTA, DTG, DSC), X Rays Diffractometer, Portable spectrophotometer for aqueous analysis, BET specific surface area analyzer, Laser particle size analyzer, Carbon and sulfur analyzer (LECO), UV-Visible-NIR Spectrophotometer (ASTM E903 - 96), Thermal emittance (ASTM C1371), Heat Flow meter (EN12667, ASTM C518).



Atmospheric & cascade reactors for acid and base environments, Bioreactors, Electrolytic cells, Microwave assisted leaching reactor, Pilot plant for ore leaching.

Rotary, electric arc, induction and microwave furnaces, Static tube, fluidized Bed furnace, Multiple heating zones vertical furnace for expansion, Determination of melting and softening points.

#### ENVIRONMENTAL CHARACTERISATION

The environmental characterization of wastes includes chemical/mineralogical analysis and determination of critical geochemical parameters, such as acid and base neutralisation capacity and metals leachability following standard European tests (e.g. EN 12457.01-04, CEN/TS 14405). For sulphidic wastes, static and kinetic tests are performed to evaluate the acid generation, potential.



# **Mineral Processing**

### **Primary crushing:**

Jaw crusher [Retsch] (productivity: 50 kg/h)

### Secondary crushing:

rotor beater mills [Retsch] equipped with bottom sieves (productivity: 20 kg/h)

## Screening:

3-deck Vibrating Tumbler Screening Machine for continuous screening (productivity 50 kg/h)

## Physicochemical Characterisation

Atomic absorption spectrophotometers ICP spectrometers (ICP-MS & ICP-OS) **XRF** spectrometer, UV spectrometer Differential thermogravimetric analyzer (DTA, DTG, DSC) **X Rays Diffractometers** Portable spectrophotometers **BET** specific surface area analyzer Laser particle size analyzer Carbon and sulfur analyzer (LECO)



# Microscopy

**Scanning Electron Microscope** [SEM] and Transmission Electron **Microscope [TEM]** able to analyze at high resolution at nano level, equipped also with Energy **Dispersive System [EDS] for** elements tracing and mapping



## **Construction materials testing**

- Compressive strength
- Bending strength
- Thermal conductivity by heat flow meter method, complied with EN12667 and ASTM C518.
- Thermal emittance, on a Devices and Services emissometer, complied with ASTM C1371.
- Solar Reflectance by spectral reflectance measurements on a UV-Visible-NIR Spectrophotometer, complied with ASTM E903
- Determination of the Solar Reflactance Index (SRI), by the thermal emittance and solar reflectance values
- Materials testing on Climatic chambers







## Hydrometallurgical processes

- Atmospheric glass reactors
- Pressure reactors (Autoclaves) for acid and base environments
- Bioreactor with temperature, pressure and pH control
- Air, water and oil baths with temperature and agitation control
- Incubator for bacterial growth
- Column reactors of variable capacities (2 – 200L)
- Cascade reactor (four 10L agitated vessels in series)
- Electrolytic cells
- Microwave assisted leaching reactor



# Pyrometallurgical processes

- Fully automated graphite vacuum furnace (max temp 2500°C)
- High temperature microwave furnace
- Electrically heated rotary furnaces
- Electric Arc furnace with graphite electrodes
- Induction furnace
- Static tube furnaces
- Fluidized Bed furnace
- Equipment for the determination of melting and softening points



# Environmental studies

- Equipment for in-situ soil sampling
- Measurement of permeability
- Dampness cells (ASTM D5744-96)
- Columns for leaching kinetic tests of soils and solid waste depositions
- pH and Redox potential measurements
- Portable equipment for dissolved oxygen, pH, redox potential and conductivity measurements
- Standard equipment for TCLP test





## **Processes upscale**

Electric Furnace for controlled expansion

Continuous flow Infra-Red Furnace for expansion of inorganic lightweight aggregates

High temperature bleaching earths unit







# Mockup testing for construction materials

- Multichannel remotely monitored system using temperature and heat flow sensors
- Atmospheric conditions: temperature, relative humidity, dew point, atmospheric pressure





## Lavrion Technological Park





condensing boiler (60 kWth)

Energy storage capacity\*: 1MWh

Intelligent Safety and **Protection System** 

User friendly and fully automated Energy Management and Monitoring System

40 kW CHP for residential applications (PEM Fuel Cell)

### **Demonstration Site** at GREECE

### Enhancing cooperation and future perspectives

- ✓ The developed RES-H₂ hybrid energy system can be used as a full-scale research, development and testing facility of:
  - H<sub>2</sub> production, storage and consumption technologies
  - Energy management systems
- Existing demonstration site presents a great opportunity to attract interested parties for direct knowledge exchange, consultancy and joint initiatives
- Contribute to standardization activities at system level for residential buildings or districts of buildings

### Public awareness



## Energy self sustained building with zero CO, emissions

## **Lavrion Technological Park**

Three types of renewables sources III Renewable district Power

structure

Infra

Ξ

Tea

## Energy storage to Batteries (1364 Ah) and Hydrogen (1MWh)



## District energy monitoring and management

## Advanced experience on process simulation, CFD and LCA software:

- ASPEN
- HISYS

Ð

tructur

S

nfra

- Matlab
- ANSYS
- FLUENT
- TRNSYS
- SUPERPRO
- COMSOL Multiphysics
- SimaPro
- GaBi



