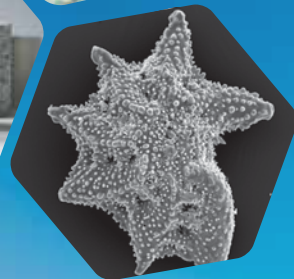


INA E&P LAB

Exploration and Production
Laboratory



SCOPE OF WORK

The key areas of activity of the Exploration and Production Laboratory (E&P Laboratory) include:

- Laboratory testing of rocks (cuttings and core samples) and reservoir fluids (crude oil, gas condensate, natural gas and water) from geological, geochemical, petrophysical, thermodynamic, corrosion and physical and chemical perspectives
- Active collaboration in the exploration and definition of new exploration areas
- Support and optimization of reservoir development and oil and gas production processes
- Expert and technical support for the energy transition and the implementation of geothermal, EOR and CCUS projects
- Preparation of laboratory reports, technical studies and expert assessments, including detailed data interpretation

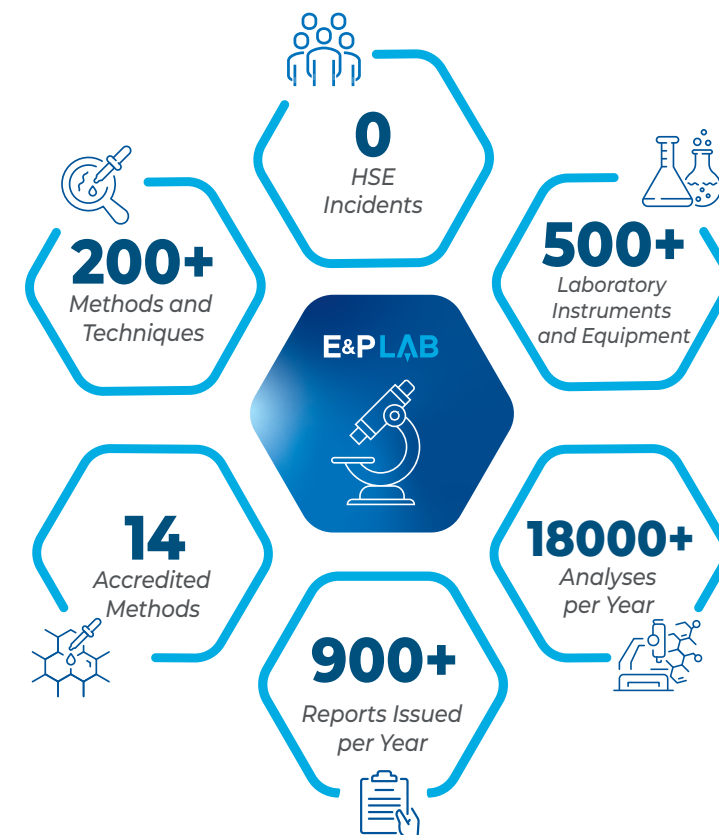
The Laboratory also provides services to external clients in accordance with the **Laboratory Services Catalogue**. In cooperation with clients, new methods are developed and existing methods are adapted to address specific requirements and regulatory obligations. This enables clients to improve their business processes through reliable laboratory data and to solve a wide range of engineering challenges using real rock and fluid samples obtained from wells.

ABOUT US

The Exploration and Production Laboratory (E&P Laboratory) provides expert support to oil and gas exploration and production projects across the INA and MOL Group, while also delivering laboratory services to external clients.

We offer an innovative approach and tailored solutions to meet client needs through standardized, in-house and custom-developed methods in the fields of oil, gas and water exploration, field development and production. Our work is based on a high level of expertise, high-quality laboratory analyses and reliable data interpretation for the needs of the entire energy sector in the Republic of Croatia and beyond.

The Laboratory proactively contributes to the energy transition through the development and application of methods and technologies for geothermal projects, hydrogen, CCUS and other energy initiatives.



Our laboratory team brings together highly qualified petroleum, geological and chemical engineers, together with experienced technicians, all with extensive expertise in the oil and gas industry and a strong multidisciplinary background.

VISION AND MISSION

VISION

Our vision is to be a leading laboratory in the energy sector that provides high-quality and reliable expert support, enabling clients to successfully drive the energy transition and achieve sustainable long-term development.

MISSION

Our mission is to lead the energy transformation through world-class laboratory solutions and a multidisciplinary approach. By combining technological excellence across the oil, gas, water and renewable energy sectors, we ensure maximum process efficiency while actively contributing to a sustainable future.

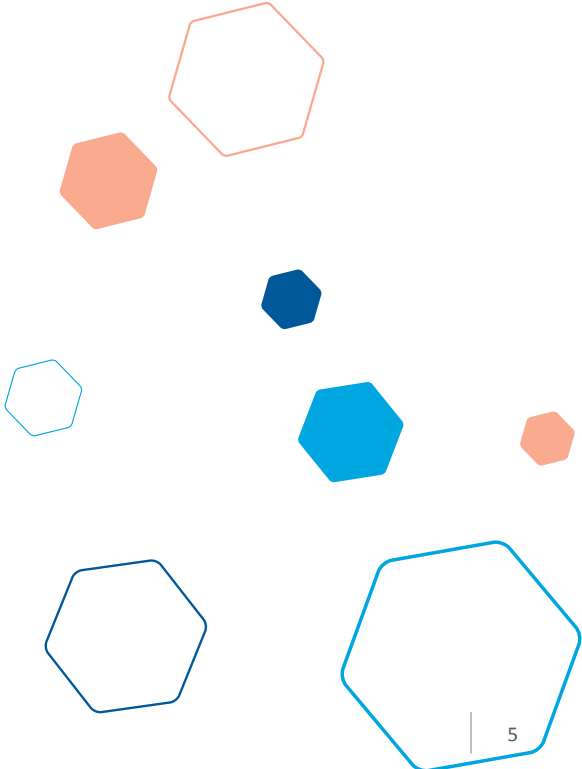
As a key partner within the INA and MOL Group, we integrate innovations that set new industry standards. We draw our strength from knowledge and reinforce our social responsibility through strong collaboration between industry and academic community. Through mentorship and practical training, we prepare future generations of experts for global energy challenges.

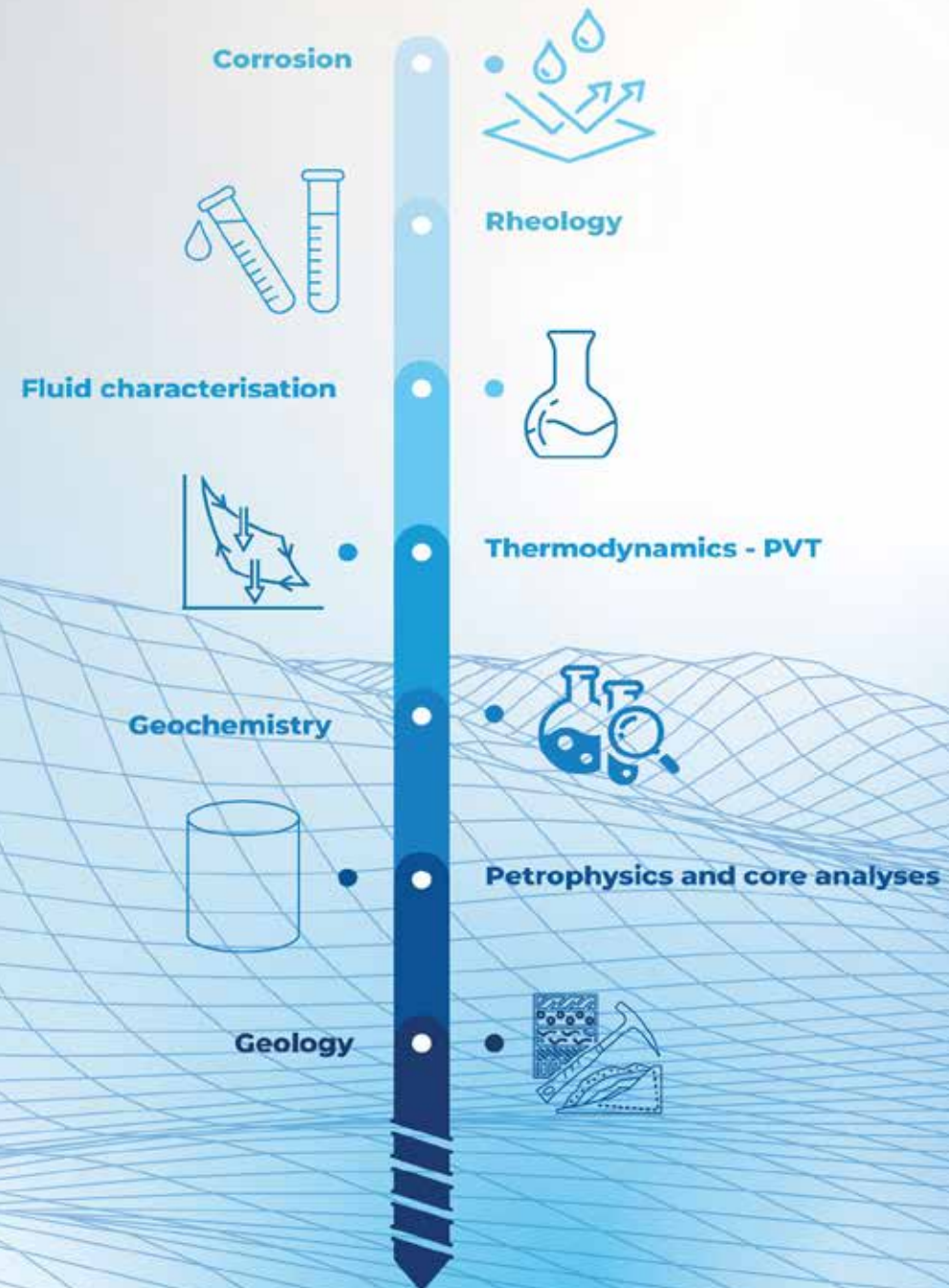


QUALITY ASSURANCE AND ACCREDITATION

Expert competence in the application of specific analytical methods is confirmed by **Accreditation Certificate No. 1048**, issued by the Croatian Accreditation Agency in accordance with the standard **HRN EN ISO/IEC 17025:2017**, covering the testing of selected quality parameters of natural gas, crude oil, lubricating oils, aqueous ethylene glycol solutions and crude oil additives.

Competence, systematic approach and quality in the performance of contracted activities are further confirmed by certifications in accordance with ISO 9001:2015, ISO 14001:2015, ISO 45001:2018, and ISO 50001:2018 awarded to INA d.d.





SAMPLING AND SAMPLE PREPARATION

PRECISION IN EVERY SAMPLE, RELIABILITY IN EVERY DATA.

The E&P Laboratory provides comprehensive professional sampling services for representative samples, as well as sample preparation for laboratory analyses, forming the foundation for high-quality and reliable analytical results.

Our portfolio of services includes:

- **Professional on-site sampling** of natural gas, gas condensate, crude oil, water and other process fluids
- **Geological sampling** and handling of core material and cuttings from wells, surface outcrops and core storage facilities, carried out in strict accordance with established protocols
- **Specialized preparation and processing of rock and fluid samples** tailored to specific laboratory testing requirements
- **Precise recombination** of reservoir fluids based on actual production data



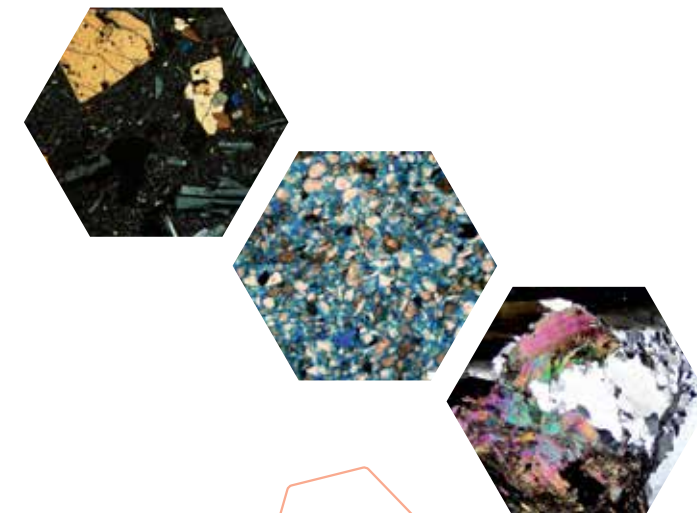
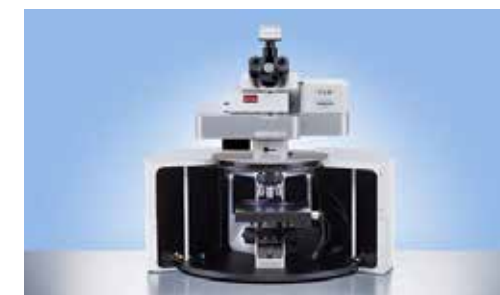
GEOLOGY

The E&P Laboratory performs biostratigraphic, petrographic and sedimentological analyses and data interpretation, ranging from urgent preliminary analyses and reports to detailed studies, basin evaluations and sedimentological modelling.

The laboratory is equipped with state-of-the-art instruments, including a scanning electron microscope (SEM/EDS), a confocal Raman microscope and various types of optical microscopes, enabling precise and highly detailed analyses that form the basis for comprehensive data interpretation.

Key activities and analyses:

- **Biostratigraphic analyses** – chronostratigraphic determination, fossil content, paleoecology, interpretation of biofacies and palaeoenvironments
- **Petrographic and sedimentological analyses** – rock classification, mineral composition, structural and textural characteristics, UV analysis, diagenesis, provenance, grain size and shape, sorting, maturity, microporosity, SEM/EDS and Raman analyses, mineral phase analysis, digital phase analysis of pore space, interpretation of lithofacies and depositional environments, preparation of lithological columns
- **Sedimentological modelling** – integration and interpretation of biostratigraphic, petrographic and sedimentological data as well as geochemical, petrophysical and other available datasets, for defining facies and their distribution



GEOCHEMISTRY

Geochemistry plays a key role in hydrocarbon exploration as it enables the determination of the generative potential of source rocks, the assessment of hydrocarbon expulsion efficiency and the interpretation of migration mechanisms. Through the application of modern geochemical analyses, genetic characterization and correlation of reservoir fluids are performed, migration pathways are identified, and changes within the reservoir are monitored.

GEOCHEMICAL ANALYSES

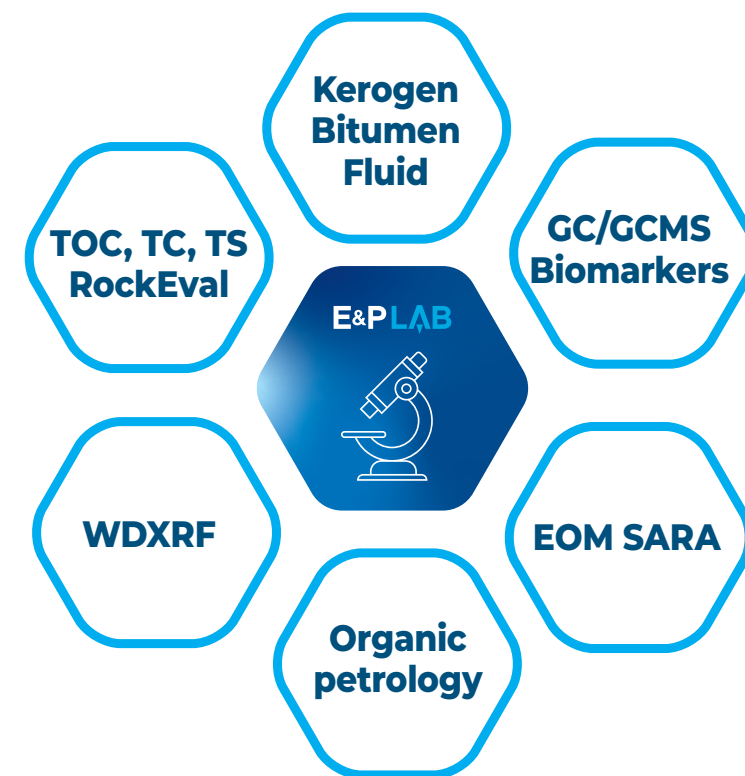
- Source rock determination
- Petroleum potential
- Organic facies and kerogen type
- Thermal maturity
- Geochemical characterization of hydrocarbons
- Biomarker analyses
- Genetic correlations
- Migration and accumulation studies
- Reservoir geochemistry
- Petroleum & geological studies, reconstruction of depositional environments and conditions, ecosystem interpretation

GEOCHEMICAL MODELING

- Data integration and interpretation for PetroMod basin modelling

OTHER

- Chemical analyses of rocks and sediments
- Acid solubility testing
- Analysis of liquid and solid phases from waste pits
- Solidification



PETROPHYSICS - CORE ANALYSES

Measurement of the petrophysical properties of core samples enables a detailed understanding of pore space, its geometry, fluid saturation and fluid distribution. These analyses are essential for evaluating the production potential of oil and gas reservoirs, geothermal energy exploitation and underground storage of natural gas and carbon dioxide.

Precise laboratory measurements on core samples allow reliable estimation of reservoir volumes and reserves, as well as optimization of production strategies.

ROUTINE CORE ANALYSES

- Spectral gamma ray measurement – core depth determination and log correlation
- Profile permeability – measurement along the full core diameter
- Porosity and permeability – at standard or reservoir conditions
- Grain density
- Laser diffraction grain size distribution
- Micro-CT imaging and digital core processing

SPECIAL CORE ANALYSES (SCAL)

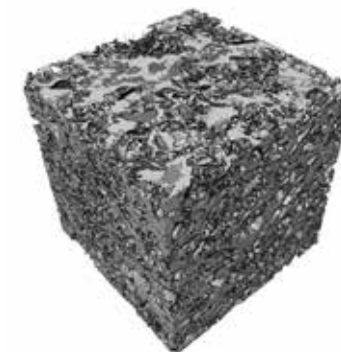
- Capillary pressure, formation factor, and resistivity index
- Relative permeability (steady-state and unsteady-state) at standard or reservoir conditions for reservoir simulation
- Water permeability tests
- Permeability alteration or return permeability tests
- Pore volume compressibility
- Caprock analysis for underground gas storage
- Particle mobilization and clay swelling tests
- Establishment of initial wettability of core samples

DIGITAL ROCK ANALYSIS AND POROUS MATERIALS

Digital analyses provide detailed insight into rock structure and pore space. Non-destructive methods are used to create 3D digital models of samples, enabling advanced analyses and numerical simulations.

Key petrophysical and structural properties determined include:

- Porosity and permeability
- Pore and pore throat size distribution
- Solid phase (grain) size distribution
- Capillary pressure, electrical properties and pore tortuosity
- Geomechanical properties





THERMODYNAMICS – PVT

PVT analyses (Pressure–Volume–Temperature) are among the most important methods in reservoir characterization and are performed at the early stages of reservoir development and production. Experimental data enable the development of a reliable thermodynamic model of reservoir fluids, which describes their behaviour throughout the production life of the reservoir.

Additional PVT studies, in combination with petrophysical core analyses, enable the planning and optimization of secondary and tertiary enhanced oil recovery methods (IOR/EOR/cEOR).

Within laboratory fluid characterization, targeted analytical methods are applied to separator or downhole samples of reservoir oil, gas condensate and formation water. The obtained results are used for the estimation of oil, gas and water reserves, as well as input data for reservoir simulation models and production forecasting.

RESERVOIR OIL

- Wellstream analysis – determination of composition and physical properties of reservoir oil
- Constant Composition Expansion (CCE) test
- Differential Liberation (DL) test
- Separator test

GAS-CONDENSATE

- Wellstream analysis – determination of composition and physical properties of gas condensate
- Constant Composition Expansion (CCE) test
- Constant Volume Depletion (CVD) test

INDIVIDUAL ANALYSES

- Gas chromatographic (GC) analysis of natural gas and liquid hydrocarbons, including extended and detailed analyses, with calculation of heating value, density, relative density, Wobbe index and other gas properties
- P–V relationships and flash tests of separator fluids at separator temperature
- Density determination at standard and p–T conditions
- Fractional distillation of liquid hydrocarbons
- Viscosity measurements of reservoir fluids at reservoir temperature
- Recombination of reservoir fluids from separator gas and liquid phases

PVT STUDIES

- EOS characterization – equation of state modelling (PVT software)
- Complete PVT study of oil, gas condensate, or gas

FLUID CHARACTERIZATION AND RHEOLOGY

Analyses of crude oil and gas condensate enable their classification based on physicochemical properties, which are essential for the design and operation of equipment in the oil industry, ensuring pipeline flow assurance, monitoring production parameters and achieving significant cost savings. The results of these analyses are also required for the calculation of royalties, inspection activities and compliance with regulatory obligations.

According to standard ASTM, ISO and UOP methods, the following properties are determined:

- Density
- Viscosity
- Paraffin wax and asphaltene content
- Distillation curve
- Sulphur content
- Pour point
- Water content and other characteristics

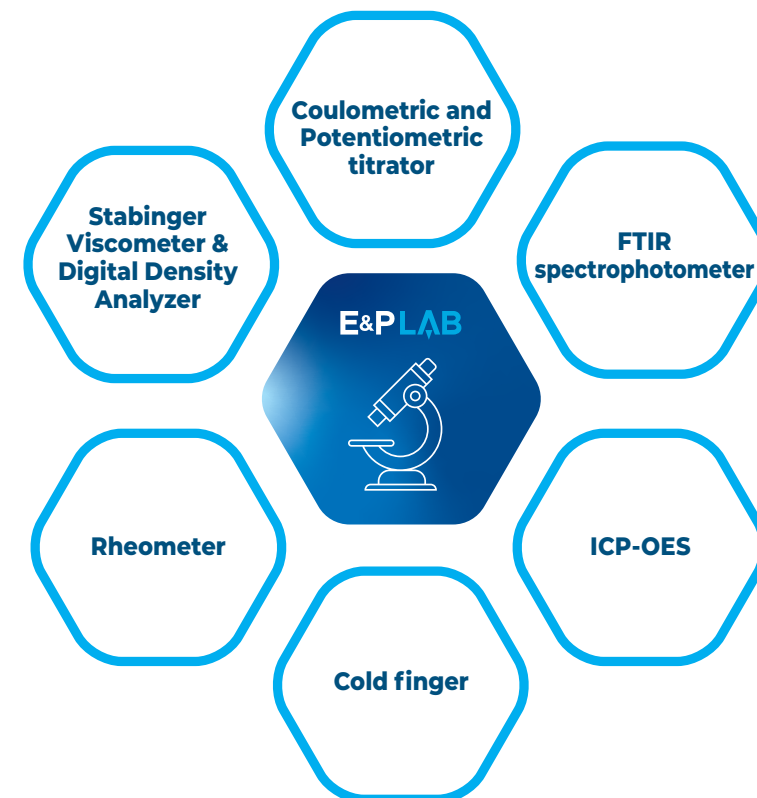
For efficient transport of crude oil with a high wax content, **rheological properties of the samples** are determined, including:

- Flow and viscosity curves
- Wax appearance temperature
- Cold Finger tests

Samples may also be tested with additives (pour point depressants, demulsifiers, paraffin inhibitors) to improve the rheological properties of crude oil.

In natural gas and gas condensate, the content of hydrogen sulphide and thiols is monitored, and total mercury content is determined in gas, gas condensate, crude oil and petroleum products.

In addition, monitoring of lubricating oils, as well as ethylene glycol (antifreeze) and triethylene glycol (gas dehydration) solutions in process equipment, is carried out to optimize consumption, monitor equipment condition (corrosion), and assess process efficiency.



WATER ANALYSES

Water analyses are essential for the accurate understanding and management of water quality in various environments, including industrial and energy applications. Analyses are performed for the characterization and classification of a wide range of water types, including drilling, formation, surface, groundwater, wastewater, process and geothermal waters.

Laboratory analyses provide data on the chemical, physical and biological properties of water. Detailed water analyses enable monitoring and assessment of process parameters, corrosion processes, industrial applications and water contamination.

Geothermal waters, used for energy production and heating, require precise analytical control due to their specific chemical and physical properties. The obtained data are essential for assessing the safety and efficiency of water use in the industry and energy sectors.

Physical and chemical water analyses:

- pH, electrical conductivity, alkalinity, carbonates, bicarbonates, salinity, density
- Water hardness (calcium, magnesium, total)
- Suspended solids and total dissolved solids (TDS)
- Total solids (dry residue at 105 °C)
- Dissolved gases (oxygen, hydrogen sulphide, carbon dioxide)
- Mercury
- Anions and cations
- Metals
- Surfactants (anionic, cationic, non-ionic)
- Chemical oxygen demand (COD) and biochemical oxygen demand (BOD₅)
- Total oil and grease, mineral oil hydrocarbons
- Total nitrogen
- Phenols
- Permanganate index
- Total organic carbon (TOC) and dissolved organic carbon (DOC)



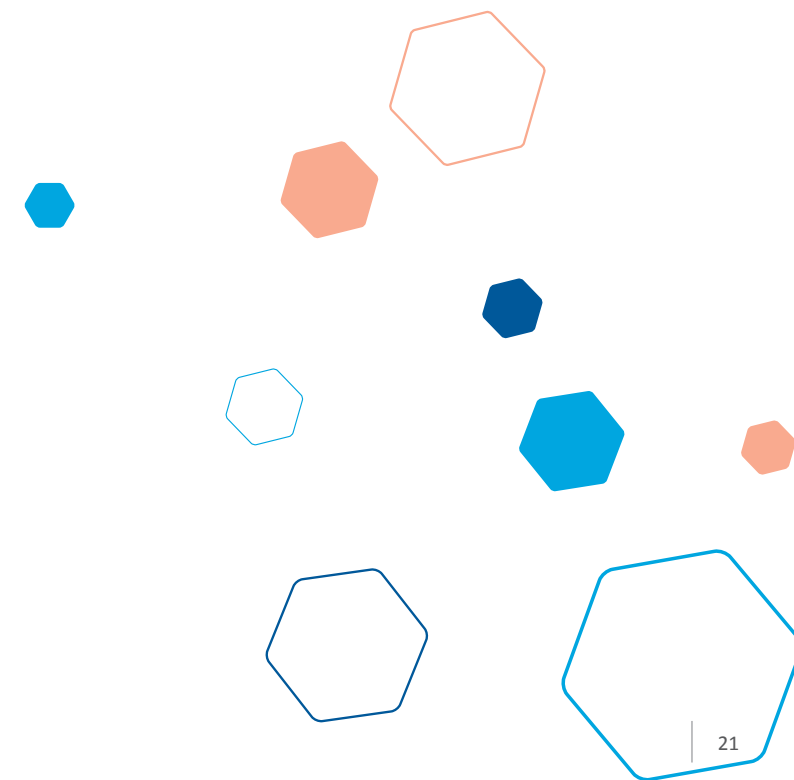
CORROSION

The activities of the E&P Laboratory are focused on the analysis and control of metal corrosion in oil and gas exploration and production systems, ensuring the reliable operation of process facilities, personnel safety and environmental protection. By applying modern laboratory techniques, advanced equipment and continuous field monitoring, corrosion risks are identified at an early stage, enabling timely preventive measures and minimizing the impact of corrosion on production systems.

In addition to oil and gas applications, the laboratory provides corrosion monitoring and evaluation services for geothermal water systems. Laboratory testing and field monitoring support the assessment of corrosion processes under geothermal operating conditions, contributing to the reliable, safe and efficient operation of geothermal facilities throughout their service life.

The most commonly used methods for monitoring and testing corrosion effects include:

- Fluid corrosion testing at various pressures and temperatures (HPHT and atmospheric conditions)
- Evaluation of corrosion inhibitor efficiency at various pressures and temperatures (HPHT and atmospheric conditions)
- Assessment of material resistance to corrosion
- Corrosivity testing of stimulation fluids
- Corrosivity testing of packer fluids
- Resolution of corrosion-related challenges in production, transport and storage
- Field corrosion monitoring
- Studies on the impact of corrosion on production systems



ENERGY TRANSITION

EOR & CCUS

The E&P laboratory utilizes state-of-the-art equipment and technologies for applying innovations in EOR (Enhanced Oil Recovery) and CCUS (Carbon Capture, Utilization, and Storage) projects.

Continuous support is provided for field optimisation and well stimulation projects in onshore oil and gas fields.

Special attention is given to EOR projects, which represent key investments in continental Croatia. These projects aim to increase hydrocarbon recovery in the Žutica and Ivanić production fields, with potential application to other reservoirs as well.

EOR STUDIES (CO₂, N₂, CH₄ INJECTION)

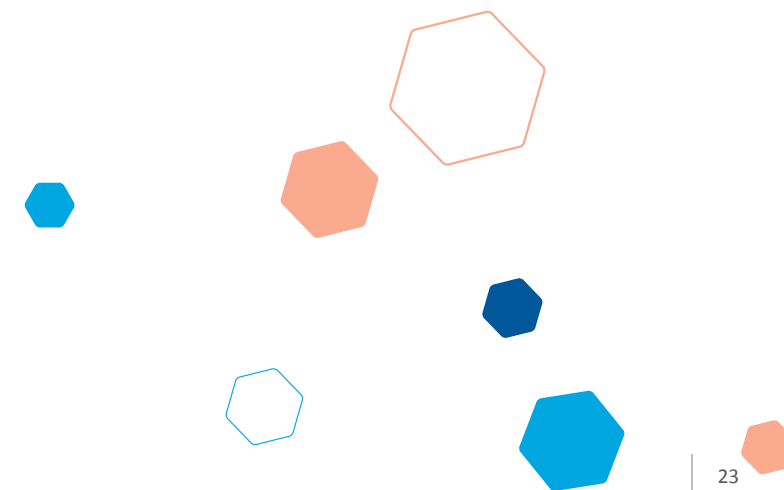
- Gas solubility studies
- Waterflooding, polymer and surfactant injection studies

SPECIAL RELATIVE PERMEABILITY STUDIES

- Precise laboratory measurements of multiphase flow systems
- Analysis of oil, water and gas interactions for optimal production
- Gas condensate blockage studies
- Innovative measurement methods providing reliable data (steady-state and unsteady-state relative permeability)
- Data suitable for reservoir optimization and efficient EOR planning

APPLICATION OF ADVANCED TECHNOLOGIES ENABLES

- Optimization of recovery and extension of the lifetime of mature oil and gas fields
- Reduction of carbon footprint supporting the energy transition
- Maximization of the use of existing infrastructure and expertise for reliable technical solutions and laboratory-based studies



GEOHERMAL PROJECTS

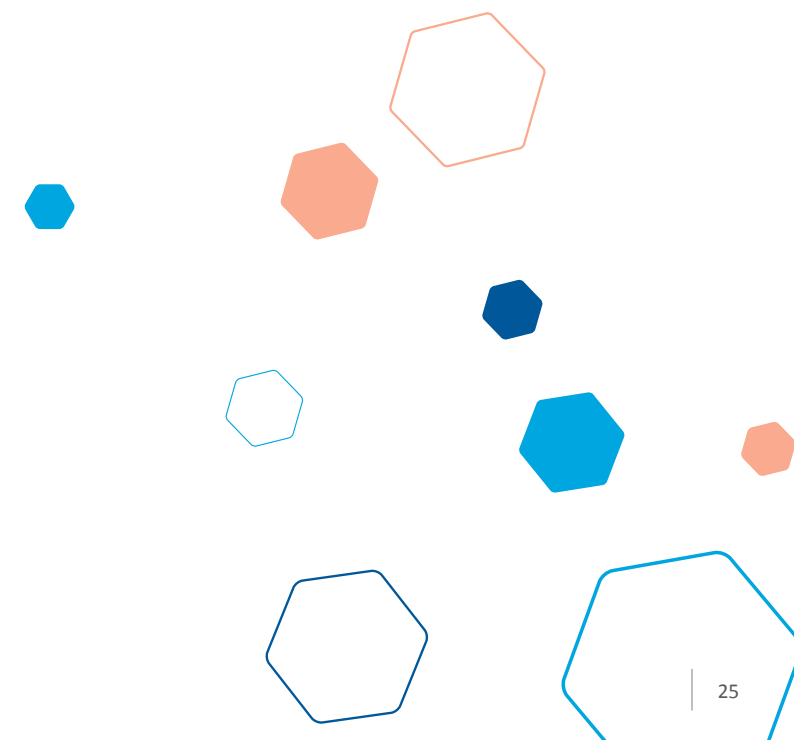
The E&P Laboratory places significant emphasis on geothermal projects, providing advanced laboratory services that support exploration, development and implementation in this increasingly important area of the energy transition.

Long-standing experience and expertise enable active participation in all project phases – from early exploration and resource assessment to the development of efficient and sustainable production solutions. Particular focus is placed on understanding the interactions between geothermal fluids and rock systems, as well as assessing potential operational challenges such as corrosion and mineral scaling.

Laboratory test results are used to optimize production conditions and ensure the long-term stability of geothermal systems, thereby contributing to the reliability, energy efficiency and sustainable development of the energy sector.

Special analyses tailored to geothermal projects:

- Complete physical and chemical characterization of geothermal waters
- Determination of phase behaviour of formation water under various pressure and temperature conditions
- Analysis of the amount and composition of gas dissolved in formation water
- Laboratory testing and evaluation of corrosion inhibitors
- Laboratory testing of scale inhibitors
- Geological, geochemical and petrophysical analyses of core material from wells and assessment of fluid–rock compatibility



REFERENCE



INA Industrija nafte, d.d.
 Exploration&Production Laboratory
 Lovinčićeva ulica 4
 10 000 Zagreb, Croatia
 e-mail: upstream.laboratory@ina.hr

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