ANALYTICAL LABORATORY

The Analytical Laboratory supports research and applied studies focused on characterization of complex materials associated with waste management, recycling, industrial production, and resource recovery. Activities cover waste-derived materials, secondary resources, primary raw materials, industrial residues, technological products, and environmental matrices such as soils, waters, and leachates. Particular attention is given to chemical characterization of electronic waste and related secondary materials. The laboratory supports process development, quality control, environmental assessment, and evaluation of treatment and recycling technologies.

METHODS AND SERVICES

- ICP-OES for multi-element analysis of digested solid and liquid samples
- ICP-MS for trace element analysis, including REEs
- XRF for rapid, non-destructive screening of solid and liquid materials
- DMA for direct determination of total mercury
- XRD for phase identification and structural characterization
- XPS for surface chemical characterization of materials, including elemental composition and chemical state analysis
- Raman spectroscopy for molecular and phase characterization
- Capillary electrophoresis for anion analysis
- Automatic titration systems for acid-base, redox, and related analyses

APPLICATIONS

- Characterization of waste, secondary resources, and primary raw materials
- Environmental analysis of soils, waters, and leachates
- Support for process development, optimization, and quality control
- Assessment of contamination and material properties

ENVIRONMENTAL CHARACTERIZATION AND WASTE CLASSIFICATION

This section supports research and applied studies focused on environmental characterization of waste, industrial residues, and secondary resources. It addresses contaminant release, mobility, and long-term behaviour under environmentally relevant conditions, providing data for waste classification, environmental assessment, and evaluation of material suitability for recycling, recovery, or reuse. Particular attention is given to potentially toxic elements, PFAS, inorganic salts, and other organic and inorganic contaminants. The work also includes chemical speciation of selected elements relevant to environmental behaviour and classification.

METHODS AND SERVICES

- Up-flow percolation tests
- Batch and pH-dependent leaching tests
- Solid–liquid partitioning tests
- Waste classification testing
- Chemical speciation studies of selected elements
- Applications
- Environmental characterization of waste and secondary resources
- Assessment of contaminant release and mobility
- Support for waste classification and hazardous property evaluation
- Evaluation of material suitability for recycling, recovery, and reuse
- Support for environmental assessment and regulatory practice

MINERAL PROCESSING LABORATORY

The ICPF Mineral Processing Laboratory supports research and teaching in mineral processing, process mineralogy, and recycling of secondary resources. It provides laboratory- and bench-scale facilities for characterization and processing of primary raw materials, industrial residues, and waste-derived materials. The laboratory is organized into three complementary sections: Mineral and Waste Processing, Process Mineralogy, and Particle Analysis. This structure links comminution and separation test work with mineralogical and particle characterization in both fundamental and applied research focused on resource recovery, recycling, and treatment of complex material streams.

MINERAL AND WASTE PROCESSING

The Mineral and Waste Processing section supports research and applied test work in comminution, classification, and physical separation of primary and secondary materials. It covers conventional mineral processing operations as well as selected technologies relevant to recycling and waste treatment, including mining waste, end-of-life batteries, and WEEE. Laboratory- and bench-scale equipment enables process development, method verification, and evaluation of separation performance for a wide range of material streams.

COMMINUTION

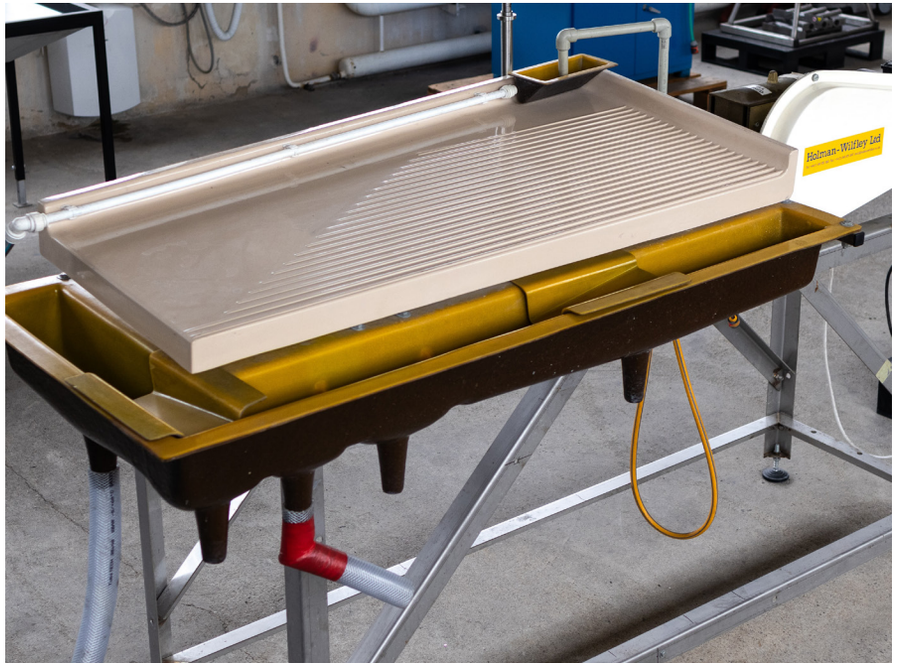
The ICPF laboratory provides a wide range of comminution test work. Available equipment includes:

- Jaw crusher
- Roller crusher
- Hammer mill
- Knife-type shredder
- Blade-type shredder
- Cutting mill
- Laboratory-scale ball and rod mills (various types)
- Vibrating mill
- Classification equipment including laboratory- and bench-scale screens and hydrocyclone

PHYSICAL SEPARATION

ICPF offers comprehensive test work in physical separation techniques employing:

- Magnetic separation (low- and high-intensity separators)
- Electrostatic separation
- Eddy current separation (conductivity-based)
- Spiral concentrators
- Shaking tables
- Jigs
- Knelson concentrators
- Dense Media Separation (LARCODEMS)
- Air Shaking Table
- Flotation
- Filtration and thickening test work



ADVANCED PROCESS MINERALOGY

The Process Mineralogy section provides mineralogical characterization for research and applied studies related to primary raw materials, waste-derived materials, and secondary resources. The facility supports investigation of mineral composition, texture, associations, and liberation characteristics, linking material properties with processing behaviour. These methods are used in studies of separation efficiency, metal recovery, and leaching behaviour.

METHODS AND SERVICES

- SEM–EDS
- XRD (with Rietveld refinement)
- Automated mineralogy and liberation analysis (QEMSCAN/TIMA)

ICPF provides automated mineralogical and liberation analysis using QEMSCAN/TIMA systems. These techniques enable high-resolution, quantitative characterization of mineral phases and their textural relationships.

APPLICATIONS

- Bulk modal mineralogy
- Liberation and mineral locking analysis
- Metal deportment studies
- Mass-balanced mineralogy of process streams
- Characterization of leach feed and residue materials

ADVANCED PARTICLE ANALYSIS

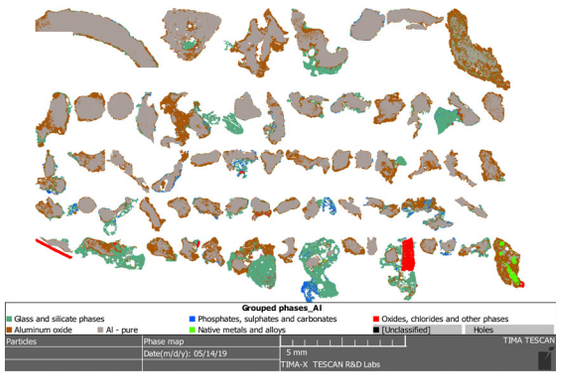
The Particle Analysis section is dedicated to characterization of particle properties relevant to mineral processing, recycling, and material evaluation. It supports research and applied studies by providing data on particle size, shape, density, and surface behaviour for process optimization, material performance evaluation, and quality control. Complementary analytical approaches enable evaluation of particle systems across a wide range of sizes and material types.

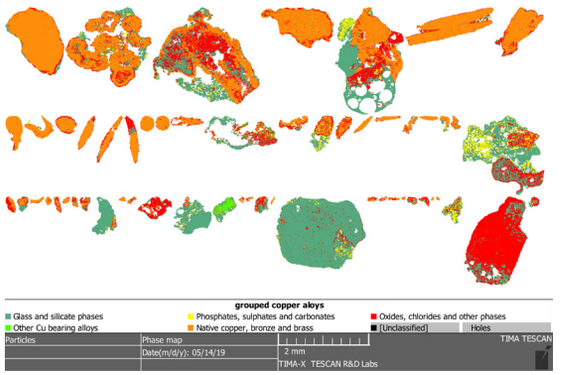
METHODS AND SERVICES

- Surface and interfacial measurements (contact angle, surface tension, particulate contact angle)
- Density measurement
- Particle size and shape analysis (laser diffraction, dynamic imaging particle size and shape analyzer, and sieve analysis)

APPLICATIONS

- Characterization of particle size, shape, density, and surface properties
- Support for process optimization and material performance evaluation
- Quality control of primary and secondary materials
- Evaluation of particle systems in mineral processing and recycling studies





HYDROMETALLURGICAL LABORATORY

The ICPF Hydrometallurgical Laboratory supports research and applied studies focused on metal extraction, solution purification, and metal recovery from complex materials associated with primary raw materials, waste management, recycling, and resource recovery. Activities cover primary raw materials, industrial residues, secondary resources, and waste-derived materials such as electronic waste, battery materials, and other metallurgical or mineral-bearing streams. Particular attention is given to hydrometallurgical treatment routes for selective recovery of valuable metals from complex matrices. The laboratory supports process development, optimization, and assessment of metal recovery technologies.

METHODS AND SERVICES

- Leaching techniques, including agitated atmospheric, column, pressure, and cyanidation leaching
- Thermal pre-treatment and amenability testing
- Solvent extraction and ion exchange
- Precipitation, crystallization, and electrowinning

APPLICATIONS

- Metal extraction from primary raw materials and secondary resources
- Recovery of valuable metals from electronic waste, battery materials, and industrial residues
- Development and optimization of hydrometallurgical processing routes
- Purification of process solutions and selective metal recovery