

ICSET

Institute for Combustion Science and Environmental Technology



Combustion and Emission Analysis Capabilities

The combustion and Emission Control Laboratory of ICSET was established in 2001. There have been more than 100 boiler units with various types of air pollutant control device configurations tested over the past years. ICSET is capable of conducting wet chemical method sampling at 6 locations simultaneously for: Hg, HCl / HF, SO₂, Trace Metals, Ammonia (NH₃), and PM_{2.5}/PM₁₀.

Mobile Emission Monitoring Laboratories

ICSET is also equipped with two mobile emission monitoring laboratories: (1) a 53-foot mobile Mercury Emission Monitoring Laboratory equipped with Leeman Hydro Auto-digestors and Analyzers, as well as four sets of continuous emission monitoring systems (CEMS). This facility enables the ICSET on-site testing crew to acquire data validation among various testing methodologies, drastically decreasing the data turnaround time; (2) a Multi Gas Emission Monitoring Laboratory, which is for use as an instrumental reference method for conducting relative accuracy (RA) testing as per 40 CFR Part 75. The laboratory is capable of continuously monitoring emissions of Hg, NOx, CO/CO₂, and SO₂.

0.6 MW Circulating Fluidized Bed Combustor (CFBC) with Multi-pollutants Control Facilities

The CFBC provides a pilot-scale test rig or an emission control test laboratory for evaluation of advanced efficient and clean coal conversion technologies. Projects to be conducted on this unit include: co-firing municipal solid waste with high sulfur coal for multi-pollutants control, Chemical looping combustion for H₂ production and CO₂ sequestration Oxygen-enhanced Combustion for CO₂ concentration, Slipstream Demonstration of Multi-pollutants Control, Advanced Coal Gasification Technology demonstration.



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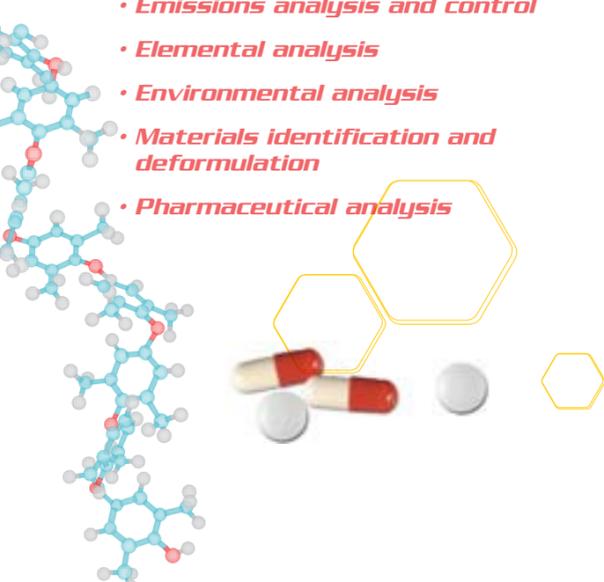




What Analytical Services are provided?

Institute for Combustion Science and Environmental Technology or ICSET offers a trained professional staff, state-of-the-art instrumentation, and use of the latest technology to provide you with quick and accurate data and solutions to meet your specific needs. ICSET services provided include:

- **Polymer analysis**
- **Coal and fuel analysis**
- **Emissions analysis and control**
- **Elemental analysis**
- **Environmental analysis**
- **Materials identification and deformation**
- **Pharmaceutical analysis**



Quality Assurance

ICSET participates in a wide range of quality assurance and quality control programs. The institute primarily uses test methods approved by ASTM and EPA, when such methods exist. However, the advanced instrumentation in ICSET extend the laboratories' capabilities beyond the methods currently approved by various standard agencies. All instrumentation is well maintained and calibrated regularly with standard reference materials to ensure accuracy of all data collected.

References

From 2002-2005, ICSET has provided services to more than 50 companies within Kentucky and more than 300 companies nationwide, including chemical industries, power generating facilities, universities, and national laboratories.



Thermal Analysis Capabilities

The Thermal Analysis Laboratory of ICSET at Western Kentucky University was established in 1987 and has evolved into one of the best, if not the best, equipped thermal analysis laboratories in the United States, which is capable of conducting:

High-Resolution/Modulated Thermogravimetric Analysis (TGA)

Material composition, thermal stability, sorption analysis and related phenomena

Micro-Thermal Analysis (μ -TA)

Surface visualization, surface characterization, spatial distribution of phases, thermal properties of small samples/small areas

Modulated and Pressurized Differential Scanning Calorimetry (MDSC and PDSC)

Simultaneous measurement of heat flows and temperature associated with transitions

Evolved Gas Analysis Systems (TGA-FTIR, TGA-MS)

Identification of gases evolved during weight loss via FTIR or mass spectrometers

Dynamic Mechanical Analysis (DMA)

Viscoelastic and rheological properties of material under an applied oscillating force

Thermomechanical Analysis (TMA)

Dimensional changes

Dielectric Analysis (DETA)

Capacitive and conductive nature of materials under a cyclic voltage

Rheology

Deformation and flow of materials under force

Thermal analysis and rheological techniques are particularly useful for determining (ASTM standards),

- Composition of multi-component systems (E-1131)
- Thermal and oxidative stability of materials (E-1858)
- Transition temperatures (D-3418)
- Estimated lifetime of products
- Decomposition kinetics of materials (E-1641)
- Moisture and volatile contents of materials
- Permittivity and loss factor
- Glass transition temperature (E-1356, E-1640, E-1824)
- Degree and rate of cure
- Coefficient of thermal expansion (E-831)
- Specific heat, heat capacity (E-1269), thermal conductivity (E-1952), vapor pressure (E-1782)
- Modulus, viscosity, and polymer morphology

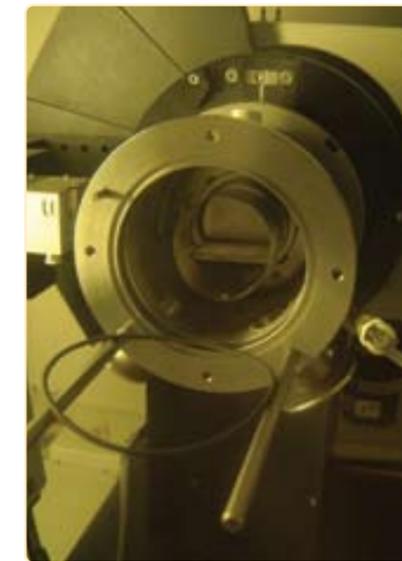
Thermal analysis and rheological techniques can be applied:

For Research and Development

- Formulation optimization
- Materials selection
- Application development
- End-use performance prediction
- Competitive product evaluation
- Theoretical research on new materials and processes

For Quality Assurance and Quality Control,

- Vendor certification
- Incoming/outgoing material consistency
- Process optimization
- Finished product performance



Surface Characterization Capabilities

ICSET is equipped with the following instruments for characterizing material surfaces:

X-Ray Diffractometer (XRD)

Identity of phases in a sample, qualitative and quantitative phase analysis, standardless quantitative analysis

Atomic Force Microscopy (AFM)

Surface imaging in studies of phenomena such as abrasion, adhesion, cleaning, corrosion, etching, friction, lubrication, plating, and polishing. AFM allows for the imaging of a surface at atomic resolution and measurement of the force at nano-newton scale.

Scanning Electron Microscopy (SEM)

High resolution, high magnification photographs. Elemental analysis with energy dispersive X-ray analyzer (EDX).

Surface Area and Pore Volume Analysis

Applying gas physisorption (BET) and chemisorption static volumetric technique to determine the surface area, percent metal dispersion, active metal surface area, size of active particles, and surface acidity of catalyst materials.



Chemical Analysis Capabilities

The ICSET always adopts the latest technology for a variety of chemical analysis.

Gas Chromatography / Mass Spectrometry (GC/MS)

Volatile organic compounds. The added ThermEx system allows us to analyze evolved gases from solid samples

Liquid Chromatography Mass Spectrometry (LC/MS)

Organic compounds in liquids

Total Organic Carbon Analyzer (TOC)

Organic carbon in liquid samples

Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES)

Major and trace elements in solutions

Cold Vapor Atomic Adsorption Spectroscopy (CVAAS)

Mercury (Hg)

Cold Vapor Atomic Fluorescence Spectroscopy (CVAFS)

Arsenic (As^{3+} and As^{5+}), Selenium (Se^{4+} and Se^{6+}), and low level Mercury (Hg)

Direct Combustion Mercury Analyzer

Determination of mercury in solid samples

Ion Chromatography (IC)

Separation and determination of anions; e.g., fluoride, chloride, nitrite, nitrate, bromide, phosphate and sulfate, as well as cations, e.g., lithium, sodium, ammonium, calcium and magnesium

Gel Permeation Chromatography (GPC)

Characterization of polymers

Carbon, Hydrogen and Nitrogen Analyzer (CHN)

Carbon, hydrogen and nitrogen in solid samples

Thermogravimetric Analyzer

Moisture, ash, volatile matter and loss on ignition via weight loss

Mixing and Reaction Calorimeter

Measuring the heat of mixtures and reactions useful for chemical, specialty chemical, petrochemical, pharmaceutical, food processing, and cement industries, among others.

Adsorption spectroscopy

Characterizing the absorption, transmission, and reflectivity of materials such as pigments, coatings, windows, and filters

Chemical analysis techniques can be applied for:

- Coal and fuel analysis
- Pharmaceutical analysis
- PAHs, PCBs in solids and sludges
- Natural, drinking, and waste water analysis
- Competitive product evaluation
- Theoretical research on new materials and processes