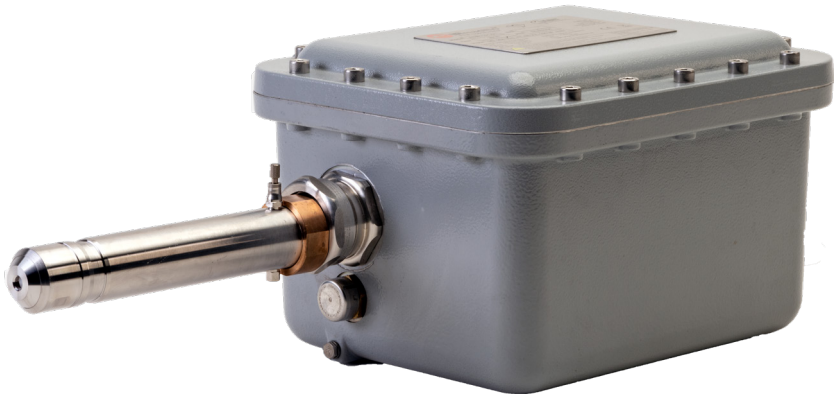
# IRmadillo™



# **IRmadillo** on-line industrial **Process Analyser**

## Real-time process monitoring of liquids | slurries | emulsions

KEIT
INDUSTRIAL ANALYTICS

TES Thomson Environmental Systems

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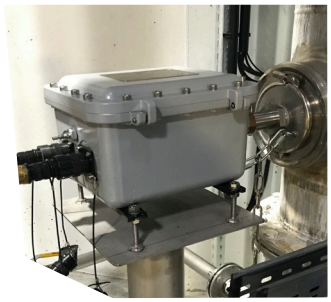
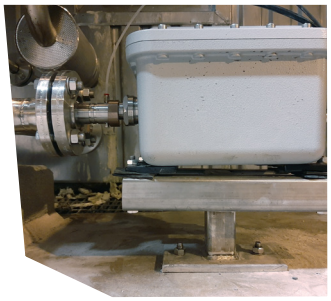
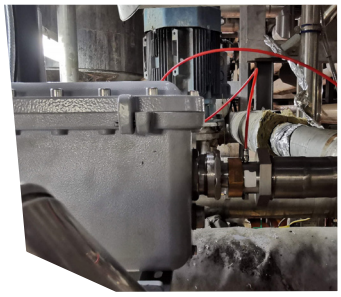





## Real-time, on-line FTIR process analyser

Getting timely and reliable information on your process chemistry is vital. The IRmadillo process analyser installs directly into your pipeline or vessel to provide real-time, continuous information about your chemical concentrations in liquid processes.

## Optimise your process - increase your savings

Imagine the possibilities of knowing the purity and concentrations of your feedstocks, products, and intermediates (and contaminants!) in your process stream, without having to wait for off-line analysis. Imagine increased safety & less worry when monitoring and analysing hazardous materials on-line. The IRmadillo eliminates barriers to faster and better monitoring - leading to better control, safety and cost savings.

## Rugged, dependable, stable - fit & forget

- Vibration-tolerant design enables on-line installation
- Compact, reliable & stable over long periods
- Maintenance Support Programme (MSP) with remote health checks

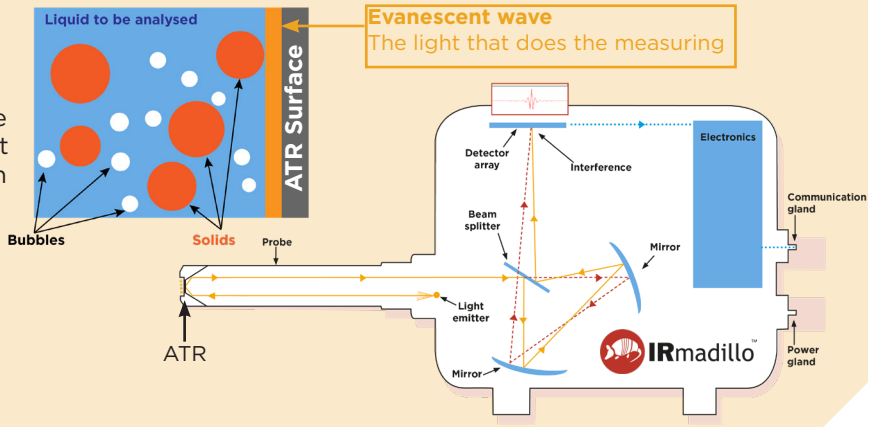
## The IRmadillo is NOT your standard FTIR

The IRmadillo doesn't belong in the laboratory. It belongs right in your process line. Traditional process FTIR instruments struggle with fragility and unreliability, with moving mirrors and delicate fibre probes. As the IRmadillo has no moving parts and avoids the use of fragile fibre probes, it is the first truly industry-ready, FTIR spectrometer.

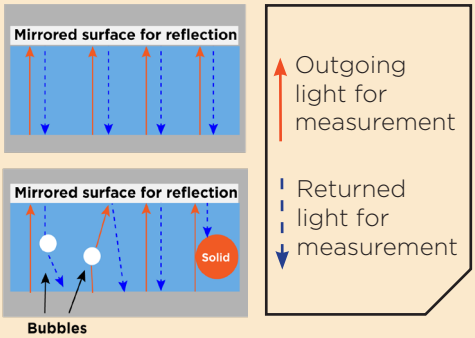
## IRmadillo's ATR probe

The IRmadillo is a static-optics FTIR analyser and is able to accurately measure liquids, slurries & emulsions even with particulates in the monitoring stream. An 'evanescent wave' of light on the surface of the ATR interacts strongly with the liquid under analysis but not the bubbles and/or solids.

The ATR method of sampling has a significantly shorter path length than transmission probes. This means ATR instruments can measure aqueous processes well, and it is no longer the case that 'FTIR doesn't work in water'.




## How does the IRmadillo compare to Near Infrared (NIR)?




**NIR reflectance probe:** In pure liquids, light is sent out through the sample and reflected off the mirrored surface back into the probe for measurement. The long path length allows for lots of signal – critical to NIR performance. Solids or bubbles will interfere with the light path causing issues with measurement.

Although NIR can be suited for simple measurements, it is less information-rich compared to FTIR (mid infrared), and sometimes will not give the level of information required to monitor an application accurately. NIR looks at overtones and combination vibrations of molecules, which means it can struggle to differentiate between very similar molecules. The key is to know which technique is right for you. **Contact Keit to find out more.**

***"...we have found the IRmadillo to be stable, robust, precise and well suited for industrial on-line applications".***

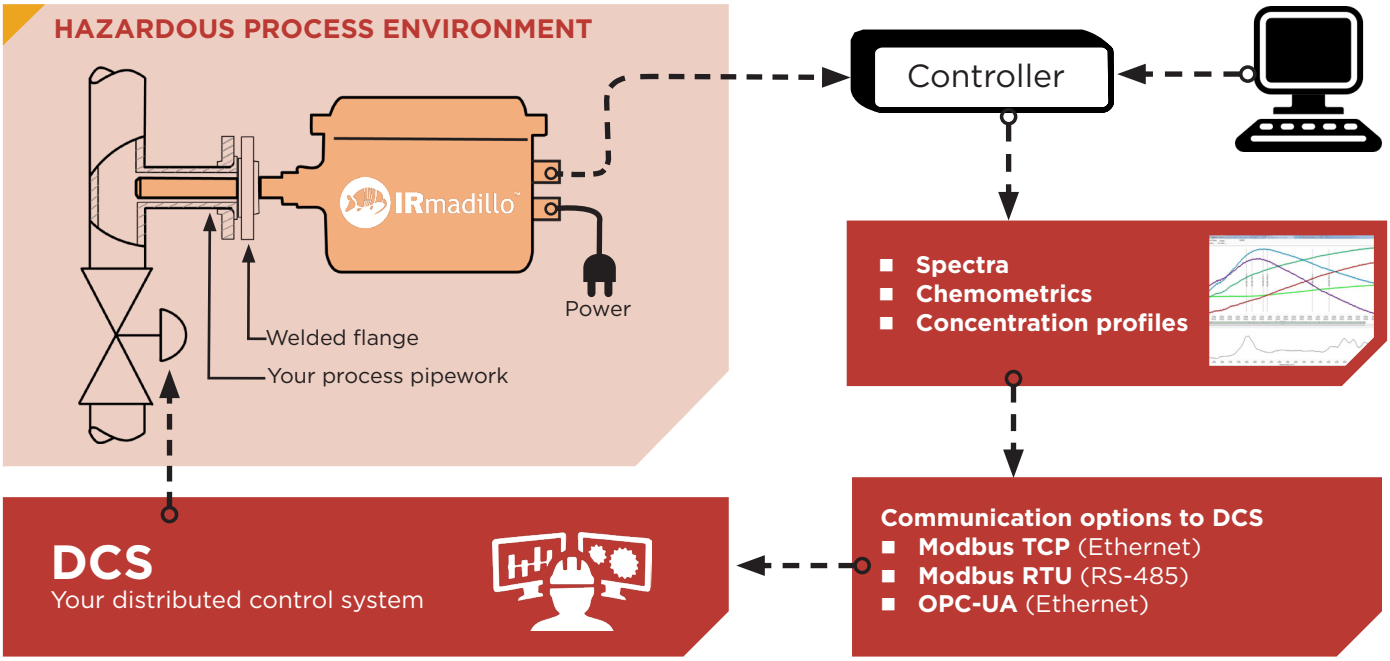
Senior Development Engineer
Leading Global Forest Products Company

KEIT spectrometers

| Industry | Applications | Chemicals & Properties of interest |
|---|---|---|
| **Pulp & Paper** | Kraft liquor monitoring (i.e. organic and inorganic compounds in the black liquor, white water and green liquor streams)<br>Tall oil yield measurement<br>Recausticising process monitoring<br>Optimisation of recovery boiler efficiency | Properties: active & effective alkali, sulphidity, causticity, reduction<br>Chemicals: sodium carbonate, sodium sulphide, sodium sulphate, sodium sulphite, sodium hydroxide, metal hydroxides, ammonia, sulphuric acid, paper additives |
| **Fats & Oils** | Analysis of crude oil for chemical dosing control<br>Analysis of final and intermediate oil quality<br>Measuring heavy phase compositions to optimise high speed separators<br>Adulteration & contamination monitoring | Properties: iodine value and degree of unsaturation, melting point<br>Chemicals: Free fatty acids (FFAs), fatty acid methyl esters (FAMEs), water, phospholipids, phosphates, phosphatides, phosphoric acid, amines, chelated and bound metals, triglyceride makeup |
| **Bioethanol & Renewable Fuels** | Optimising fermentation processes in ethanol production<br>Monitoring purity and optimisation of feedstock in renewable diesel pre-treatment & hydrogenation processes | Ethanol: DP4+, DP3, DP2, dextrose/glucose, lactic acid, glycerol, acetic acid, ethanol<br>Biodiesel: free fatty acids (FFAs), fatty acid methyl esters (FAMEs), methanol, sodium or potassium methoxide<br>Renewable diesel: free fatty acids (FFAs), phosphates, phospholipids, phosphites, chelated and bound metals |
| **Industrial Biotechnology** | Fermentation monitoring<br>Feedstock monitoring<br>Hydrolysis monitoring<br>Starch processing monitoring | Sugars, alcohols, ethers, organic acids (i.e. lactic, formic, pyruvic and acetic), inorganic acids and salts (i.e. sulphate, nitrate, phosphate), protein, biopolymers, oligomers, nutrients |
| **Alumina (Metals, Mining & Minerals)** | Measuring product and intermediate purity in the Bayer (alumina refining) process<br>Optimising recausticising process – monitoring & control of caustic soda dosing<br>Monitoring flocculant concentration in thickeners to minimise waste | Dissolved alumina, sodium hydroxide, sodium carbonate, organic acid salts, silicates, flocculants other dissolved metals |
| **Starch Processing** | Sugar profiles: Makeup of sugars in syrup products & total fermentable sugars in fermentation feed<br>Protein levels: Protein leaching for gluten free flour, potein levels in liquefaction & gluten measurement in starch/protein separation process<br>Soluble starch: Soluble starch levels and dextrose equivalent in liquefaction | Organic molecules (sugars, alcohols and acids)<br>Inorganic molecular salts (sulphates and nitrates)<br>Ions ($Na^+$ and $OH^-$ ions) |
| **Chemicals (bulk, specialty, petrochemicals)** | Monitoring purification, distillation, crystallisation, absorption and separation processes<br>Monitoring transition metal catalysed coupling reactions (i.e. Cativa and Monsanto reactions)<br>Monitoring addition, elimination and substitution chemical reactions, protection and deprotection steps, chemical rearrangements & hydrogenation and other catalysed reactions | |
| **Oil & Gas** | Upstream (glycol dehydration of natural gas, water levels in crude oil, sulphur levels and sweetness of crude oil, hydrocarbons in produced water)<br>Mid-stream (Total acid number – TAN – determination, glycol dehydration of natural gas, vapour pressure and other physical property monitoring)<br>Downstream (PIONA analysis, RON/MON and other octane measurements, aromatics monitoring, alcohol and ether additives in gasoline blending) | |
| **Pharmaceutical & Biopharmaceutical** | Optimisation of cell-culture feedstock monitoring<br>Small molecule reaction monitoring<br>Monitoring purification, distillation & separation processes | Active pharmaceutical ingredients (APIs), reagents, reaction intermediates.<br>Bioprocesses: sugars, alcohols, ethers, organic acids, inorganic acids, salts, protein, biopolymers, oligomers, nutrients |

***"We have been searching a long time for a rugged industrial infrared ATR spectrometer...The instrument is working like clockwork, demonstrating remarkable stability and precision on our application".***

Principal Scientist
Global Chemical Company




## You can't control what you can't measure

Understanding how your process operates in real time is vital to improving production efficiency and achieving best-in-class performance. Manufacturing industries strive for process improvement to gain commercial advantages, but struggle to find methods to measure, monitor and control their production quickly and accurately. Keit offers you better on-line monitoring technology with real-time capabilities enabling better monitoring & control for cost savings in your plant or mill.

## IRmadillo Working Environments

| Material & Process Environment | IRmadillo & IRmadilloEx* |
|---|---|
| ATR material | Diamond |
| pH range | 0-14 |
| Temp (analyte) | -20°C to +220°C |
| Hazardous environment certifications* | ATEX*<br>IECEx*<br>UKEx* |
| Clean-in-place (CIP) & Sterilise-in-place (SIP) compatibility | Yes |

## How good are the measurements?

The IRmadillo can be calibrated to read concentrations of various chemicals in the process stream with a typical detection limit of 100 ppm for a range of organic and inorganic chemicals. In some situations, it can be possible to achieve a detection of < 1 ppm!

The IRmadillo can also provide qualitative classifications (for example "in spec", "out of spec") or both quantitative and qualitative measurements at the same time. This output can be sent directly to any existing DCS, PLC or SCADA system using Modbus or OPC-UA communication protocols. This means that once installed, the IRmadillo will tell you exactly what's going on in your process in real time, 24 hrs a day, 365 days a year.

## Contact us

Get in touch with us to find out more.

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IRmadillo™

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