

## TRACER FLOW TESTING (TFT<sup>®</sup>)

### The Need for On-line Two-phase flow Measurement

Geothermal well flow testing is conducted by field operators to assess the energy potential of a well and gain valuable information to assist in reservoir modeling and designing power stations. Once wells are on-line and producing to a plant, it is important to continue flow testing to monitor changes in output and enthalpy, which may occur due to processes such as injection breakthrough, scaling, local boiling and steam cap formation.

Traditionally geothermal well flow testing has been carried out using a production test separator or an atmospheric separator and James-Tube. The separators required are very costly and the James-Tube method is only an empirical correlation with limited accuracy. Wells producing to a plant with shared separators must be taken off-line for testing, disrupting operations and causing lost generation revenue.

### MicroMod Tracer Flow Testing System

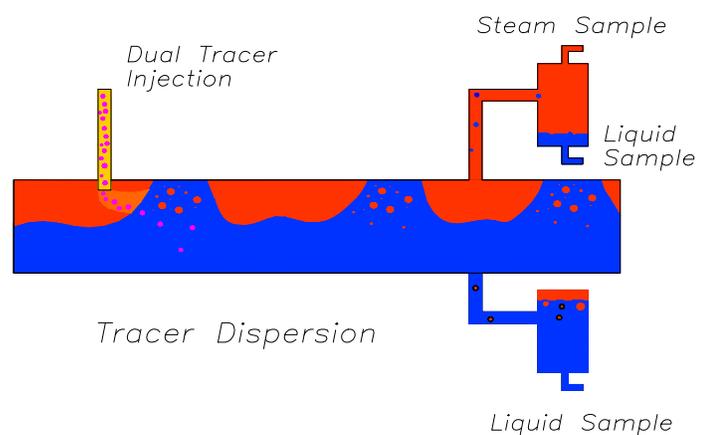
Alternatively, well flow testing is carried out using Tracer Flow Testing (TFT<sup>®</sup>) with fluids discharged into a low-cost atmospheric muffler or while on-line to a power plant. Several options for discharging wells are possible using a TFT<sup>®</sup> system; through a Blooie-line and drilling muffler, to an atmospheric muffler or rock pit, or to a power plant. Thermochem also provides low-cost atmospheric mufflers for well testing purposes.

The TFT<sup>®</sup> concept was originally developed by Thermochem over 25 years ago and is the only TFT<sup>®</sup> process used routinely in the USA, Indonesia, The Philippines, Central America, Hawaii, Iceland, New Zealand and Africa. This is the system chosen by all the major geothermal operators in the world, including Chevron, Ormat, Energy Development Corporation (EDC-PNOC), Mighty River Power Contact Energy and Reykjavik Energy.

#### Operating Conditions:

The Thermochem MicroMod TFT system is accurate over a wide range of conditions:

- Steam fraction: 1 to 99+ %
- Can measure < 1% water fraction
- Pressure: 0 to 5000 psig
- Flowrate: 0.5 to over 5000 KPH



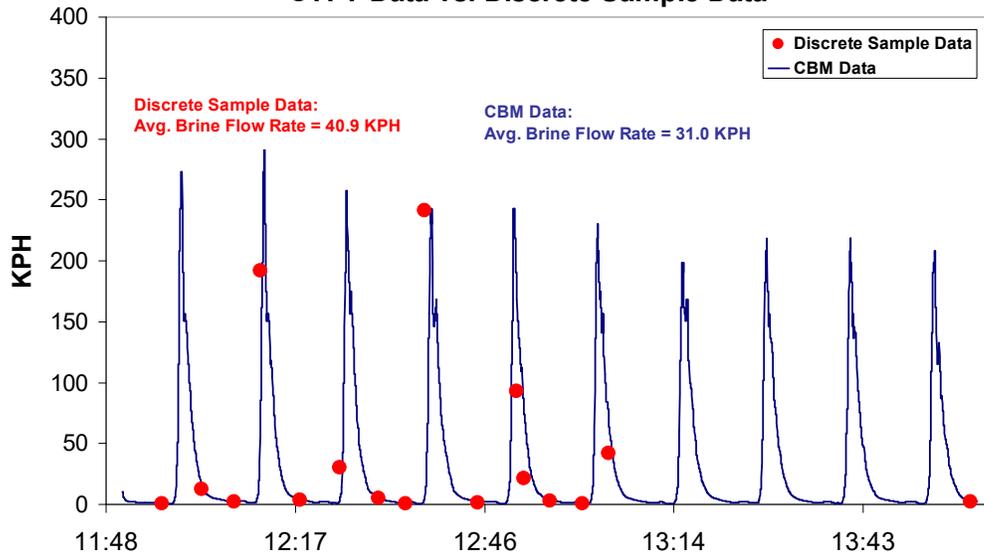
Thermochem's MicroMod TFT® system enables simple, cost-effective, direct measurement of single and two-phase mass flow, enthalpy and steam quality. The system is small, portable, and battery powered- for use in remote and rugged locations throughout a wellfield or power plant.

**Key features and benefits of the system include:**

- Low injection rates of non-hazardous tracers
- Extremely large turn-down: > 4 magnitudes
- Fundamental, traceable measurements
- True weighted average under surging flow
- No corrections for tracer partitioning
- Dedicated portable analyzers
- Provides real-time liquid mass flow-rate data
- On-site field analysis options available
- Automated on-line systems (CTFT®)



**CTFT Data vs. Discrete Sample Data**



## ABOUT THERMOCHEM

Thermochem is an integrated consultancy, service, and OEM instrument firm empowering energy industries since 1985. Our mission is to protect the assets and resources of our clients, ensuring the most efficient use of equipment and resources, through preventing corrosion and scale damage to valuable equipment and providing early detection and solutions to resource problems. We service clients in more than 30 countries, providing chemical engineering solutions and equipment for geothermal energy, oil and gas, combined cycle, cogeneration, fossil fuel and nuclear power plant projects from our offices and laboratories based in the USA and Indonesia.

We provide solutions to our clients from the ground up: exploration through operations. Our extensive range of products and services includes greenfield exploration, well testing, geochemical modeling, chemical process engineering, analytical chemistry, reservoir engineering, permit support, due diligence and specialized instrumentation such as two-phase wellbore samplers, pH-modification equipment and on-line steam quality and purity meters.