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Use of Separator Mass Balance to Ascertain Tracer Flow Measurements, A Case Study for KenGen-Olkaria Production Wells

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INTRODUCTION

- Monitoring enthalpy of fluids in two-phase geothermal fields is crucial for reservoir performance.
- Decreasing enthalpy may indicate water breakthrough or cooler groundwater invasion; increasing enthalpy suggests reservoir boiling and steam cap formation.
- Enthalpy and mass flow rate determine steam availability from wells and overall energy output.
- Individual geothermal wells with dedicated separators allow direct measurement of mass flow rates and total enthalpy.
- Most systems use satellite separation stations, where multiple wells feed into one separator.
- In many cases, two-phase fluids are combined and separated at the power plant, preventing individual well measurements.
- We've implemented a mass balance method to assess production from each well and verify output after separation, indicating potential losses

TRACER FLOW TESTING METHODOLOGY

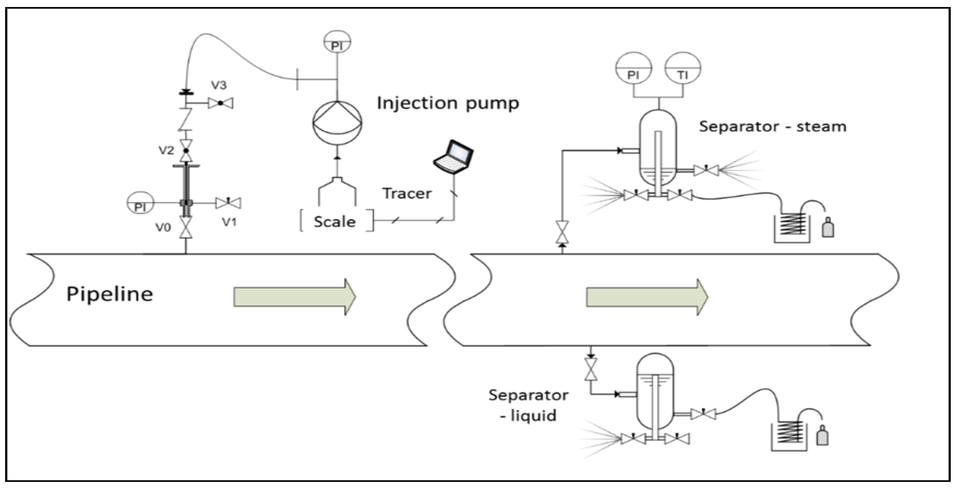


Figure 1: **The figure above is a schematic drawing showing injection equipment, tracer injection point, steam pipe, sampling point and equipment**

RESULTS

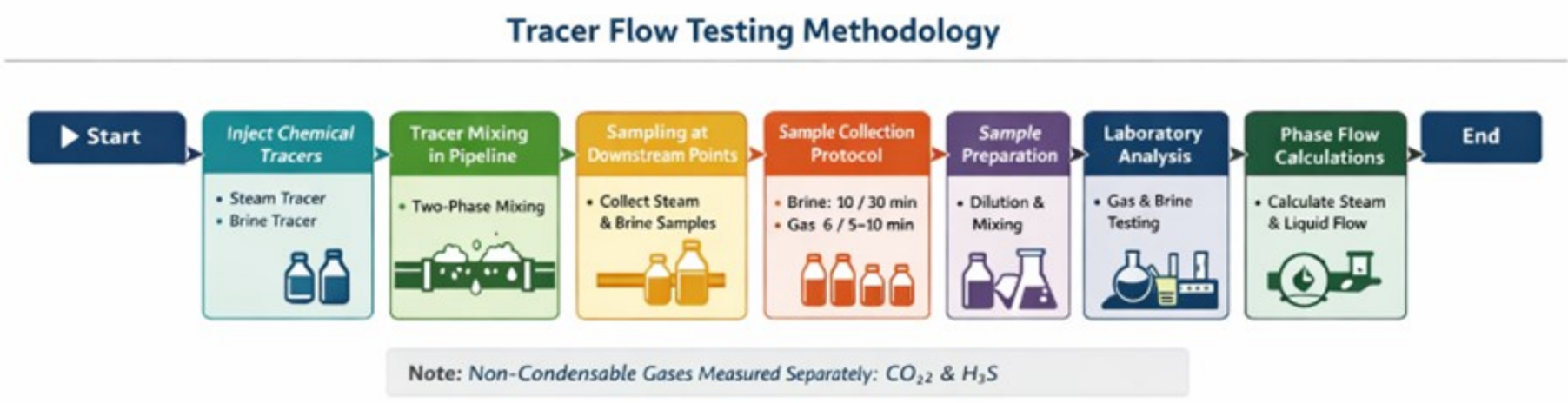


Table1: Results for flow measurements for Olkaria well 725 and 705 sharing a separator station and their respective flow results tested during the same period

Well No.	WHP (bars)	Enthalpy (KJ/Kg)	Steam flow (T/Hr)	Brine flow (T/Hr)	Total Mass flow
OW 725	6.2	1596.5	79.7	100.8	180.5
OW 705	7	1863	28.7	22	50.9
Separator Station		1264	108.4	122.3	**230.7** **(231.4)**

DISCUSSION

Advantages of TFT (Non-invasive online testing):

- No interruption to power station operations.
- Avoids generation losses from shutting wells.
- Maintains stable production conditions.
- No need for permanent wellhead test equipment (only sampling ports).
- Prevents atmospheric wastewater discharge.
- Provides flexible testing schedules.

Strategic application:

- Most effective when integrated during steam field design, not retrofitted.
- Increasingly replaces dedicated wellhead test equipment in new geothermal projects.
- Additional applications:
- Power plant steam audits
- Combined flow measurements from multiple wells

CONCLUSION AND RECOMMENDATIONS

- Tracer Flow Testing (TFT) is a reliable and accurate method for measuring two-phase mass flow rates in pipelines.
- Accuracy depends on **proper tracer selection** and **precise mass injection techniques**.

Recommended tracers:
- Vapour phase: Sulfur hexafluoride
- Liquid phase: Sodium benzoate
- Alcohol tracers such as Isopropanol are not suitable due to solubility in the liquid phase and possible chemical reactions in brine fluids.
- Field tests at Olkaria Geothermal Field show low variance and comparable results to previous flow measurement methods.

KenGen has adopted TFT because it:
- Provides **accurate mass flow measurements**.
- Helps evaluate **separator efficiency**.
- Allows testing **without interrupting electricity generation**.

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