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ADVANCED ON-LINE STEAM PURITY ANALYZER

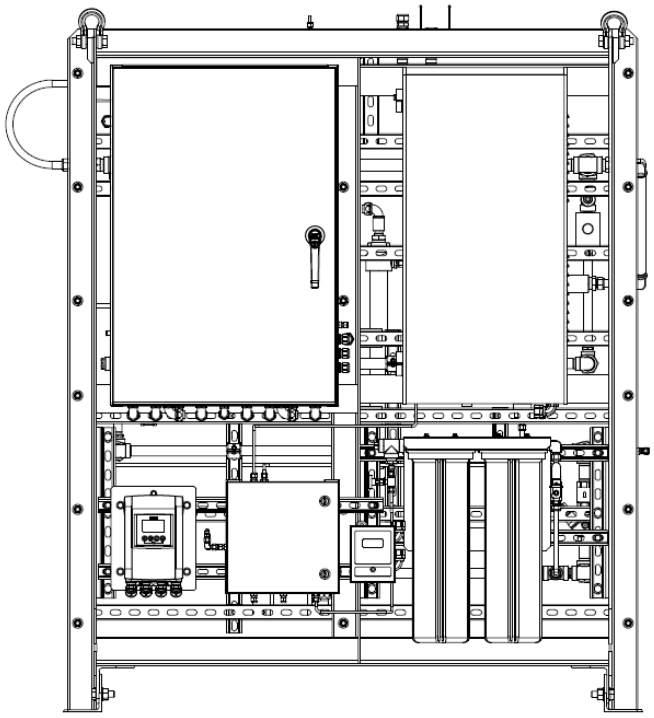
Overview

Geothermal steam contains impurities, such as silica, sodium, chloride, iron and solid particles, which can cause corrosion, scaling and erosion of power plant equipment, especially steam turbines. These Impurities may be present as dissolved species in liquid water droplets entrained in the steam, or as solid particulate material. Volatile silica and chloride may exist in high-temperature saturated or in superheated steam. In order to determine the amount of these impurities in steam, isokinetic sampling is required followed by specialized analytical techniques for low-level detection in the presence of various interfering species in the steam condensate sample, such as H_2S, CO_2 and NH_3.Typically, detection limits down to at least 100 to 50 ppb in steam for sodium, silica, chloride and iron are required to meet steam turbine purity limits, although measurement to lower levels (10 to 20 ppb) is often required to minimize turbine scaling, erosion and corrosion. Detection to these levels can be very difficult, especially in the presence of interfering species.

An advanced on-line steam purity analyzer has been developed by Thermochem that measures sodium, silica, chloride, iron, turbidity (TSS) and/or noncondensable gas (NCG) in saturated or superheated steam. The heart of this analyzer is the Steam Sample Concentrator / Conditioner (SSCC) which concentrates and pretreats the steam sample for ultra low-level detection of common impurities in geothermal steam and allows accurate NCG measurement. The SSCC interfaced with a commercial power plant on-line sodium, silica or chloride analyzer will precisely measure the impurity content of a sample extracted from steam lines after production separators in a wellfield and before / after purifiers and scrubbers at a power plant.

Process Description

The steam sample is collected using a fixed Thermochem multi-nozzle isokinetic sample probe (MNP2000). The sample stream is directed under pressure to a sample conditioner through stainless steel tubing, within about 10 m from the sample point. The steam sample flow is regulated by a critical flow device to maintain isokinetic conditions. A desuperheat pump recirculates condensate to ensure the sample remains saturated and does not deposit any impurities upstream of the analyzers. The sample stream is concentrated and degassed in a proprietary process and cooled. The separated NCG is measured by a mass flow meter to determine the NCG concentration in steam. The concentrated and degassed liquid sample is then pumped to an on-line analyzer for sodium, silica, chloride, iron and/or turbidity measurement.



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Fundamental Advantages

This new Steam Purity Analysis system has unique fundamental advantages over prior attempts at on-line monitoring for geothermal steam purity:

- Sample preconcentration by an order of magnitude (10 to 20 times) above raw levels in steam
- Chemical pre-treatment to remove interfering species (> 99.9% removal of H_2S and CO_2)
- High-efficiency degassing allows accurate NCG measurement
- Isokinetic sample flowrate control
- No air or nitrogen purging required for interference removal
- No ion-exchange cartridges used for preconcentration

Sample pre-concentration provides a huge advantage for trace-level impurity analysis. Contamination is a constant problem under these conditions, for both grab samples with laboratory analysis or for on-line analysis. Ultra-pure sampling apparatus, containers, deionized water and reagents are required. False positive results for impurities and bias towards erroneous elevated values are common when performing these measurements. By increasing the sample concentration an order of magnitude directly in the sample collection process, these problems are virtually eliminated.

An on-line analyser designed by Fuji Electric was installed at the Nga Awa Purua (NAP) geothermal power plant in New Zealand in 2010 (Taguchi, Makimoto and Ishii 2010). This analyser relied on N_2 purging and membrane separation for removal of interfering species. The process was inadequate for interference removal prior to silica analysis and was disconnected from the plant by the owner (Mighty River Power) not long after commissioning due to this and other functional problems.

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Commissioning New Steam Purity Analyzers at Silangkitang and Namora-I-Langit geothermal Power Plants (330 MW) in Sumatra, Indonesia

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ABOUT THERMOCHEM

Thermochem is a vertically 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.