

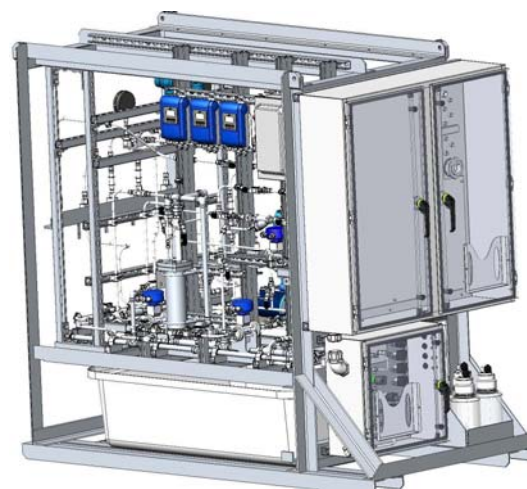
CHEMICAL PROCESS TREATMENT EQUIPMENT

Chemical Treatment for Corrosion and Scaling Problems

Scaling and corrosion is a common and costly problem for geothermal operations. Scale can accumulate in wellbores, gathering systems, in the plant and reinjection pipelines, derating generation and causing regular plant shut-downs. Corrosive fluids damage equipment and present significant safety issues, from well blow-outs, burst pipelines to turbine failures. With the correct process design and chemical treatment, corrosion and scale problems can be effectively mitigated. Often this can be done with inexpensive commodity chemicals rather than high-priced proprietary inhibitors.

Silica Scale Control

Silica scaling affects nearly all geothermal projects, especially high-enthalpy resources. In order to maximize energy extraction from the fluid, the brine reinjection temperature must be reduced to below the silica saturation limit. Silica scaling can be mitigated kinetically by optimizing the reinjection temperature and pH-modification. In a properly-designed process, the brine should actually be sub-cooled to the maximum extent possible given heat rejection limitations. The low brine pH *and* low temperature kinetically controls silica deposition. Thermochem has the expertise and experience to optimize your power plant process and deliver pH-modification and control systems to inhibit silica scaling.



Corrosion Control

Corrosion is caused by acidic brine, condensate and steam, resulting in damage to well casings, gathering systems, turbines and injection systems. Acidic brine and steam may require treatment downhole. Superheated, corrosive, steam is typically treated on the surface, and acidic oxygenated condensate is treated at the injection pipeline or wellhead. Thermochem can identify potential corrosion issues before they cause damage and shut-downs. We design effective downhole and the surface mitigation methods, using commodity chemicals rather than expensive inhibitors where possible.

Downhole Treatment for Scale and Corrosion

Thermochem can access the nature of wellbore scaling and corrosion problems using our exclusive two-phase downhole sampler, identifying the fluid phase regime, temperature, brine and gas chemistry, versus depth. Solutions may include plugging corrosive entries, installing liners, or downhole chemical injection. Thermochem can simulate the required treatment process and design the downhole tubing string assembly, surface chemical metering skid and monitoring system to effectively mitigate difficult downhole scaling and corrosion problems.

Automated pH-modification Systems

Thermochem designs and installs pH-modification and control systems for well fields and power plants. Thermochem is the world leader in the application of the pH-mod process, and has designed the pH-mod systems for Coso, Blundell and Puna, USA; and Kawarau, New Zealand.

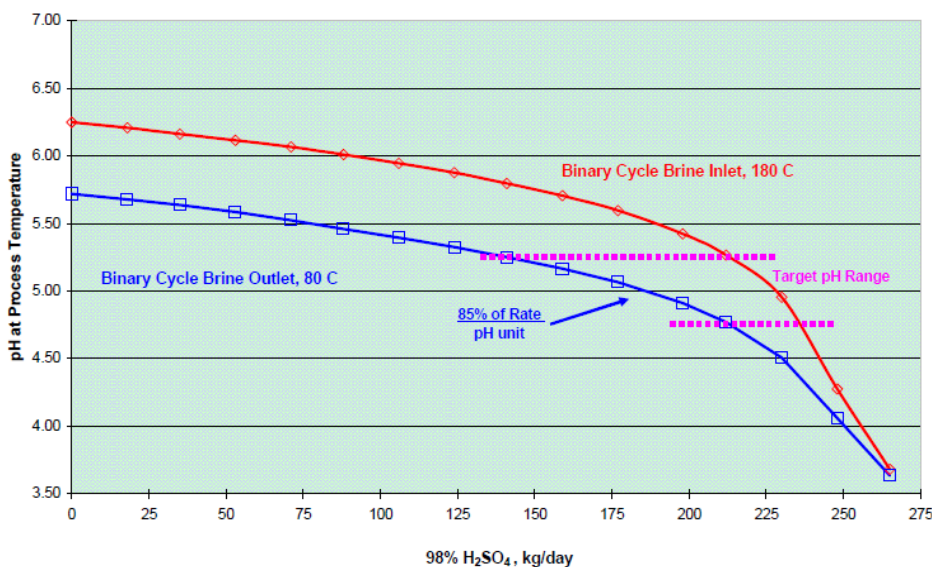
The pH-mod and monitoring systems are usually assembled on a skid at Thermochem's USA headquarters and fully tested before shipment and commissioning.



Characteristic pH Modification Curve for Pumped-well Binary-Cycle

pH-modification system features:

- On-line pre-dilution of acid
- Teflon-lined hardware
- High-alloy mixing spools
- Redundant pumps and meters
- Pulse-less pumping units
- Integrated with control systems
- Fully automatic pH analyzer
- Self-cleaning and self-calibrating
- Rapid response, precise control
- Acid flows from 0.1 to > 800 GPH



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 and fossil fuel power plants 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.