Sandia National Laboratories

Energy, Climate, & Infrastructure Security

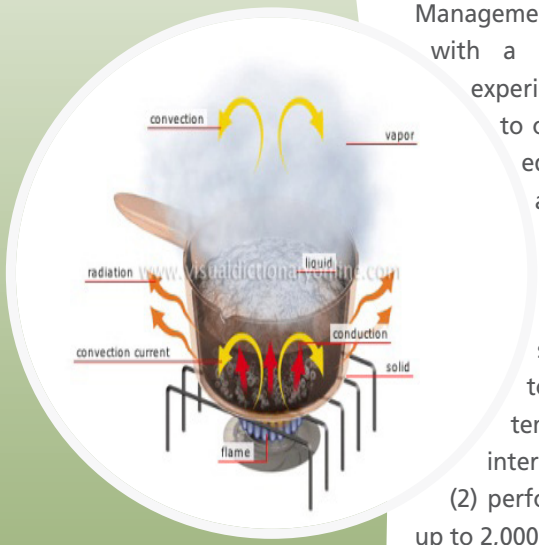
High Temperature Aqueous Chemistry

SAND2013-7330P

Sandia National Laboratories' Defense Waste Management Programs is equipped with a state-of-the-art hydrothermal experimental system.

Description

Accurate knowledge of aqueous chemistry at high temperatures and pressures is important in many applications including nuclear waste disposal and energy extraction. Sandia's Defense Waste Management Programs is equipped with a state-of-the-art hydrothermal experimental system that allows us to obtain high quality kinetic and equilibrium data at temperatures and pressures of interest up to 600°C and 1,000 bars (100 MPa). This state-of-the-art hydrothermal experimental system includes the ability to (1) sample solutions at temperatures and pressures of interest (i.e., in-situ sampling), and (2) perform experiments with volumes up to 2,000 mL.



Heat Transfer Mechanisms in Aqueous Chemistry

The hydrothermal experimental system can be used to perform:

- Experiments investigating solid-liquid-gas phase equilibria to 343°C and 345 bars below critical point of water,
- Experiments investigating solid-liquid phase equilibria to 600°C and 1,000 bars above the critical point of water,
- High temperature corrosion experiments investigating the stability and corrosion rates of various waste forms, canisters, and waste packages for high level nuclear waste,
- High temperature corrosion experiments investigating the stability and corrosion rates of nuclear reactor cooling systems;
- High temperature hydrothermal synthesis and characterization,
- Various high temperature experiments applicable to geothermal energy extraction, including scale formation prevention, phase separation, and degradation of materials in high temperature environments,
- Experiments at high temperatures and pressures investigating material stability in a deep borehole environment,
- Directly measuring pH values in brines at high temperatures and pressures,
- Experiments investigating transport and formation of ore deposits with strategic importance such as rare earth elements (REE), beryllium, cobalt, gallium, indium, and telluride deposits, etc., which will guide exploration for such deposits and extraction for those elements;
- Experiments investigating chemical interactions in hydrofracking, and
- Experiments investigating the processes including cement stability in oil and gas drilling in deepwater and on land.

Publications

Xiong, Y.-L., Deng, H.-R., Nemer, M., and Johnsen, S., 2010. Experimental determination of the solubility constant for magnesium chloride hydroxide hydrate ($Mg_3Cl(OH)_5 \cdot 4H_2O$, phase 5) at room temperature, and its importance to nuclear waste isolation in geological repositories in salt formations. Geochimica et Cosmochimica Acta, 74: 4605–4611.

Brush, L., Xiong, Y.-L., 2010. Predictions of long-term, near-field geochemical processes and conditions in the WIPP. Geological Society of America Abstracts with Programs, Vol. 42, No. 5, p. 357.

For more information, please contact:

Yongliang Xiong
E-mail: yxiong@sandia.gov
Phone: (505) 284-2713
Website: energy.sandia.gov

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND2013-XXXXP