This Week at NETL

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Fossil Energy (FE)-developed Treatment Method Would Reduce Water Consumption by Power Generators

Power plant cooling water is typically treated with chemicals and fresh make-up water to reduce scaling on steam condenser tubing. Researchers at Drexel University have devised and demonstrated a bench-scale prototype approach to minimizing this performance-degrading problem mechanically. with little maintenance, and using less water. The scaling that inhibits heat transfer is caused when the concentration of minerals such as calcium and magnesium builds up in recirculating cooling water systems as water evaporates in the cooling towers. The Drexel technology, developed as part of a water management project within FE's Innovations for Existing Plants portfolio, managed at NETL, employs an immersed pair of electrodes to discharge a high-voltage spark every 10–50 nanoseconds into the recirculating water. The low-energy pulsating electric field of approximately 40,000 volts per centimeter produces a variety of chemically active oxidizing agents that cause calcium and magnesium to precipitate as solids, which can then be mechanically filtered from the water upstream of the condenser. For a typical 1,000 megawatt fossil-fueled power plant now consuming 10 million gallons of water each day, Drexel's plasma water treatment method could reduce freshwater consumption by approximately 25 percent.

Northern Great Plains Water Consortium (NGPWC) Project Completed

Researchers at the University of North Dakota Energy & Environmental Research Center (UNDEERC) completed eight separate activities over 5 years as part of the joint research and development (R&D) program for FE-related research between NETL and UNDEERC. The researchers—

1. Investigated water supply and disposal issues in the Bakken shale oil play, where advances in hydraulic fracturing are allowing production of a projected 300 to 400 billion barrels of original oil in place, and successfully demonstrated how reverse osmosis can be employed economically to treat non-potable saline groundwater for re-use as make-up frac water.
2. Identified the potential to recover up to 200,000 gallons a day of high-quality water from Great River Energy's lignite fuel enhancement system, which can dry up to 20,000 tons-per-day of lignite with a commercial ambient air heat exchange process marketed by SPX Cooling Technologies as ClearSky™ technology.
3. Identified water supply and use issues related to both existing and planned coal-fired power generation facilities in the Northern Great Plains Water Consortium (NGPWC) region, and compiled data and information on surface water resources, groundwater resources, and municipal and industrial wastewater treatment plant discharges for the NGPWC's Water Resource Decision Support System.
4. Developed a half-hour documentary, "Water: The Lifeblood of Energy."
5. Examined water usage for carbon capture during post- and oxyfuel combustion.
6. Investigated energy-saving opportunities for water treatment, including ozonation and ultraviolet disinfection processes, and found ozonation to be cost-effective.
7. Demonstrated key operating concepts of a dry cooling alternative for power plants that led to successful process development and demonstration.
8. Studied water-supply and -treatment issues faced by oil refineries that are processing lower-cost crude oils and heavier feedstocks containing higher levels of sulfur, selenium, and heavy metals; recommended instrumentation needs and approaches to control these constituents, which can also

produce hazardous air pollutant emissions; and completed a review of the economics related to wastewater issues.

Application Expands for Product of FE Materials R&D

The Boiler and Pressure Code Standards Committee of the American Society of Mechanical Engineers approved the use of precipitation-hardenable Inconel® 740 wrought sheet, plate, rod, seamless pipe and tube, fittings, and forgings in welded construction for service up to 800°C under Section I rules. The nickel-based alloy has proven to be the best candidate material of construction for components such as steam headers and piping of a boiler operating at advanced ultra-supercritical steam conditions (760°C; 5,000 psi). Now the super alloy will be evaluated by the National Renewable Energy Laboratory as part of a project within the SunShot Initiative portfolio managed by DOE's Office of Energy Efficiency and Renewable Energy. Corrosion testing at the University of Wisconsin will determine the material's suitability for use in a multi-megawatt power cycle in which the working fluid is supercritical carbon dioxide heated to 700°C by concentrated solar energy. Special Metals Corporation of Huntington, WV, developed the metal's optimum composition working with an NETL-supported collaboration led by Energy Industries of Ohio, with participation by major U.S. boiler manufacturers, the Electric Power Research Institute, and Oak Ridge National Laboratory.

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