Shaping the Future

Non-Stick Components for Power Plants?

By Tom Shiel

Advanced coatings under investigation are potential "game-changers" to improve performance of heat exchangers and other power plant components, reducing operations and maintenance costs and emissions.

Heat exchangers play an important role in keeping a power plant's heat rate low, but their tubes can be subject to fouling when contaminants in the coolant water affect their surface conditions.

A coating with non-stick properties similar to those of Teflon™ can potentially reduce fouling and improve heat transfer. Just a 1% heat rate improvement at a typical 500-megawatt power plant can result in more than $500,000 in annual fuel savings and an annual reduction of 40,000 tons of CO_2 emissions.

EPRI and Heat Transfer Research Institute developed a list of attributes needed for an effective heat exchanger coating. These include:

- Non-stick
- Durable
- Compatible with water and steam
- Withstand power plant temperatures and pressures
- Non-toxic to aquatic life (because coatings will contact cooling water released to lakes and rivers)
- Non-toxic to humans (because maintenance workers will contact coatings)
- Compatible with materials in heat exchanger tubes
- Affordable installation, maintenance, and inspection
- Minimal resistance to heat transfer
- Minimal effects on flow inside heat exchanger tubes

The team reviewed manufacturers' claims, scientific literature, and other data for more than 100 coatings, identifying their features, benefits, and limitations. Researchers gathered additional information on the coatings through interviews with manufacturers and coatings users.

"Many of these coatings are still in the university research or initial development stages," said EPRI Technical Executive Sam Korellis.

Based on this analysis, researchers identified eight coatings approaching commercial availability and demonstrating promise to have most of the preferred attributes. The next step is to lab-test these products to quantify their attributes. The team has developed a set of tests for this purpose.

According to Korellis, one challenge will be to simulate power plant conditions in the lab tests, which will be conducted first on metal plates and then on metal tubes.

To mimic conditions typically encountered by heat exchangers, researchers abrade the coated tubes by pumping a high-concentration sand and water solution and pushing brushes or scrapers through them. The coatings will be sprayed with steam and exposed to high temperatures for extended periods. Small coating samples will be analyzed for chemical composition to determine toxicity. Following these and other tests, EPRI will publish a report and continue to collaborate with its funders and the manufacturers to consider potential improvements and applications.

Coatings that perform well in the lab tests will be field-tested on operating heat exchangers, which can be up to 20 feet in diameter and 100 feet long. Testing is expected to take about two years.

Korellis views these coatings as a potential step up from solutions that involve cleaning heat exchanger tubes with brushes, chemicals, and scrapers.

“Coatings could enable us to avoid cleaning and scraping the tubes and losing performance between cleanings,” he said. “The coatings will not last forever, and we’ll eventually need to reapply them, and that’s part of understanding their operations and maintenance costs. If we have to apply them once a week, that would probably be cost-prohibitive. Once a year or longer would be in the range the industry would prefer and could afford.”

“These coatings are potential game-changers for the power industry,” he said. “If proven effective, they could be used on anything from turbine buckets to cooling towers to fan blades and alleviate fouling, contaminated surfaces, and other degradation that affects plants. The U.S. Navy is working with many of the same companies EPRI has identified, as ships and equipment can be adversely affected by fouling and corrosion brought on by exposure to large amounts of sea water.”

“Right now, we’re looking at heat exchanger tubes because they offer potentially large benefits and can provide us with insights on the coatings’ capabilities,” he said. “We’ll proceed to other parts of the power plant based on the results in this project.”

KEY EPRI TECHNICAL EXPERTS

Sam Korellis