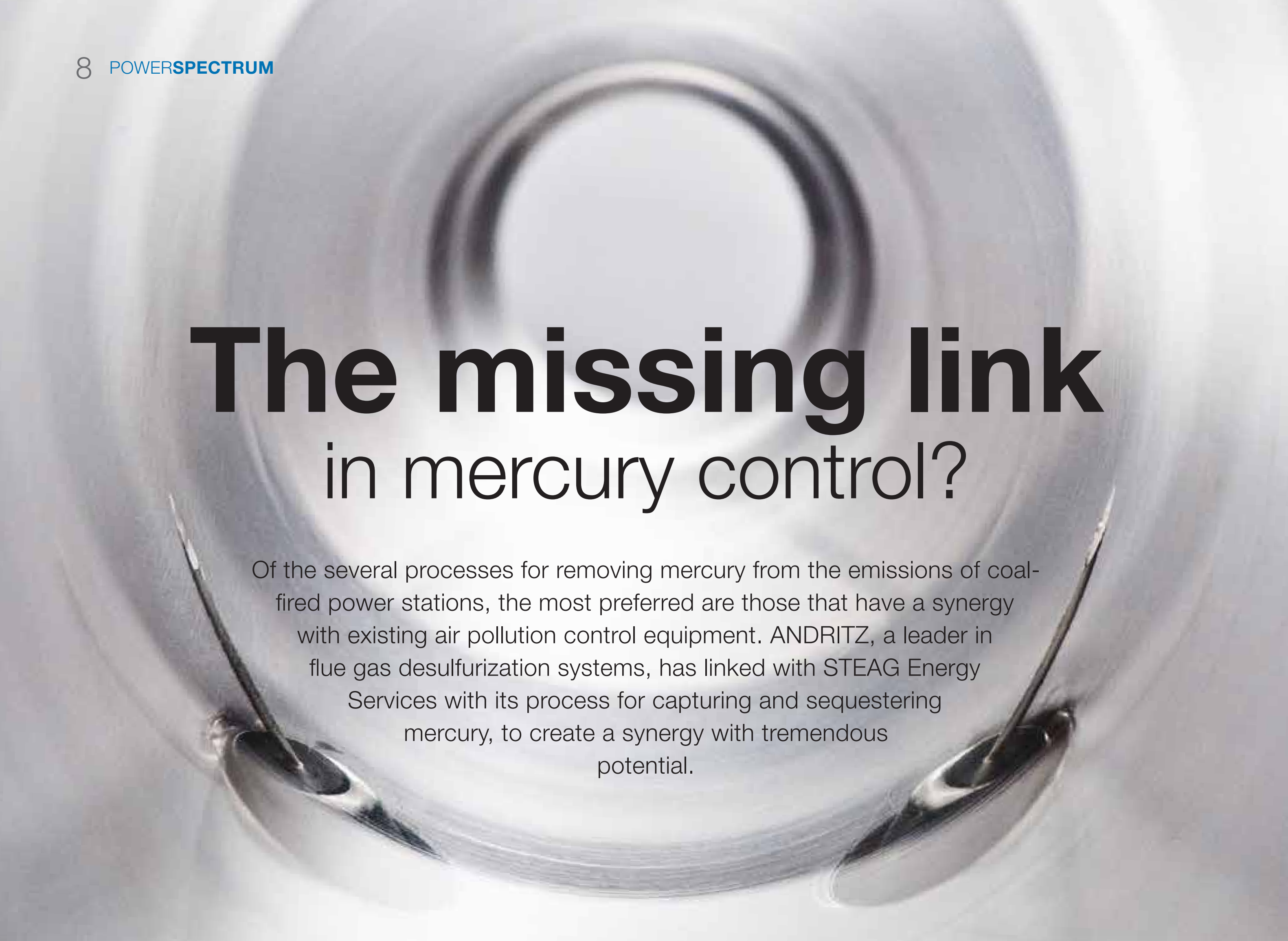

The missing link
in mercury control?

Of the several processes for removing mercury from the emissions of coal-fired power stations, the most preferred are those that have a synergy with existing air pollution control equipment. ANDRITZ, a leader in flue gas desulfurization systems, has linked with STEAG Energy Services with its process for capturing and sequestering mercury, to create a synergy with tremendous potential.

Mercury is a potentially deadly neurotoxin. Mercury emissions from coal-fired power stations are a major environmental concern due to the toxicity and persistance of mercury that accumulates in our waterways.

Stringent mercury emission limits in the USA and upcoming BAT and IED regulations in Europe present a significant challenge, according to Andreas Gruber-Waltl, Team Leader for Process Development at ANDRITZ Energy & Environment. "These limits must be met," he says. "We even have to consider clean gas mercury concentrations below 2 µg/m³ STP dry."

To meet these limits, ANDRITZ and the German company STEAG have developed a highly efficient mercury separation process. ANDRITZ's contribution is an improved design for hydrocyclones following their wet flue gas desulfurization (FGD) system. STEAG contributes its patented process for adding activated carbon into the scrubber, transferring the mercury-adsorbed carbon via the wastewater stream from the FGD, and producing two different filter cake fractions in the wastewater treatment plant. One of those fractions (about 95% of the volume) is virtually mercury-free and can be recycled to the boiler's coal pile. The mercury-laden fraction is then disposed of at considerably less cost.

The effectiveness of the synergy, according to Michael Kramer, Process Engineer for AE&E, is that the success of the overall process depends on the innovations of both companies. "Without our hydrocylone technology, the STEAG process was causing blackening of the gypsum to the point that it could not be used in the construction industry," he says.

Wet FGD systems remove mercury by dissolving it in limestone slurry in the absorber tower and removing it through the blowdown process in a device called a hydrocyclone. Particles in the hydrocyclone are separated according to their sedimentation speed. Big and dense particles (like gypsum) are discharged in the hydrocyclone's underflow (the Apex flow). The gypsum is dewatered and is then ready for use.

"Activated carbon particles are very fine and their specific weight is significantly above the fluids density," Kramer says. "The problem with a standard hydrocyclone is that it cannot separate activated carbon particles out of the underflow. Although the sedimentation speed of activated carbon particles is rather low, some will end up in the Apex flow, which blackens the gypsum and makes it unusable."

▲ ANDRITZ developed a new hydrocylone design which significantly reduces fine particles (such as mercury-laden activated carbon) from the underflow. Shown here is a small prototype that was built to prove the concept.

▲ Michael Kramer, Process Engineer for ANDRITZ Energy & Environment (left) and Andreas Gruber-Waltl, Team Leader for Process Development

"I think we are closing the gap in mercury removal technology for FGD systems which was overlooked by our competitors."

Andreas Gruber-Waltl
Team Leader for Process Development
ANDRITZ Energy & Environment

"The hydrocyclone has always been considered an auxiliary piece of equipment for us, standing between our FGD and the wastewater treatment system," Gruber-Waltl says. "We have never actually focused on its design before. However, when STEAG approached us with the challenge, we took a fresh look at the standard design. This was our starting point."

"We thought about different ways to approach this problem with a different kind of hydrocyclone in 2011," Kramer says. Kramer had the idea to use a clean water wash to eliminate the fine particles in the underflow. A backwash of clean water would transport the fines into the overflow so that they do not affect the gypsum.

The ANDRITZ solution is different than a water injection system. "We re-designed the bottom of the hydrocyclone where we introduce the wash water," Kramer says. "Water is added without causing turbulence. The wash water does not pass through the suspension, but actually covers it by coating the inside of the cyclone cone. Coarse particles can pass through the sedimentation layer, but fines are caught within it and carried to the overflow."

"We did our first trial tests at the ANDRITZ technical center here in Austria," Gruber-Waltl recalls. "We worked with existing hydrocyclones to see if we could prove our concept. In February 2012, we submitted applications for two patents: one for the design of the hydrocyclone itself, and one for the process."

In 2012, ANDRITZ did its first tests at a hydrocycyclone supplier in Germany. "Their system was very sensitive to plugging as soon as the water injection failed," Kramer recalls. "Their design was not robust. Also, the targeted mass transfer point could not be met with their technology."

So, the next step was for ANDRITZ to design its own prototype. This was completed in the spring of 2012. Tests with the prototype showed that the amount of mercury-laden activated carbon in the underflow could be reduced significantly. "Mercury separation efficiency of up to 95% has been proven," Kramer says. "The gypsum was clean with no black activated carbon particles. In addition, it was possible to keep the operating point at a high 80-90 wt% mass transfer to underflow, which is essential for fines management in an FGD system."

"I think we are closing the gap in mercury removal technology for FGD systems which was overlooked by our competitors," Gruber-Waltl says. "Where we are now is that we are looking for industrial partners to demonstrate this technology at industrial scale."