GORE™ Mercury Control System

FOR COAL-FIRED UTILITIES

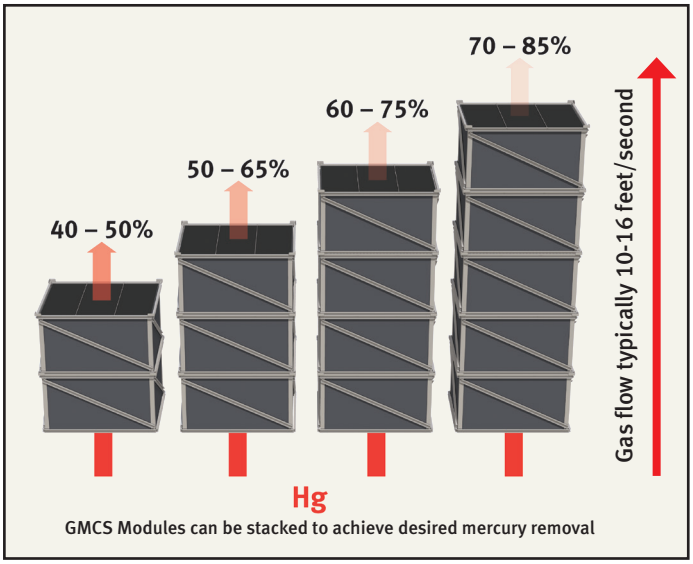
A Simple and Effective Way to Comply With Regulatory Requirements

Stricter Regulations, New Standards

Coal-fired power plants in the U.S. are subject to increasingly strict emissions regulations. The Mercury and Air Toxics Standard (MATS) requires plants to achieve very low outlet emissions. There are a number of different mercury control solutions that can be utilized to achieve this standard. Since each power plant is different, the effectiveness of each solution is highly variable site-to-site. Some plants are faced with significant operating costs, or undesirable side-effects due to their selected mercury control approach. In an increasingly competitive power market, there is a need for a simple, cost-effective way to reduce mercury emissions.

Now There's a Better Way

The GORE™ Mercury Control System (GMCS) is a unique fixed sorbent system for capturing elemental and oxidized gas phase mercury from industrial flue gas. The system is based on discrete stackable modules that are installed downstream of a particulate collection system. The modules are designed with a unique open channel structure which provides extremely low pressure drop, avoiding the need for an additional booster fan. Operation is passive; the modules will continuously capture mercury for many years without requiring any adjustment, regeneration, or replacement. They also provide an SO_2 removal co-benefit. The system is completely scalable – modules can be stacked in the direction of the gas flow to achieve desired mercury removal efficiency.



GMCS Modules can be stacked to achieve desired mercury removal

Low Process Impact

- No injection of sorbents:
  - No impact on fly ash properties
  - No impact on PM emissions
  - Significantly less solid waste vs. carbon injection
- Captures elemental mercury without requiring the use of oxidizing chemicals
  - No corrosion of air preheater
  - No waste water treatment system complications
- Re-emissions barrier:
  - No need for re-emissions additives
  - No gypsum contamination
- Zero footprint in scrubber installations:
  - No gas conditioning needed
  - Extremely low pressure drop—no booster fan required

Simple Operation

- No moving parts
- No chemicals to manage
- Long module lifetime; very low operating cost

Robust Compliance

- Insensitive to coal changes or load changes
- Not impacted by SO_3
- SO_2 polishing co-benefit
- Scalable removal efficiency

June 2016

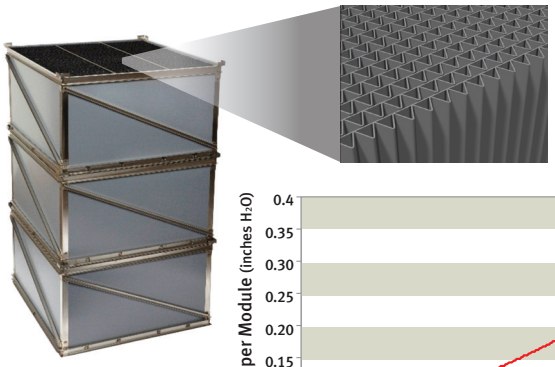
GORE™ Mercury Control System

FOR COAL-FIRED UTILITIES

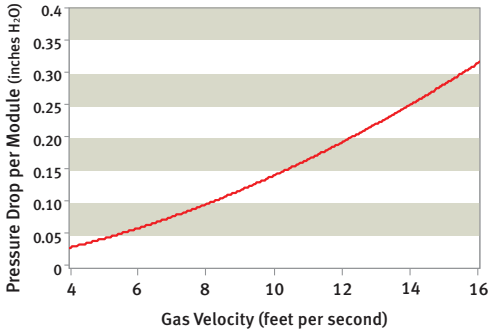
The Science Behind the Solution

At the heart of the technology is an innovative, fluoropolymer-based material developed by scientists at W. L. Gore & Associates: Sorbent Polymer Catalyst (SPC) composite material.

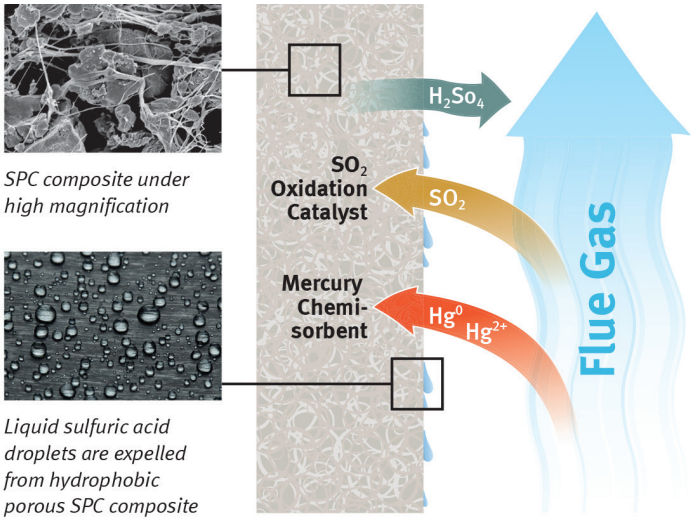
The sorbent in this material efficiently captures both elemental and oxidized mercury from the flue gas stream. As such, it is insensitive to fuel or process changes that affect mercury speciation. Mercury is securely bound within the SPC via chemisorption. Unlike many activated carbon sorbents, the presence of SO_3 does not inhibit mercury capture by the SPC, making it a very effective solution for high sulfur coals or for units with SO_3 gas conditioning. Since there are no injected sorbents, there is absolutely no concern over fly ash contamination or creating additional particulate matter that needs to be collected. Chemicals for oxidation are also not needed thus eliminating halogen-induced corrosion concerns or wastewater treatment complications.



The unique open channel structure of the GMCS module provides extremely low pressure drop.



The SPC can function in a wide range of operating conditions, including the most challenging high humidity (wet) acid gas streams, making it ideal for location above the mist eliminators in a wet FGD (flue gas desulfurization) system. When installed in the outlet of a wet scrubber, the GMCS serves as a barrier to mercury re-emissions. This allows a plant to avoid the use of scrubber re-emissions additives, and focus the scrubber operation on avoiding other unwanted problems like selenate formation. SO_2 in the flue gas is converted to sulfuric acid which is expelled out of the hydrophobic SPC material. This provides increased SO_2 compliance margin and may eliminate the need for a scrubber upgrade. Some operators may take advantage of this SO_2 removal and choose to detune their scrubber (i.e., turn off a spray header) thus saving on power costs.



The SPC composite captures and sequesters elemental and oxidized mercury while converting SO_2 to liquid sulfuric acid

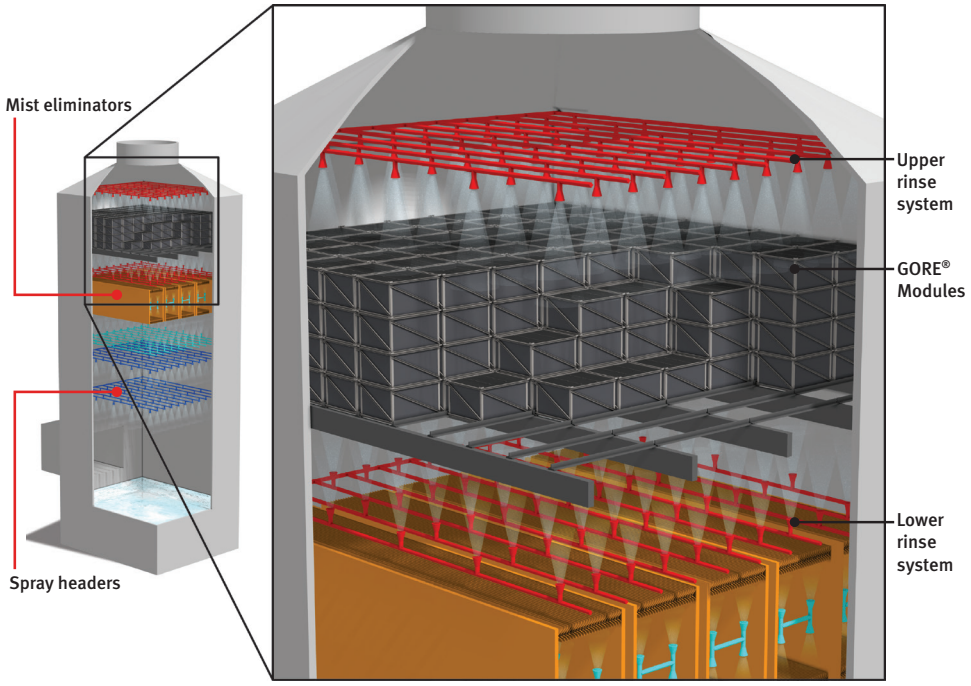
Operation of the GMCS is exceedingly simple. Since the modules contain no moving parts, there is no need for any adjustments to maintain performance as unit operations change. The modules are resistant to fouling or plugging, in part due to smooth, non-stick nature of the SPC, and in part due to the continual acid wash created by the conversion of SO_2 to liquid sulfuric acid. A simple water rinse system is typically installed above and below the modules, similar to a mist eliminator wash, but only operated once or twice per day to help rinse acid and dust off the module surfaces. Other than this small amount of water usage, there are no other consumables, power, or maintenance requirements to operate the system. The system has a very low operating cost, since module replacement is very infrequent. The SPC can retain 5% of its weight in mercury without a drop in removal efficiency, equating to 1 to 2 tons of mercury holding capacity for a 1000 MW plant. As a result, the projected module lifetime for most power plants based on mercury capacity of the modules is often greater than 10 years.

Minimal Solid Waste Generation

When the modules have reached end of life, the SPC material can be removed from the metal frames for disposal while the frames (which are constructed of corrosion-resistant alloy) can be reused. Options for SPC disposal include landfill in an approved hazardous waste landfill or sending to a retort facility for mercury removal and disposal in a non-hazardous landfill. The quantity of SPC material that needs to be disposed of at the module end-of-life is typically several orders of magnitude smaller than the quantity of injected sorbents that would be used to control mercury with a sorbent injection system for the same period of time. As a result, the disposal costs are typically much lower than the disposal costs associated with an activated carbon system.

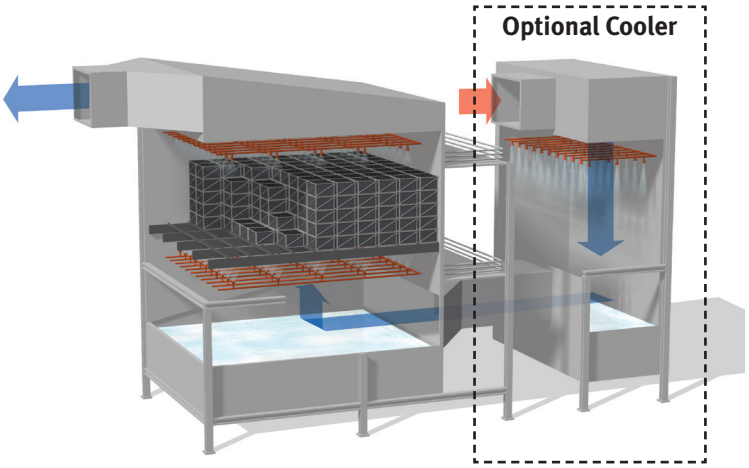
Installation in Wet Scrubber

Installation of GMCS inside a wet scrubber results in no additional footprint requirements on-site, which is particularly important for sites with space constraints. A typical new installation inside of a wet scrubber can be completed during a 3–4 week outage. Module stacks are supported on beams and the modules fill the cross-sectional area of the scrubber above the mist eliminators. If there is insufficient vertical space in an existing scrubber design, the mist eliminators can be replaced with a compact design and installed in a lower position in the scrubber to make space for the modules. Gore will team with utilities and their preferred engineering partners to insure a successful design and resulting installation.



Stand-alone Installation

For plants that do not have wet FGD's installed, this technology can be applied after a dry scrubber, or even as a stand-alone solution for mercury and SO_2. Depending on the temperature of the flue gas, an evaporative cooler may be installed upstream of the Gore modules to cool the gas stream to below 180°F (82°C) for maximum effectiveness. For plants that do not have any acid gas scrubbing systems and need to reduce SO_2 emissions, the GMCS can be configured as a very attractive alternative to a new wet or dry scrubber. GORE™ Mercury Control Systems have been tested and installed in numerous industrial non-power applications including incinerators, cement and metals plants. The robust nature of the modules makes them suitable in a wide range of applications.

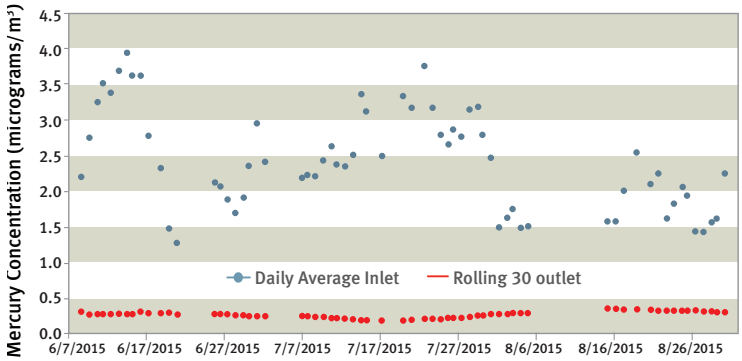


Stand-alone installation shown with optional cooler to maintain optimal operating temperature below 180°F (82°C)

Full Scale Installations

GORE™ Mercury Control Systems are currently in operation in five absorbers in the coal-fired power industry. Several more are currently under construction for start-up in early 2016, at which point the installed operating capacity will exceed 2100 MW. Gore's high volume module manufacturing lines in Elkton Maryland have produced the nearly 10,000 modules that have been installed in these applications over the past two years. Current module manufacturing capacity exceeds 20,000 modules/year, and can be readily expanded when needed. Including full-scale and slip stream pilot experience, GMCS Modules have successfully operated on flue gas from power plants burning all types of coal: high and low sulfur bituminous, PRB, and lignite. Outside of coal-fired power, GMCS Modules are installed in more than 15 sludge incineration units in the U.S.

Full-Scale Coal-Fired Power Plant: 220MW Scrubber

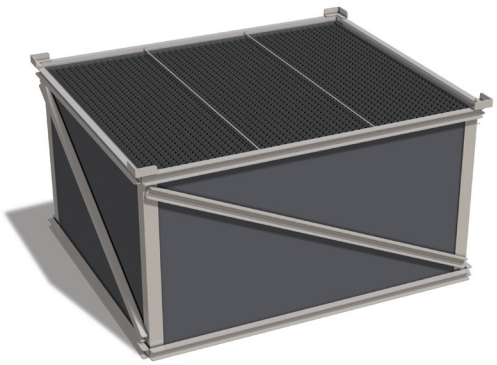


GORE™ Mercury Control System

FOR COAL-FIRED UTILITIES

GMCS Being Installed in Coal-Fired Power Plants

The GMCS is an innovative solution that eliminates many of the undesirable complications and high operating costs associated with traditional mercury control systems. GMCS can be a viable alternative, replacement, or complement to an existing system, providing decreased operating costs, increased compliance margin, and simplified plant operation. Gore engineers are ready to evaluate installation options for specific plants, in order to determine approximate costs and projected cost savings that may be realized.



FOR INDUSTRIAL USE ONLY. Not for use in food, drug, cosmetic or medical device manufacturing, processing, or packaging operations.

W. L. Gore & Associates GmbH
Hermann-Oberth-Straße 26
85640 Putzbrunn Germany
Tel: +49 (0) 89 4612 2211
Email: industrialfilters@wlgore.com

gore.com/mercury

For more information, contact
W. L. Gore & Associates GmbH

Ole Petzold:
Tel: +49 89 4612 2348
Cell: +49 172 8148 705

GORE
Creative Technologies Worldwide

GFP-030-R2-TEC-US-JUN16