Mercury Technology Bulletin Series: 013

Removal of Mercury from Flue Gas by Fixed Sorbent System

Background

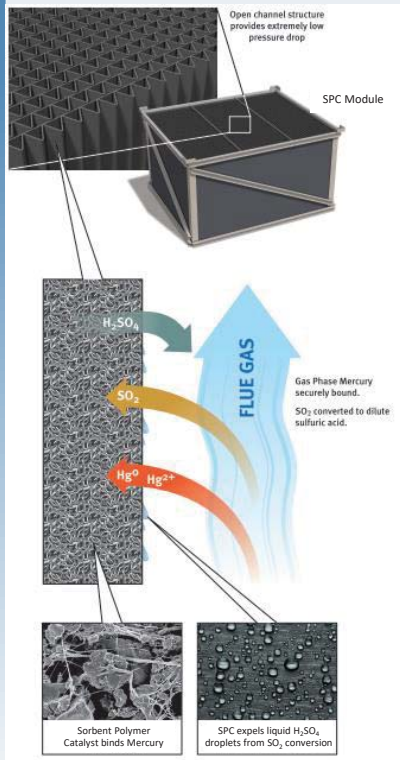
Requirement of the Minamata Convention on Mercury

Controlling the emissions of mercury is required by Minamata Convention and local laws in most countries worldwide. Article 8 of the Minamata Convention relates to emissions from the point sources of mercury listed in the Annex D, including coal-fired power plants. Flue gas treatment method for mercury removal is commonly used and can be universally applied to industrial processes. Such a method that does not require treatment of any resulting process effluent streams is more desirable for facility operators.

Overview of the Technology

Mercury Control Method

There are multiple methods to remove mercury from industrial flue gas. Some rely on physical adsorption while others involve chemical reactions. Among these methods, fixed sorbent system utilizes a composite structure containing chemical sorbents and catalysts in a polymeric matrix to chemically capture and bind mercury. The table below outlines key attributes of common mercury removal techniques.



Source: W. L. Gore & Associates, Inc.

Mercury Removal Selection Matrix:

Hg Reduction Technology	Pros	Cons
Activated Carbon Injection	• Low Capital Cost • High removal efficiency with baghouse • Small footprint	• Potentially high operating cost depending on injection rate • Additional particulate matter introduced • Contamination of process dust with Hg on carbon
Oxidizing Agents	• Low Capital Cost • Low Operating Cost • Small footprint	• Limited Hg removal • Relies on wet scrubber to capture oxidized mercury • Potential for corrosion of process equipment and waste water treatment impacts
Chelating Agents	• Low Capital Cost • Controls Re-emissions from wet scrubber • Small footprint	• Limited Hg removal • Only effective for binding mercury already in soluble form • Potentially high operating cost depending on injection rate
Traditional Fixed Carbon Bed	• Capable of very high mercury removal • Low process impact • Long history – established technology • Passive Operation	• Not designed for saturated gas streams – requires pre-conditioning which adds significant cost • High Pressure Drop • Large footprint
Fixed Sorbent System	• Low Operating Cost • Low Pressure Drop • Passive Operation • Low process impact • Small or zero footprint • SO_2 removal co-benefit (reported removal up to 75%)	• Initial capital cost • Commercial experience limited (2013 to present) • Difficult to operate over 100C~

Mercury Technology Bulletin Series:

Advantages/Strengths

Fixed sorbent system can be universally applied to the tail end of almost any industrial processes and have no adverse impact on usual/existing the operation of the process. It provides continuous mercury removal from the process without the use of any chemicals or reagents. Mercury is securely bound in a safe, environmentally sound form and treatment of fly ash/effluents for mercury removal is not necessary.

Source: W. L. Gore & Associates, Inc.

Source: EnviroCare International

- Requires No Chemicals or Reagents
- Extremely Low Operating Cost
- Simple Passive Operation
- Low Pressure Drop
- Almost No Impact on Existing Process
- Substantial SO_2 Removal Co-benefit - can eliminate need for scrubber upgrade or enable lower SO_2 limits to be met
- Scalable Design

Applicability

Fixed sorbent system offers an alternative method to control gas phase mercury emissions from industrial applications while providing additional SO_2 removal. These systems have been successfully installed globally in coal fired power plants, sewage sludge incinerators, and various metals/ minerals applications for over a decade. This system can be incorporated into existing industrial processes with minimal to no disruption of the existing plant operations. Byproducts such as fly ash or gypsum from coal fired power plants are unaffected enabling their continued beneficial use. Similarly, process dust collected from metals/minerals applications may continue to be recycled within the process without concern over cycling up mercury concentrations.

Further Reading

1. Mercury emission profile for the torrefaction of sewage sludge at a full-scale plant and application of polymer sorbent (https://reader.elsevier.com/reader/sd/pii/S0304389421021543?token=B83A362F38C30BCDE76AC487F77B4B6DEA5E31DBEC99F90F8808A8226562B7BE52C4AC514BA002190C9CBEF04C2CE65F&originRegion=us-east-1&originCreation=20211216012623)
2. Mercury removal technology from the flue gas at Sewage Sludge Treatment Facility (http://www.jefma.or.jp/jefma/68/pdf/jefma68-10.pdf)
3. Innovative technology reduces mercury emissions to keep Ohio's Sewage Sludge Incinerators hot and costs cool, WEF Residuals and Biosolids Conference 2017 (https://www.gore.com/sites/g/files/ypyipe116/files/2017-08/WEF-Residuals-Conference2017-Incinerator-Emission-Control-for-SSI_Footer_8_07_17.pdf)

Published in: March, 2022
Edited and published by: Office of Mercury Management
Environmental Health Department
Ministry of the Environment, Japan
1-2-2 Kasumigaseki, Chiyoda-ku Tokyo, 100-8975, Japan
Tel: +81-(0)-3-5521-8260, E-Mail: suigin@env.go.jp
http://www.env.go.jp/en/chemi/mercury/mcm.html

環境省 Ministry of the Environment