

# Taiwan Addresses Ambient Air Pollution by Mercury with Advanced Technology and Pollution Countermeasures



Taiwan is committed to improving air quality, and has undertaken steps towards this goal for many years. In 2017, the island's highest government authority, the Executive Yuan, launched the Air Pollution Prevention Strategy to ensure long term viability of an environmentally healthy and vibrant Taiwan. This followed the convention of the local Environmental Protection Agency (EPA) and related governing offices for the strategic planning and review of air pollution prevention and control.

## Assessment of Taiwan's Current Air Quality and the Challenges of Mercury Emissions

From as early as 1995, the EPA implemented tariffs to control air pollution as Taiwan headed towards industrialization and urbanization. The island began to experience environmental changes during modernization and the tariffs enabled the EPA to extend air pollution management and controls from traditional pollutants to mercury. Mercury is an emerging challenge in a number of markets worldwide. For instance, Japan passed the Minamata Convention in Minamata City, Kumamoto Prefecture in 2013. This is also an international convention regulating mercury pollution worldwide. Mercury is ubiquitous in our daily lives, such as in dentures and fluorescent lamps as well as some industrial processes such as VCM and the making of sodium pentachlorophenate, among others. Over the years, the EPA had effectively addressed the problem of pollution of mercury heavy metals and mercury emissions by implementing waste recycling.

### Market

- Taiwan

### Key Challenges

- Taiwan faces health and safety hazards from air pollution caused by emissions of toxic gases such as mercury due to rapid urbanization and industrialization.
- Issues of public trust and objectivity among governmental, non-governmental and commercial organizations in the monitoring, assessment and management of environmental data hamper the implementation of policies and goals for sustainability.

### Solution

- Thermo Scientific™ Mercury Freedom System

### Results

- Participation in global environmental protection conventions and cooperation with environmental agencies worldwide enable Taiwan to progress on the path to long term management of mercury emissions in the environment.
- Use of continuous monitoring system for real-time data analysis empowers local businesses to monitor air emissions efficiently.
- Stay at the forefront of environmental protection through active participation in global conventions. The use of advanced technologies such as the Thermo Scientific™ Mercury Freedom System enable local businesses to comply with high standards of local regulations and those set by the United States Environmental Protection Agency (US EPA).

With regards to management of air pollution, the international community has been focusing mainly on three major industries: early waste incinerators, coal-fired power plants, gold mining and metallurgy. Through a multi-prong approach by the EPA on the treatment of waste and improvements to air quality emitted from incineration plants, the issue of mercury emissions from old or abandoned incinerators has been greatly reduced.

Looking west, Taiwan saw that in 1994, the United States had been regulating coal-fired power plants. Following the US example, Taiwan had similarly formulated various coal-fired emissions standards.

### **New Technologies and Greater Controls Needed to Improve Environment and Health**

Taiwan's environmental problems, such as greenhouse gas emissions, electricity consumption, pollutant emissions, air pollution and resource consumption, among others, are raising concerns. The public is getting more vocal with their demands for higher levels of environmental protection. Presently, although Taiwan is managing mercury emissions well, the local government agencies continue to push the boundaries for better air quality controls. The Lulinshan Station at the junction of Nantou and Chiayi is Taiwan's first monitoring station for long-term monitoring of mercury in the air within and around the Taiwan island. The EPA has a long-standing agreement with the US EPA to monitor mercury emissions in the air and to share data or information aimed at improving air quality for the long-term.

Additionally, Taiwan is reducing its cement production and as such, cement kilns are being converted to waste treatment plants, and the mercury emissions during waste processing in cement kilns is emerging as a new area of concern for Taiwan's environmentalists.

### **Addressing Air Pollution Concerns with Clear Guidelines, Manage with Continuous Emissions Management Equipment**

The EPA issued its latest guidelines – the Public and Private Places Fixed Pollution Source Fuel Co-firing Proportion and Composition Standards – in March 2020. The new update, an amendment to Article 28, item 2 of the Air Pollution Control Law, comprises clear specifications for fuel source management including composition standards for raw coal, fuel oil, petroleum coke and primary solid biomass fuel, as well as restrictions on the proportion of mixed combustion of waste fuels.



Use of continuous monitoring system for mercury emissions in a coal-fired thermal power plant

With this new amendment, businesses could no longer purchase coal that exceeded the EPA's set limit of 0.15mg mercury content in coal. Prior to this amendment, only the Taiwan Power Company had set its own mercury standards of 0.12mg mercury content in coal for its operations. The new guidelines will now control mercury emissions at the source level.

The reason for the widespread issue of mercury emissions is that mercury has a very low boiling point. Present in a gaseous state during the combustion process, mercury circulates in the air, soil, and water bodies, and has become a global pollution problem.

Unlike general organic substances, mercury changes from a solid phase to a gaseous phase, and then from a gaseous phase back to a solid phase. Mercury that is attached to a particular matter can be controlled physically but as a gas, mercury is difficult to control. Upon discharge as a gas, it will circulate worldwide in the atmosphere.

While it is possible to manage mercury by setting standards of mercury content in coals for coal-fired power generation, advanced technology can further help to address the issue of mercury in air pollution. Jeff Socha, Senior Manager of Technology Development at Thermo Fisher Scientific points out: "Both elemental mercury and oxidized mercury can continuously be monitored by a continuous mercury monitoring system (Hg CEMS) in the flue. What is of key concerns to power plant operators or environmentalists are the concentrations of both types of mercury in varying fuel and operating conditions. If the data shows that elemental mercury is relatively high, how does one ensure that the removal of the stable elemental



File image showing the manufacturing of a Thermo Scientific mercury CEMS system.

mercury? While we can try to convert elemental mercury into oxidized mercury through the SCR at the front end, the issue arises if the concentration of oxidized mercury is relatively high, indicating a problem with FGD. This raises more questions such as whether oxidized mercury should be dissolved into water. By implementing Hg CEMS at the back end, there will be continuous data for analysis and better decision making.”

Throughout the world, ensuring clean air requires a collaborative effort with governments maintaining regulations that minimize the release of pollutants and harmful toxins, including mercury, in the air.

Thermo Fisher Scientific is on a mission to enable customers around the world to make the world healthier, cleaner and safer.

Ensure complete regulatory compliance with unattended, true continuous monitoring. Thermo Scientific™ Mercury Freedom System integrated mercury emissions monitoring systems measure elemental, ionic and total mercury in exhaust stacks from coal-fired boilers, waste incinerators, cement kilns and other industrial combustion sources.

**Regulatory compliance peace of mind:**

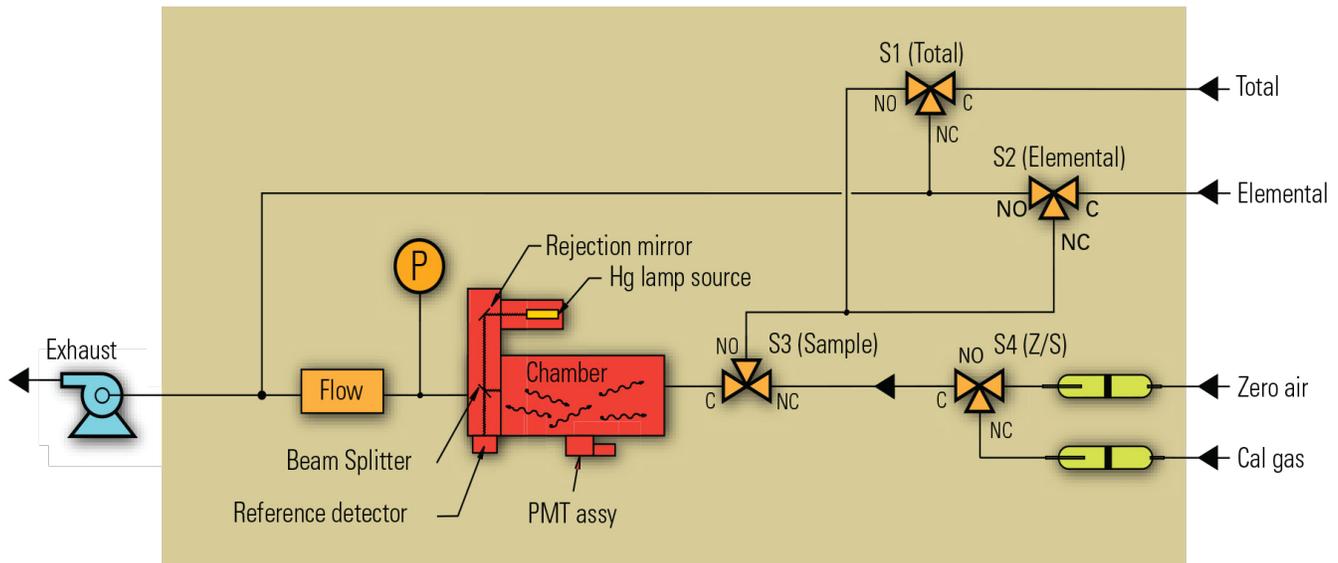
- Meets U.S. EPA 40 CFR Part 75 requirements with true continuous monitoring
- Get ahead of the curve and be prepared for increasingly stringent regulations with the highly sensitive direct cold vapor atomic fluorescence technology

**Easy to own and operate**

- Reduced umbilical temperature extends life of umbilical line and reduces service needs
- Split umbilical available as separate cold/hot lines which can further extend umbilical life
- No expensive consumables
- Modular design allows for easy access to equipment and reduced maintenance time and cost
- Highly sensitive cold vapor atomic fluorescence analyzer requires no wet chemicals or costly gold amalgamation concentrator
- Rack-mountable components integrate seamlessly into most existing stack monitoring configurations
- No argon carrier gas is required, saving space and expenses



Thermo Scientific™ Mercury Freedom System



### How Mercury Analyzers Work:

This example of a mercury analyzer is based on the principle that Mercury (Hg) atoms absorb ultraviolet (UV) light at 254 nm, become excited, then decay back to the ground energy state, emitting (fluorescing) UV light at the same wavelength. Specifically,  $\text{Hg} + h\nu(254\text{nm}) \rightarrow \text{Hg}^* \rightarrow \text{Hg} + h\nu(254\text{nm})$ .

It is one of four major components of a total mercury monitoring system. The analyzer uses an advanced cold vapor atomic fluorescence technology to provide continuous sample measurement, with no additional gases or accumulations required and virtually no interference from  $\text{SO}_2$ .

### Probes to Determine Mercury Emissions:

- Dry converter located in probe eliminates the transport of oxidized mercury
- Reduced umbilical temperature extends life of umbilical line and reduces service needs

### Thermo Fisher Scientific offers robust and reliable probes that can:

- Handle high particulates
- Carbon carryover from plants with loss of ignition or upstream of pollution controls

### Monitoring Solutions for Regulatory Compliance and Process Control Needs

Continuous emissions monitoring systems can be required for any number of reasons for stationary source monitoring. Thermo Fisher Scientific offers a wide range of products and services to meet customers' specific regulatory compliance and process control needs, and highly experienced experts to read air permits and integrate solutions and service in the field.

We understand that every plant, facility, and customer is uniquely different. Our applications specialists are ready to speak to you regarding mercury emissions regulations and continuous monitoring solutions.

Find out more at [thermofisher.com/CEMS](https://www.thermofisher.com/CEMS)

**ThermoFisher**  
SCIENTIFIC