

Co-benefit control and its enhancement can cost-effectively mitigate mercury emission from coal-fired power plants in China

Atmospheric mercury pollution has been a global concern owing to its neurotoxicity, persistence, long-range transportability and bioaccumulation in ecosystems, especially since Minamata Convention on Mercury was adopted internationally in 2013 to jointly control mercury emissions and releases. Thousands of coal-fired power plants in China emit nearly 100 tons of mercury in 2010, about 5% of the global anthropogenic mercury emission inventory. To fulfill its commitment to Minamata Convention, China has been seeking approaches to reduce or mitigate mercury emissions starting from the coal-fired power sector.

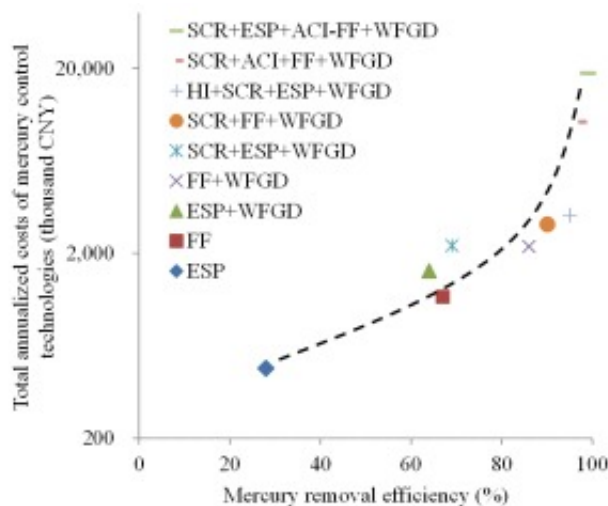


Fig. 1. Relationship between mercury removal efficiency of APCD combinations and the total annualized costs apportioned to mercury removal.

To control conventional pollutants such as sulfur dioxides (SO_2), nitrogen oxides (NO_x) and particulate matters (PM), Chinese power plants have already equipped with some air pollution control devices (APCDs). Electrostatic precipitator (ESP) and fabric filter (FF) are two types of commonly used PM control devices. Particulate-bound mercury can be effectively captured by ESP or FF. Wet flue gas desulfurization system (WFGD), designed to scrub SO_2 , has a high removal efficiency for divalent mercury in flue gas. There is a rapid growth of the installation of selective catalytic reduction system (SCR) for NO_x control. SCR catalysts can transform elemental mercury to divalent mercury, which would enhance the mercury capture rate in the downstream WFGD. Co-benefits from existing APCD combinations can be assigned to different air pollutants based on their impacts on the environment and human health. The so-called “co-benefit control technologies” can

achieve up to 90% mercury removal efficiency, with the most cost-effective combination being FF+WFGD.

The mercury removal efficiency of existing APCD combinations can be promoted by additional chemical injection, which is usually referred to as “co-benefit enhancement technologies”. Halogen injection (HI) technology is one of them. Halogen promotes the oxidation of elemental mercury, leading to more divalent mercury. Therefore, a very small amount of halogen compound (e.g., 25 ppm of CaBr_2), with the existence of a downstream WFGD, can contribute to over 95% mercury removal rate. Due to the high sulfur content in coal, almost all the Chinese power plants are equipped with WFGD, inspiring WFGD-dependent control technologies. HI is the most economic co-benefit enhancement technology for the Chinese case (the combinations near the bending point of the curve in Fig. 1 are the most cost-effective ones). Despite of its advantages in price and performance, the widespread application of HI in Chinese power plants is still held up by the lack of long-term field demonstration and secondary impact assessment (e.g., corrosion of the boiler, excessive halogen slip, etc.).

Activated carbon injection (ACI) is a dedicated mercury control technology, which has been adopted by many U.S. power plants. However, ACI is still expensive to Chinese power plants, not only for the costs of treated activated carbon but also for the loss from fly ash sales (due to the deterioration of its quality for reutilization).

Publication

[Economic analysis of atmospheric mercury emission control for coal-fired power plants in China.](#)

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