

**To MACT or not to MACT:**

**Mercury Emissions from Waste-to-Energy and Coal-fired Power Plants**

Nickolas J. Themelis<sup>1</sup> and Nada Assaf-Anid<sup>2</sup>

<sup>1</sup>Department of Earth and Environmental Engineering,  
Earth Engineering Center, Columbia University  
New York City, NY 10027 ([njt1@columbia.edu](mailto:njt1@columbia.edu))

<sup>2</sup>Department of Chemical Engineering, Manhattan College,  
Earth Engineering Center, Columbia University

**ABSTRACT**

During the combustion of fuel in Waste-to-Energy (WTE) and coal-fired power plants, all of the mercury input in the feed is volatilized. The primary forms of mercury in stack gas are elemental mercury ( $\text{Hg}^0$ ) and mercuric ions ( $\text{Hg}^{2+}$ ) that are predominantly found as mercuric chloride. The most efficient way to remove mercury from the combustion gases is by means of dry scrubbing, followed by activated carbon injection and a fabric filter baghouse. Back in 1988, the U.S. WTE power plants emitted about 90 tons of mercury (Hg). By 2003, implementation of the EPA Maximum Achievable Control Technology (MACT) standards, at a cost of one billion dollars, reduced WTE mercury emissions to less than one ton of mercury. EPA now considers coal-fired power plants to be the largest remaining anthropogenic source of mercury emissions. Approximately 800 million short tons of coal, containing nearly 80 short tons of Hg are combusted annually in the U.S. for electricity production. About 40% of this amount is presently captured in the gas control systems of coal-fired utilities. Since the concentration of mercury in U.S. coal is ten times lower than in the MSW feed and the volume of gas to be cleaned 55 times higher, the cost of implementing MACT by the U.S. coal-fired utilities is estimated to be about \$25 billion. However, when this retrofit cost is compared to the total capital investment and revenues of the

two industries, it is concluded that MACT should be affordable. Per kilogram of mercury to be captured, the cost of MACT implementation by the utilities will be twenty times higher than was for the WTE industry. However, implementation of MACT by the utilities will also reduce the emissions of other gaseous contaminants and of particulate matter.

**The authors:**

Nickolas Themelis is Stanley-Thompson Professor of Chemical Metallurgy, Department of Earth and Environmental Engineering, and Director of the Earth Engineering Center of Columbia University.

Professor Nada Assaf-Anid is Chair of the Department of Chemical Engineering of Manhattan College in New York City and also Research Associate of the Earth Engineering Center of Columbia University. Dr. Assaf-Anid specializes in the fate of organic and inorganic contaminants in water, sediments and soil.

**Mercury in WTE**

A study by Themelis and Gregory for the New York Academy of Sciences [1] described how the U.S. WTE industry reduced its mercury emissions from 89 tons, reported by NREL in 1988, to less than two tons by 2000 (Figure 1).

This dramatic decrease was principally due to the implementation of MACT standards by the industry at a reported total cost of one billion dollars. A recent check by the authors of mercury emissions from the five WTE facilities in New Jersey [2] showed that, in 2003, the mercury emissions of these plants, which in