



MercOx at Sydkraft SAKAB

Mercury reduction by the MercOx process



EU Life99 ENV/S/000626

The MercOx process:

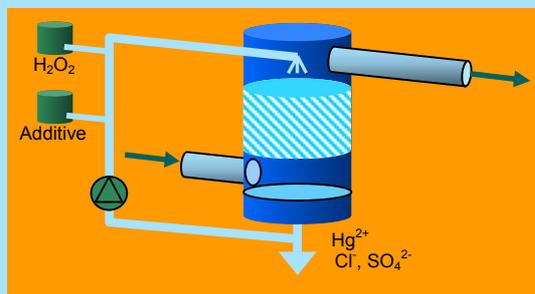
- *A new “green” technology for the removal of mercury in flue gases*
- *The environmentally friendly oxidising agent hydrogen peroxide is used*
- *Removes mercury, HCl and SO₂ from gases in one unit*
- *Has a wide range of applications*

Environmental problems and objectives

Mercury is a well-known environmental problem. According to the position paper on mercury (October 2001) 340 tonnes are emitted annually from anthropogenic sources in Europe. Only in Sweden, it is estimated that pike in more than 10 000 lakes has a concentration of methyl mercury exceeding 1 mg/kg (wet weight), meaning this has economical significance as well as it affect peoples quality of life. Human activities that lead to mercury emissions to air are combustion of coal, peat, sludge and waste. Further more, industrial processes such as smelters, cement kilns and caustic soda production are of significance. Finally, activities such as soil remediation and cremation are also leading to mercury emissions.

Project organisation

This EU-Life project has been a collaboration between Forschungszentrum Karlsruhe in Germany and Götaverken Miljö AB in Sweden. EKA Chemicals in Sweden has been involved as a host for the full-scale demonstration plant at their thermal soil remediation facility. The contributions by EU-Life have made possible to test the process at different flue gas compositions and to demonstrate the process in a full-scale soil remediation plant with the aim to find more sustainable solutions for the reduction of mercury emissions in different industries throughout Europe.

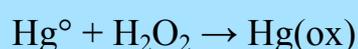


Schematic view of a MercOx scrubber

Description of the process

MercOx is a wet scrubber technique utilising hydrogen peroxide to oxidise elemental mercury to a water soluble form. The oxidation and absorption is performed in a scrubber with tower packing. The flue gas is passed counter current to the scrubber liquid. In the scrubber both SO₂ and Hg⁰ are oxidised by the hydrogen peroxide forming sulphuric acid and Hg²⁺. The oxidised mercury could either be precipitated and collected for safe deposit or recycled as Hg⁰. An additive further enhances the removal efficiency of mercury.

Chemical reactions



Target Groups

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Incinerators for:
 - Hazardous waste
 - Municipal waste
 - Sludge
 Crematories
 Soil remediation plants

Possible applications

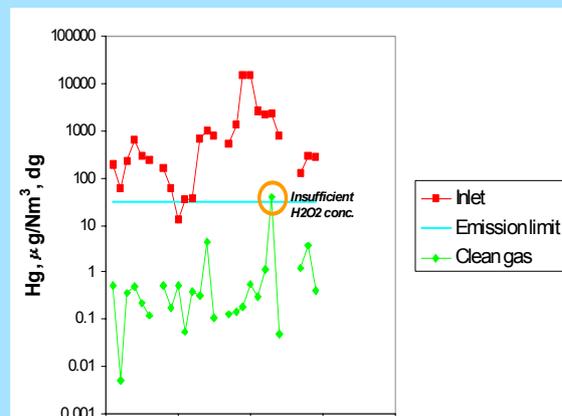
Chemical industry
 Battery and
 electronic recycling
 Coal combustion

Pilot plant

The MercOx pilot plant at Forschungszentrum Karlsruhe is connected to the test plant AGATE-2. At AGATE-2, it is possible to produce flue gases with different chemical compositions, simulating real process gases from e.g. hazardous waste incineration. Experiments were made during municipal waste incineration at the FZK pilot plant TAMARA. This plant consists of a grate furnace, a boiler and a flue gas cleaning line. Gas streams from different industrial processes can be simulated in these plants in order to optimise MercOx for specific conditions.



The AGATE-2 pilot plant in Karlsruhe



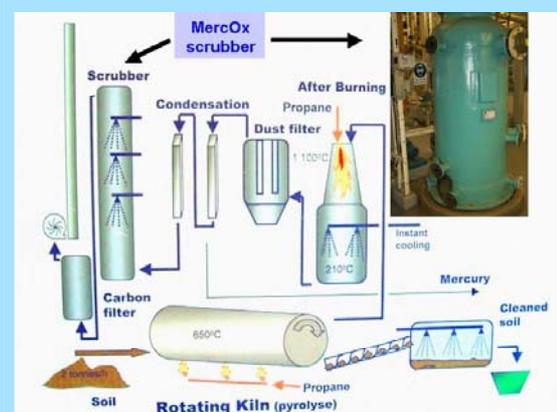
Raw and clean gas concentrations of mercury at the SAKAB Hazardous Waste Incineration MercOx scrubber during the performance test. (1/2 h mean values).

Hazardous waste

The MercOx process was first taken into operation in full scale at the hazardous waste incineration plant at Sydkraft SAKAB in may 2000. The performance test was done by incinerating waste with extremely high Hg-content, in order to investigate the performance during Hg-peaks. A removal efficiency better than 99.9 % was obtained during these measurements, although the raw gas concentrations are sometimes even higher than 10 000 $\mu\text{g}/\text{Nm}^3$. These measurements reflect the excellent buffer capacity of the MercOx scrubber, which is due to the long residence time of the scrubbing liquid volume.

Soil remediation

The MercOx demonstration plant is located at the thermal soil remediation plant at the EKA Chemicals facility at Bohus in Sweden. The process conditions for developing MercOx are very convenient since the soil remediation plant generates a gas with a high and relatively constant concentration of elemental mercury. In the plant, 2 ton of mercury and dioxin contaminated soil are treated an hour, generating a flue gas with a concentration of 10 000 $\mu\text{g}/\text{Nm}^3$ before the MercOx scrubber.



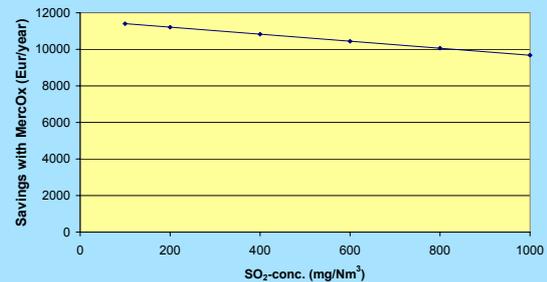
The Eka Soil plant with the MercOx scrubber

Cost comparison

Computer programs for technical design and economical evaluations have been developed in the project. In the figure a comparison is made between two different process solutions at the demonstration plant:

1. A SO₂-scrubber with sodium hydroxide addition and a fixed bed carbon filter.
2. A MercOx scrubber and a fixed bed carbon filter.

In the first alternative the carbon traps all mercury and SO₂ is absorbed by NaOH, while in the second one, the carbon is only used as a police filter and mercury and SO₂ is captured by H₂O₂.



A comparison between MercOx and fixed bed activated carbon filters. In this example, a saving of 10 000 Euro a year can be accomplished by using the MercOx process.

Proven efficiency

During the EU-LIFE project, experiments have been performed at different pilot plants. A full scale MercOx scrubber at the hazardous waste incineration plant at Sydkraft SAKAB is also in operation.

Plant	Type of plant	Efficiency (%)
AGATE-2	Experimental pilot plant	95-99.9
Sydkraft SAKAB	Hazardous waste incineration (full scale)	95-99.99
Eka Soil	Thermal soil remediation (full scale plant)	90-99
TAMARA	Municipal waste incineration (pilot plant)	97-98

Hg (tot) removal efficiency

The MercOx process has been found to work well at all applications. In future new applications, a removal efficiency of 99 % or better can be obtained.

Innovative features

Standard techniques have problems to abate elemental mercury in flue gases in such a way that emission limits are fulfilled. Other techniques such as fixed bed activated carbon filters or addition of activated carbon to the flue gas, generate huge volumes of waste that might lead to new problems. The environmental benefits with the MercOx process are:

- Hydrogen peroxide is a “green” chemical, generating only water and oxygen as a waste product.
- The process is very good for peaks due to its large buffer capacity.
- Both metallic- and oxidised mercury as well as SO₂ and HCl are absorbed in one unit.
- Equipped with Adiox scrubber packing, the same unit can also absorb dioxins.
- Mercury is absorbed in a liquid and can be precipitated to the stable form of HgS.
- If desired, mercury can be recovered as metallic mercury and reused.



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