# Emissions of thermal treatment of asbestos containing waste (ACW)

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**Keywords**: asbestos, emission, thermal treatment, fibres, impacts
**Topic**: Hazardous waste
**Type of presentation preferred**: oral

## Introduction

Today the term of Asbestos indicate a group of six commercial silicate minerals: chrysotile, actinolite asbestos, amosite, anthophyllite asbestos, crocidolite and tremolite asbestos.

In 2012, asbestos was considered by IARC (International Agency for Research on Cancer) “Carcinogenic to humans” (IARC, 2012). Then main problem was to dismiss companies, make places safer and healthier and dispose of asbestos. The current legislation requires that Asbestos Containing Materials (ACM) must be removed in accordance with safety regulations. The actual treatments of asbestos in contaminated sites proceeded with three different approaches: removal, encapsulation or confinement. Generally, after the removal activity the asbestos containing waste (ACW) are landfilled. The landfilling is not always great solution because the fibres can release from the packaging and contaminate the leachate.

About the safety of landfill disposal, the European Parliament in 2012 said that “delivering asbestos waste to landfills would not appear to be the safest way of definitively eliminating the release of asbestos fibres into the environment particularly into air and groundwater”, then promoted the use of alterative solutions such as asbestos inertitations plants. There are different techniques based on thermal, chemical and mechanochemical processes (Paolini *et al*., 2019), the fist one altertives is the most invetigated methodology. Although there are more studies on all technologies, little is known about the emissions of asbestos and other pollutants related to a hypothetic thermal plants for asbestos treatment. This study aims to increase knowledge about environmental impacts of thermal inertization because, nowadays, there isn’t specific experimental study about emissions.

## Material and Methods

Two different kind of ACW were collected and tested: commercial asbestos cement (C) and asbestos cement with polymers (CP) (Figure *1*). The samples were analysed in terms of chemical and mineralogical compositions before the treatment and are packaged to simulate the security packaging used for asbestos removal. The samples were treated with experimental conditions according with Bloise *et al*. (2016); Gualtieri *et al.* (2008), in a dedicated prototype with two different temperature programs on the basis of the different sample type.

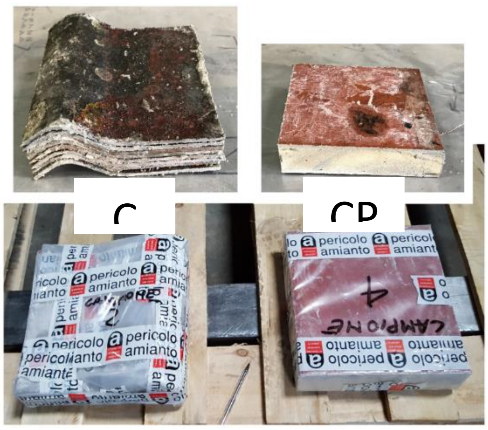


Figure 1 Picture of Commercial asbestos cement (C) and asbestos cement with polymers (CP)

During the treatment were analysed gaseous emissions include nitrogen oxides ($NO_x$), sulfur dioxide ($SO_2$), carbon monoxide (CO), carbon dioxide ($CO_2$) and oxygen ($O_2$) with a multi-gas analyser PG-250. Volatile organic compounds (VOCs) were collected with a portable dynamic dilution sampler on activated carbon cartages and analysed using thermal desorption, cryo-focusing and gas-chromatography coupled to quadrupole mass spectrometry (TD-GC/MS).

The total solid particles were isokinetically sampled on filter, condenser and XAD cartridge for measurement of total suspended particles (TSP), asbestos fibres, heavy metals, and organic micropollutants such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) dioxins and furans (PCDD/Fs). The filter is analysed with gravimetric analysis, XRF analysis and SEM/EDS to define the amount of total dust, heavy metals composition and the presence of asbestos fibres respectively.

The condensation water, the soxhlet extraction from the remaining part of filter and XAD cartridge were purified and analysed by Ultra Trace GC coupled to a TSQ mass spectrometer, with a TriPlus autosampler (GC-MS/MS) to define the PAHs, PCDD/Fs and PCBs pollutants. The solid residue of treatment was collected and analysed using X-ray powder diffraction (XRPD) and scanning electron microscopy (SEM) in order to verify the transformation of asbestos fibres. Figure 1 shows the monitoring plan in term of methodology for sampling and analysis for the different pollutants.

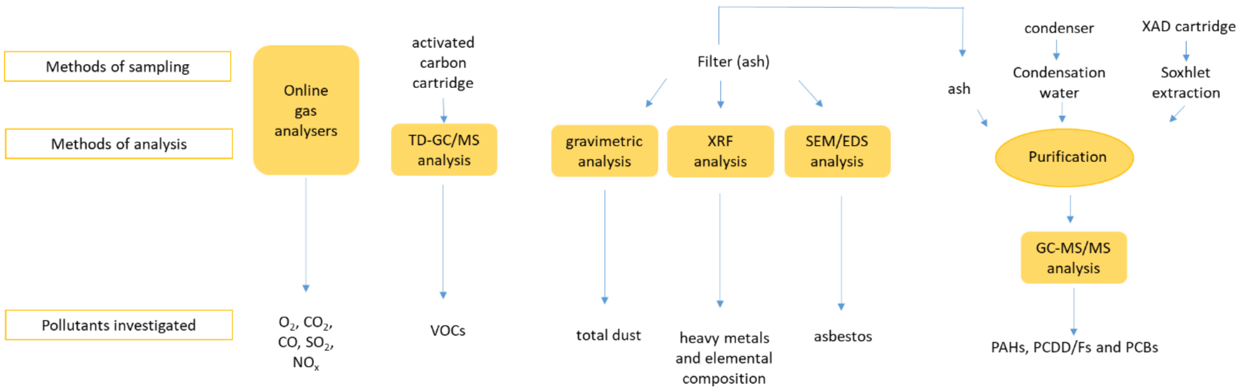


Figure 2 Methods of sampling and analyses

**Results and conclusions**

The most important result of tests is the absence of asbestiform fibres in the emissions flux during the thermal treatment. This aspect is more important related to health risks themes. In the same time, no asbestos fibres were found in solid residue.

Other pollutants were monitored, the concentrations of NOx, $SO_2$ and heavy metals are comparable with municipal solid waste incinerators (MSWI) and cement plants. The two different kind of samples have different emission of PAHs, BTEX (benzene, toluene, ethylbenzene, xylenes) and styrene that are higher for polyurethane samples. The polyvinyl chloride (PVC) in the coating used during the removal of asbestos cement can influence the emission of halogenated VOCs, PCBs and PCDD/Fs, so the use of different coating without vinyl chloride would likely reduce the emissions of chlorinated pollutants.

In conclusions, the process is safe, a hypothetical industrial reactor would not needs of particular abatement systems. Therefore, given the results, the implementation of this plants could reduce the concern related to landfilling and follow the European guidelines.

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**Acknowledgements**

This work was supported by the Italian Ministry of Environment and Land and Sea Protection, General Direction for Waste and Pollution (MATTM-DGRIN), under the Agreement RINDEC-20016-4 of November 25th 2015, entitled “Development of a novel methodology for asbestos inertisation, emission abatement and analysis of the supply chain” and under the granted project Decr. Dir. Min. Ric-Dec_2017_0000196, 22/12/17, “Tecnologie di trattamento di rifiuti contenenti amianto (RCA) e riciclo per la produzione di piastrelle ceramiche, nell’ottica di una economia circolare”.