Emissions of thermal treatment of asbestos containing waste (ACW)

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Inertization: European Parliament Resolution

According to current legislation, ACW (Asbestos Containing Waste) must be removed and properly managed in accordance with safety regulations.

The European Parliament resolution 2012/2065 (INI) of 14 March 2013 ("asbestos related occupational health threats and prospects for abolishing all existing asbestos") states that:

"whereas 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) and whereas therefore **it would be far preferable to opt for asbestos inertization plants**".

"creating landfills for asbestos waste is only a temporary solution to the problem, which in this way is left to be dealt with by future generations"

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2

Inertization: Thermal treatment

This category is very articulated and incorporate the **most important industrial experiences**.

The common **critical issues** for all thermal treatments are:

- **the high energy required** to heat a thermally inert material such as asbestos.

- **formation of atmospheric pollutants** during the heating phases (vinyl-asbestos can lead to the formation of persistent organic pollutants such as dioxins and polychlorinated biphenyls)

The **main advantages** connected to thermal treatment are:

- **incorporation of large amounts of heavy metal ions** inside an inorganic amorphous network;
- the **final** process **product is inert**
- flexibility to **treat wastes** of **various type;**
- a **reduced amount of waste** is obtained.
- **consolidated** technology;

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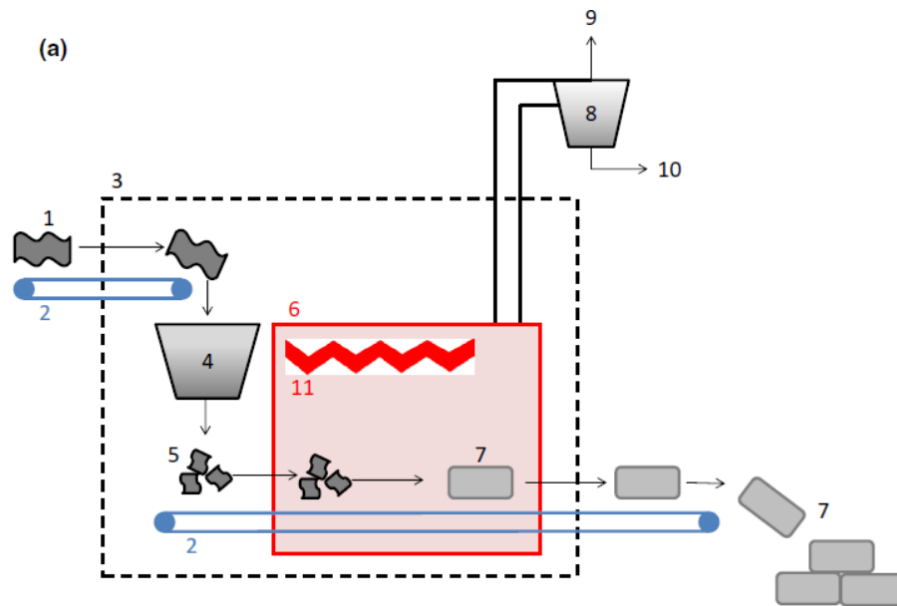
3

Inertization: Thermal treatment

KRY-AS Process – The cooking cycle uses a "tunnel" continuous industrial gas oven

The big bags are put on furnace without pre-treatment.

The process work at 1200-1300 °C for 26 hours.

3 Phases:
- Pre heating
- Cooking
- cooling

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4

Samples characteristic

Two different kinds of ACW were used, in order to observe the impact of waste composition on the emissions.

- commercial asbestos cement ➡ most prevalent kind of ACW

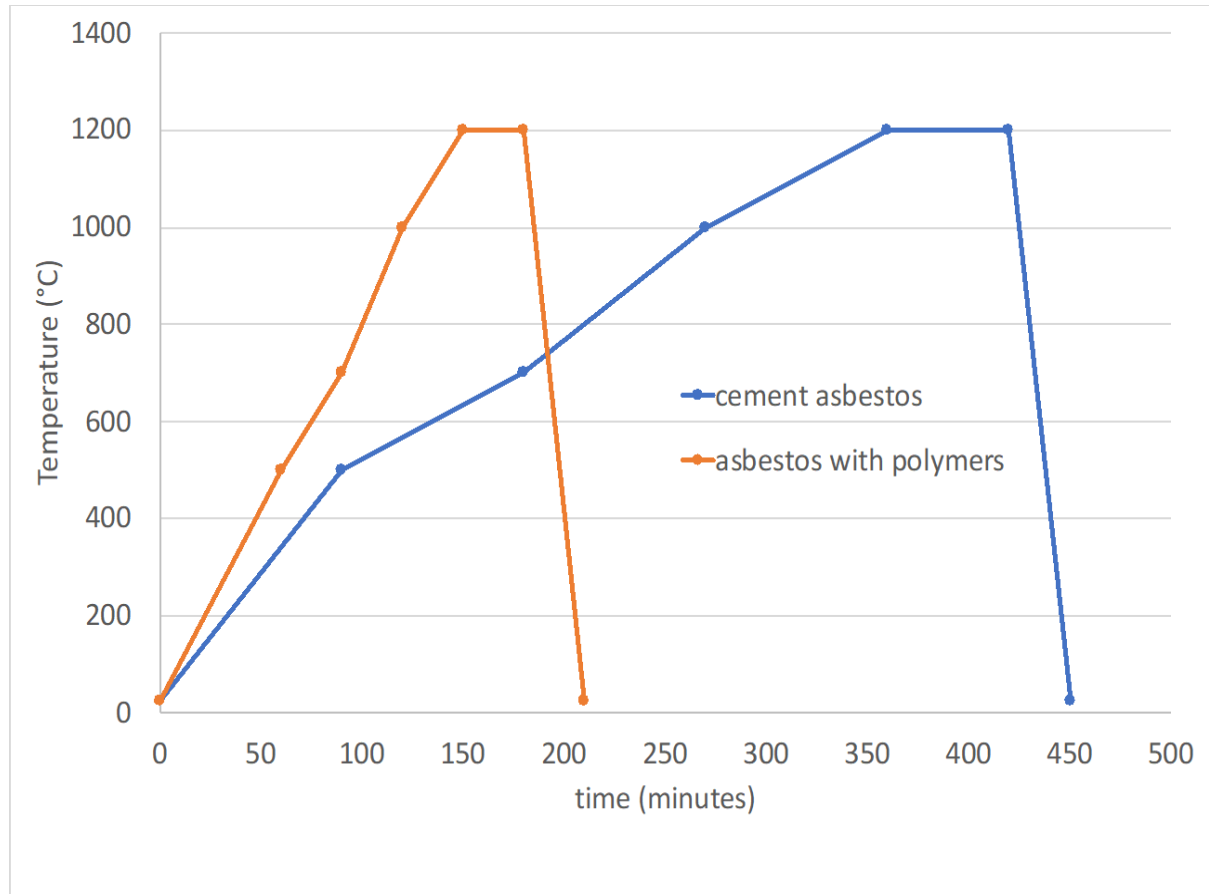- asbestos with polymers ➡ Common and significant emission of pollutants was expected

C   CP

Sample code	Description	Weight (kg)
C1	Asbestos cement	5.294
C2	Asbestos cement	4.627
CP1	Asbestos with polymers	1.035
CP2	Asbestos with polymers	1.135

The samples were packaged to simulate the security packaging used for asbestos removal.

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5

Inertisation methodology

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Inertisation methodology

BEFORE

AFTER

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Monitoring strategy emissions

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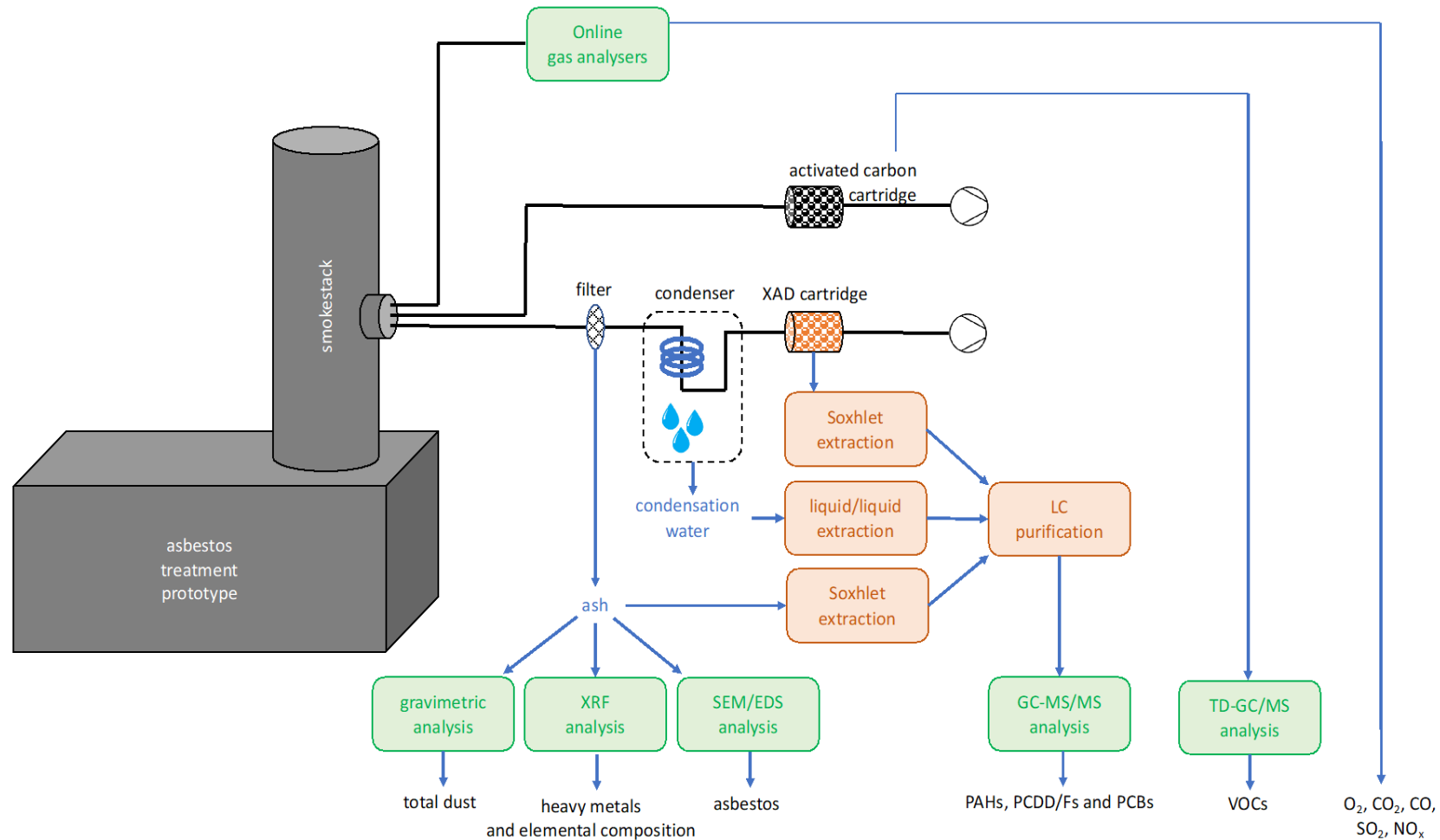
Monitoring strategy emissions

C1
Asbestos cement

CP1
Asbestos with polymers

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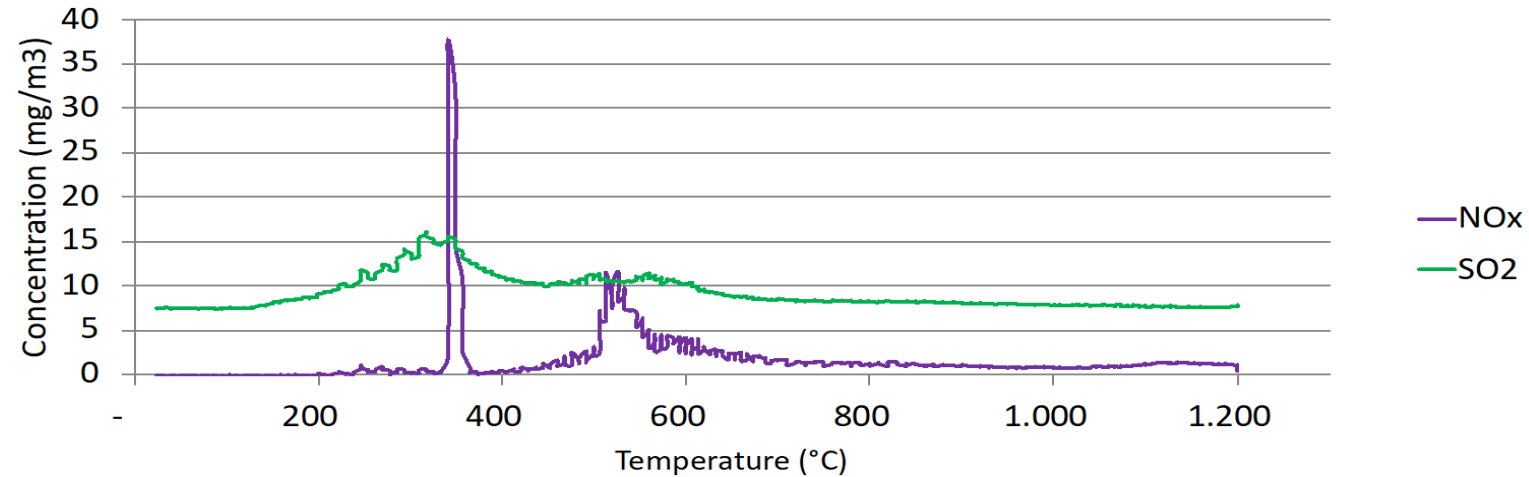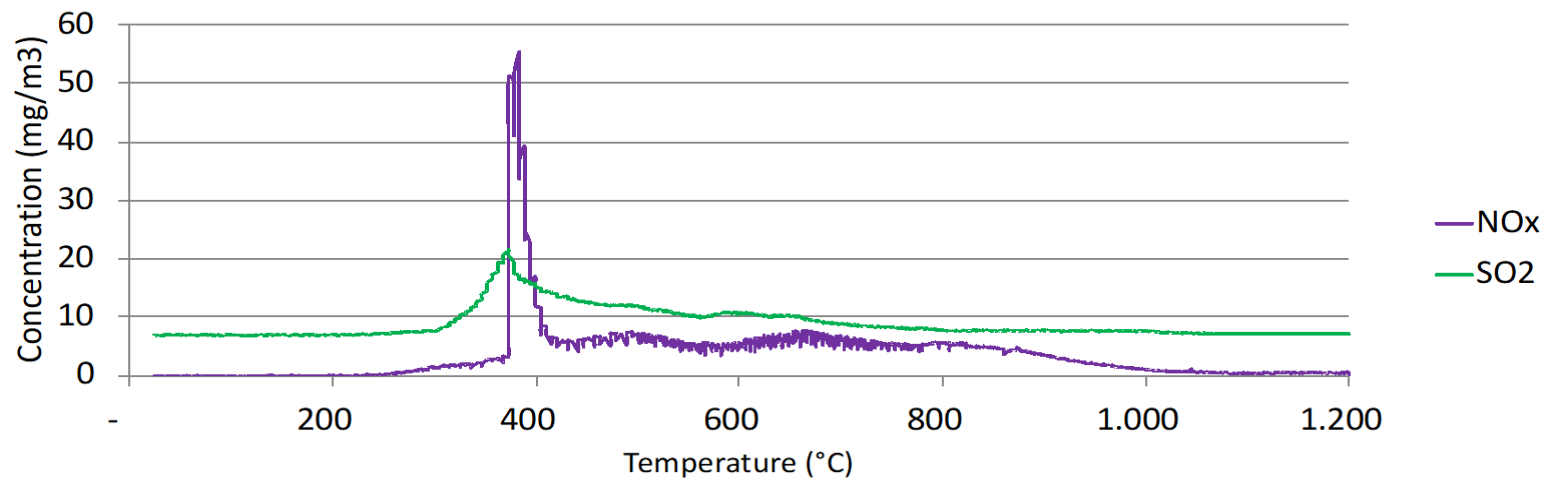
Monitoring strategy emissions

They are commonly associated to the incomplete combustion of the carbon-containing substances, so they can be attributed to the oxidation of the plastic bag were the ACW was confined.

the highest VOC concentrations are observed for CP samples.

due to the combustion of polyurethane

	Samples C	Samples CP
Acetone	0.10	0.18
1-chloro-1-propene	-	0.13
1-hexene	-	0.25
Chloro-butane	0.71	0.27
Benzene	12.7	16.5
1,2-dichloropropane	0.39	0.25
Toluene	1.53	2.80
Chlorobenzene	0.33	0.18
Ethylbenzene	0.18	0.45
1,3-xylene and 1,4-xylene	0.33	0.91
1,2-xylene	0.05	0.13
Styrene	6.89	2.98
1-ethyl-2-methyl-benzene	-	0.11
1-methylstyrene	0.32	0.20
Naphthalene	-	0.49

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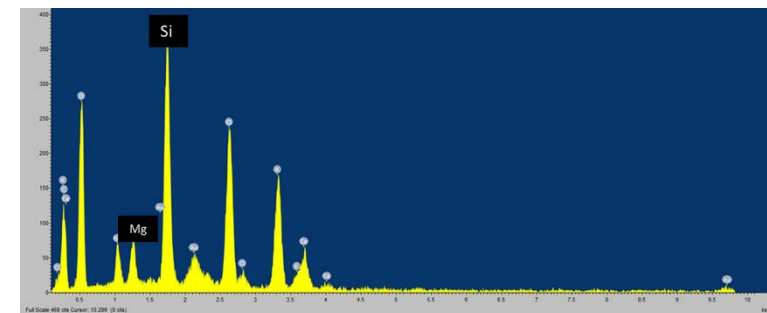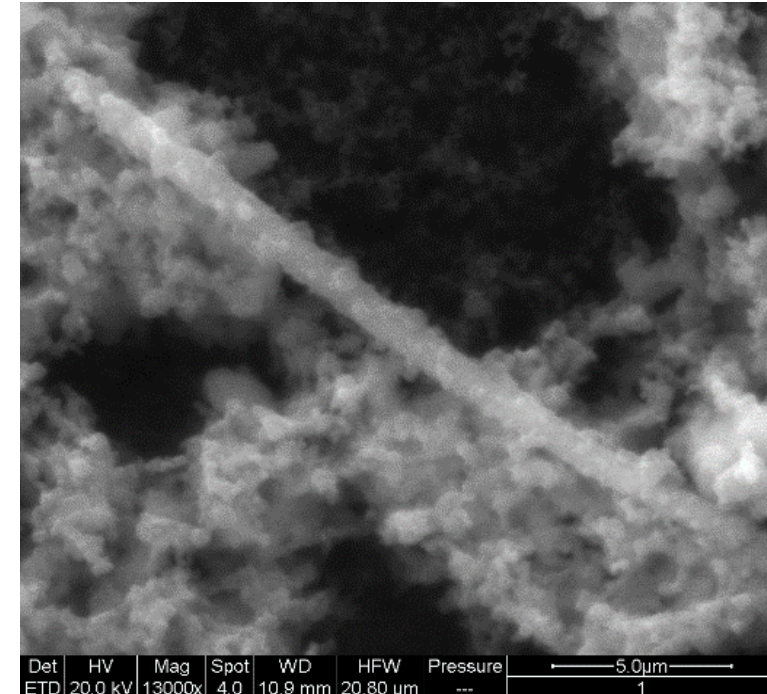23-26 JUNE 2021, THESSALONIKI, GREECE

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Asbestos fibres

The SEM-EDS analysis confirmed the presence of a typical structure resulting from chrysotile degradation

can be observed the growth of crystals of sub-spherical silicates, which are typical of the minerals constituting the inert material.

The EDS spectra confirm the presence of Mg silicates and borosilicates, produced during the thermal inertisation.

In general, a very limited number of fibres was detected. None of them can be classified as asbestos.

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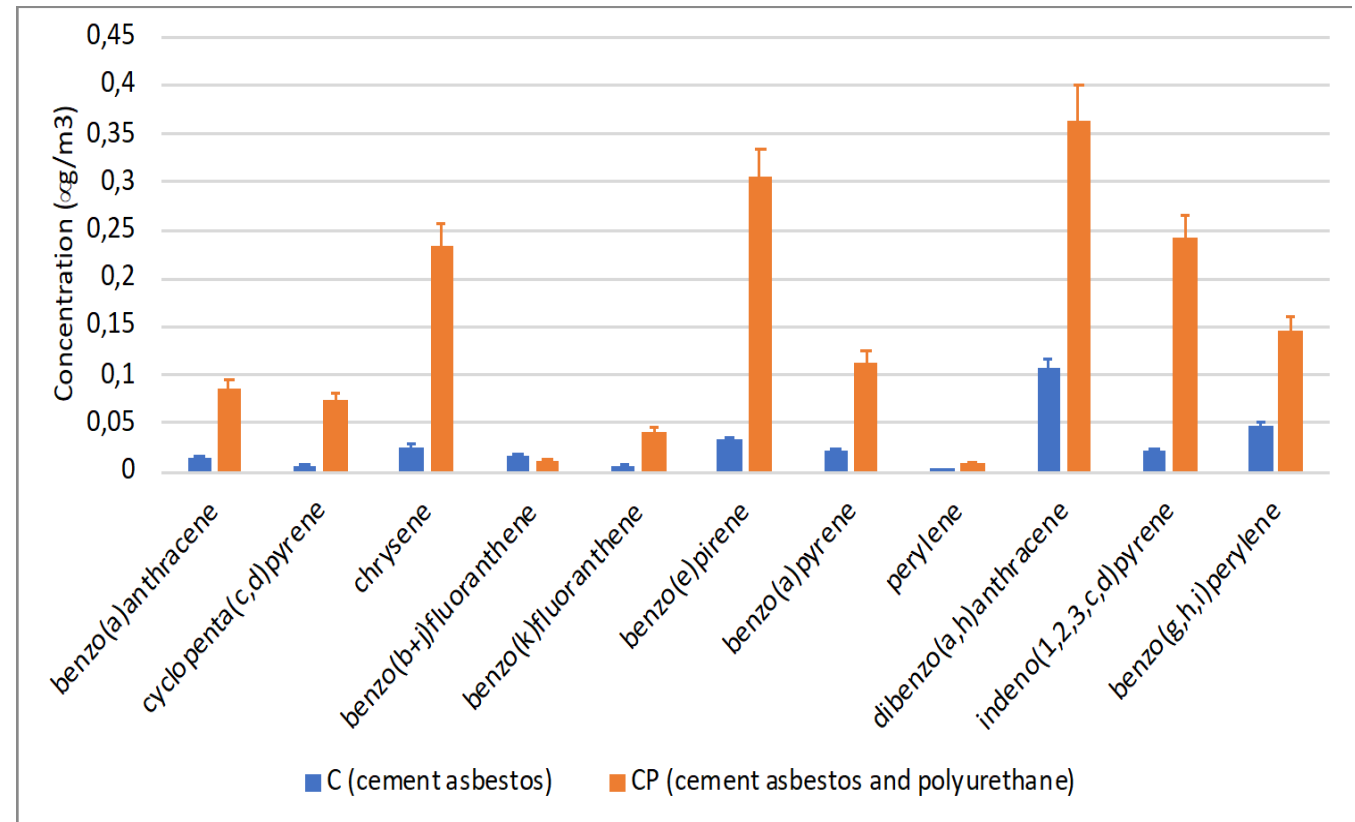23-26 JUNE 2021, THESSALONIKI, GREECE

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PAHs

the most abundant PAHs are those with 3 aromatic rings (acenaphthene, acenaphthylene, phenanthrene and anthracene)

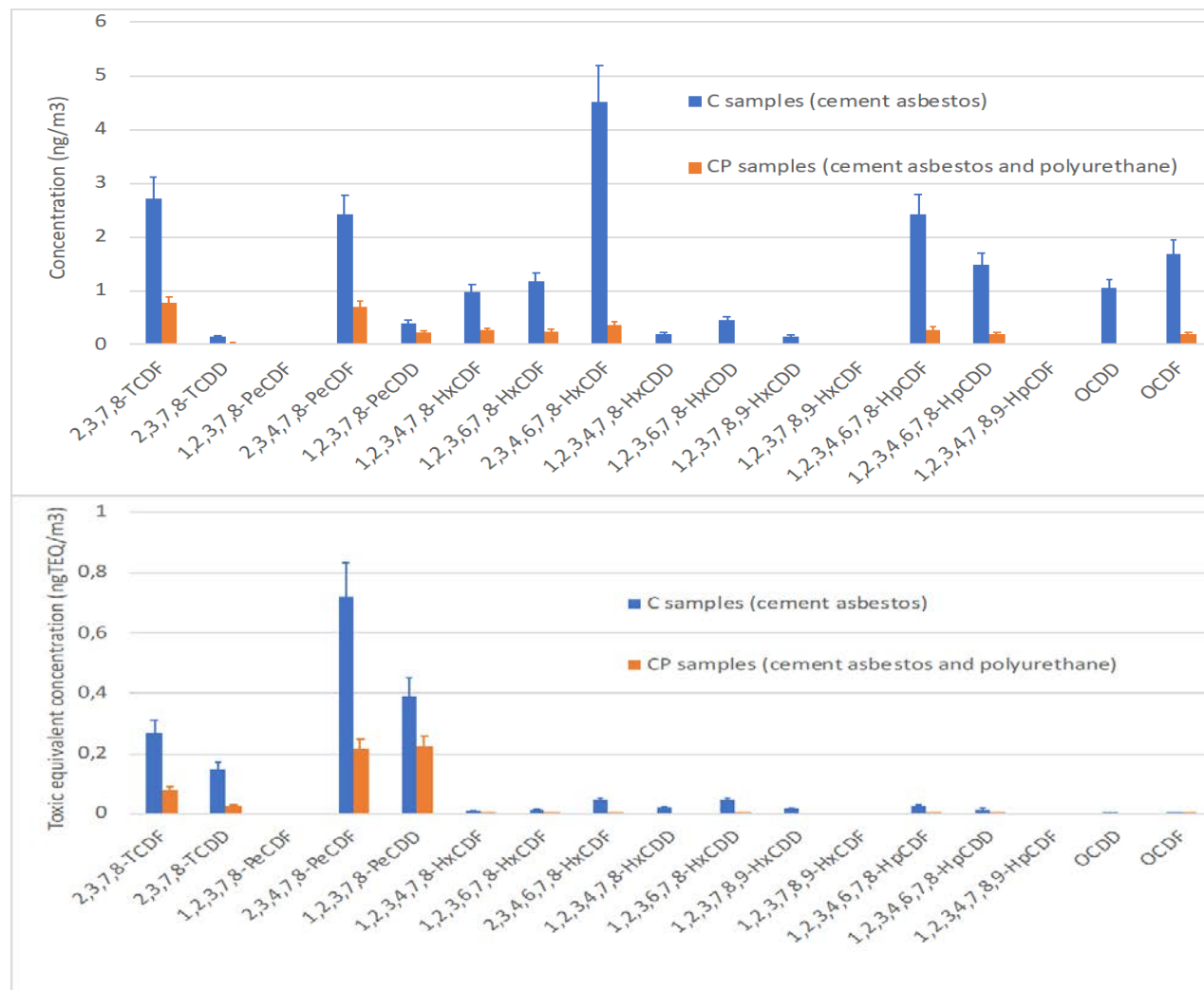least toxicity to humans (IARC,2012,2010,2987)

the concentration of PAHs is comparable to the emissions from the incineration of other kinds of waste (Kuo et al., 2008; Sarti et al., 2017; Wang et al., 2017; You, 2008).

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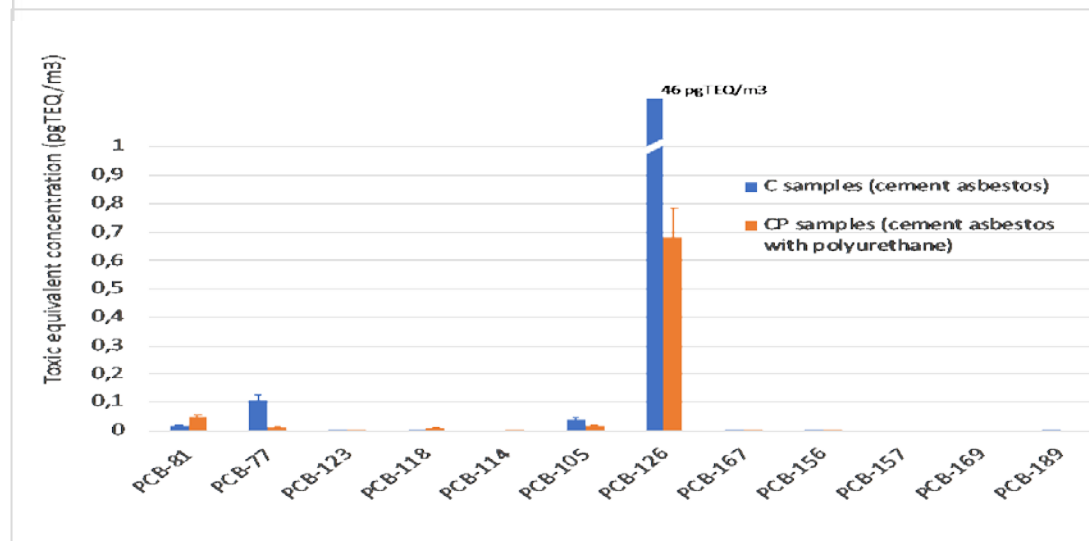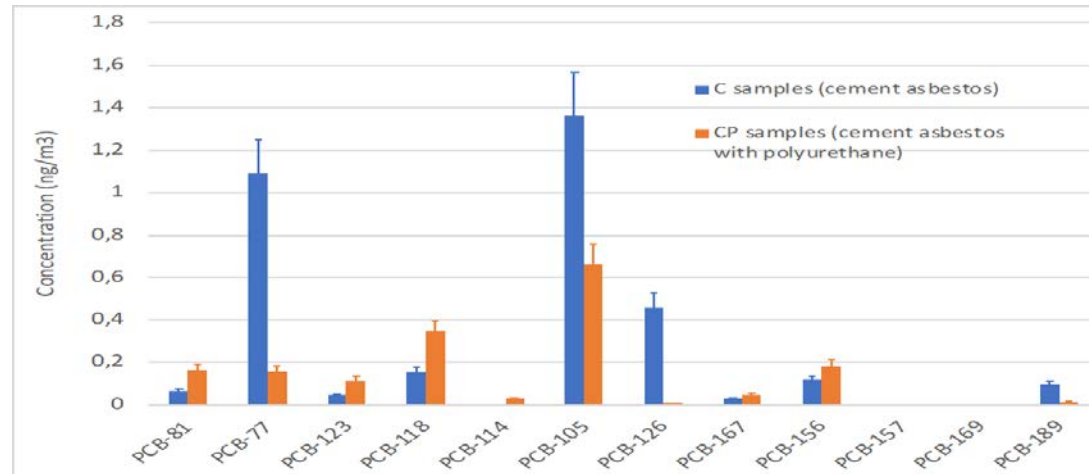23-26 JUNE 2021, THESSALONIKI, GREECE

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PCDD/Fs

There is a relative abundance of PeCDDs (pentachlorodibenzo-p-dioxin), which is typical of industrial emissions, such as municipal solid waste incinerators (Wang et al., 2010; Zhang et al., 2012) and production of cement (Conesa et al., 2011; Li et al., 2014) and steel (Gao et al., 2019; Y. Li et al., 2010).

the highest concentration is observed for samples with only asbestos cement

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PCBs

For dl-PCBs the highest emissions are observed for CP samples. Consequently, the emissions of dl-PCBs can be attributed to the PVC coating rather than to the combustion of the polyurethane.
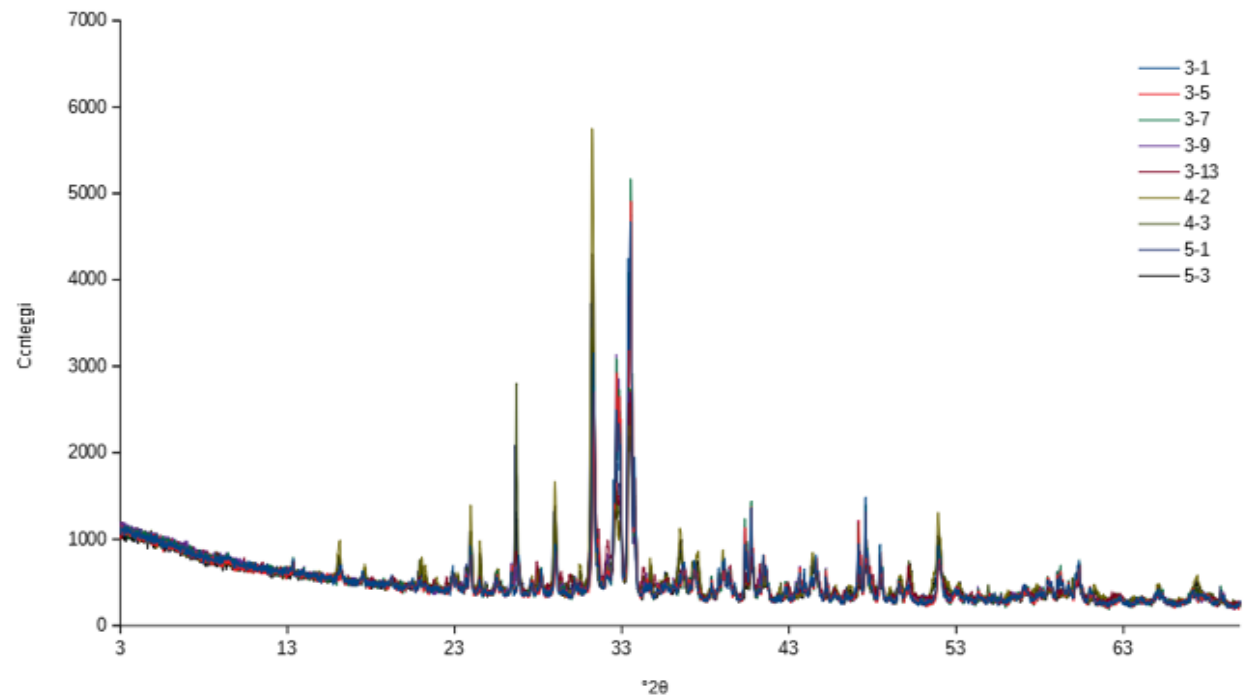
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Solide residues

XRPD analyses

confirmed the removal of asbestos fibres.

All samples are composed by Al-Ca-Mg silicates, namely
akermanite,
bredigite
merwinite

Other minor components:
larnite (Ca_2SiO_4),
monticellite ($CaMgSiO_4$)
ternesite ($Ca_5(SiO_4)_2SO_4$)

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Conclusion

Data obtained in this part of study demonstrate the absence of asbestos fibres in the emission.

Important finding is the role of the chlorinated coating used during the removal of asbestos cement. This coating is a vinyl resin can strongly increase the emission of chlorinated VOCs and dioxins (PCDD/Fs and dl-PCBs), the use of alternative coatings should be recommended.

The comparison between two blends of waste (samples C and CP) confirmed that the emission of PAHs and non-halogenated VOCs is mainly related to the combustion of carbon-containing components (polyurethane), rather than to asbestos cement.

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