With the contribution of the LIFE financial instrument
of the European Union

FIBERS

Fibers innovative burning and reuse by Self-propagating High temperature Synthesis (SHS)

Layman's report

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FIBERS

The LIFE FIBERS “FIBERS INNOVATIVE BURNING AND REUSE BY SHS” project aims to develop an innovative technique for the treatment of asbestos-containing waste with the SHS* process, by implementing two prototype plants.

*Self - propagating high - temperature synthesis

The objectives of LIFE FIBERS:

- To implement two prototype ovens from lab scale to intermediate scale (able to burn hundreds grams) up to pre-industrial scale (able to burn tens of kgs).
- To use the SHS reaction to neutralise the asbestos fibers. During the project the efficiency of reactions at mid- and large-scale was assessed to verify the extent of transformations of the fibrous mineral waste to non-fibrous minerals with a different crystal chemistry.
- To test the application of the SHS process to other fibrous waste.
- To explore the reuse of breakdown products as secondary raw materials.

The FIBERS partners

FIBERS, step by step

STEP 1

Starting from a small laboratory apparatus, a larger prototype for the SHS combustion of hundred grams waste was designed and built (prototype 1).
A Safe and Clean Laboratory for testing the mid scale combustion was built at the University of Genoa.
As many types of asbestos waste as possible were characterised before combustion.

STEP 2

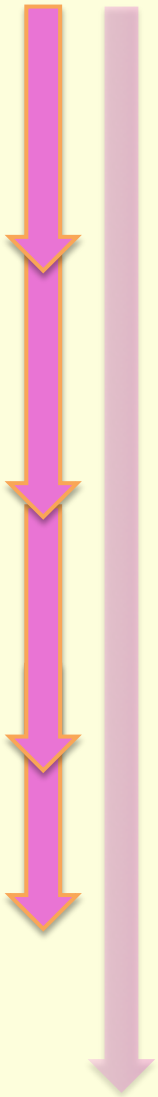
After some tens of tests with blank samples, over 100 SHS waste + reagents mixtures were combusted.
Afterwards, analyses to verify that the waste was effectively treated demonstrated neutralisation for mixture up to 70% waste.

STEP 3

The second prototype profited of all previous tests: Telerobotlabs engineered the continuous feeding of waste + reagents as fast as the SHS reaction. Several waste type, 240 kgs, were successfully treated at Vico, in their Area 51 plant.

STEP 4

Multiple analyses validated the treatment: scanning electron microscopy, XR diffractometry, thermal analyses, bioessays.



STEP 5

Presentation of our goals, dissemination of our results to specialists at conferences, social outreach at scientific fairs. Networking with stakeholders.

The partnership

The LIFE FIBERS project gathered three partners:

- The University of Genoa, to coordinate and develop the SHS technology applied to asbestos – containing waste via the prototype 1.


- Telerobots Labs, to bridge the laboratory data and the prototype 2.


- Vico, to provide all waste types and to host the prototype 2 and its run in a safe, confined, environment, Area 51.

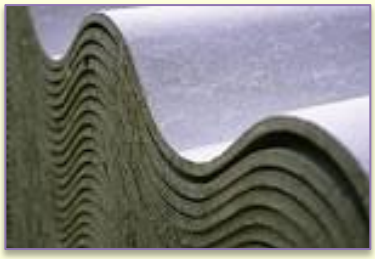

Asbestos: a multidimensional problem

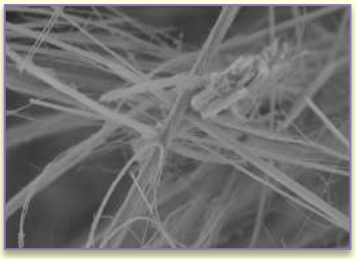
- **Health** and occupational exposure
- **Social outreach** (local authorities, experts in management, monitoring networks, quality in monitoring…)
- **Normative harmonisation** (international ban, decommissioning, end of life for waste, second life for neutralised products…)
- **Environmental** (geohazard from ophiolites, waste landfill)
- **Technological** (substitute materials, effective neutralisation)

The waste

Asbestos-containing waste (ACW) is the most abundant type after municipal solid waste, and the most abundant toxic waste.

The safe management of ACW is problematic for several reasons, to the environmental impact of new landfill sites, and the costs of adjustments to event stricter regulations.
Finally, local governments tend not to allow the development of new landfill sites.
This scenario requires urgent contribution for ACW management.





The SHS process

The SHS process profits from a strongly exothermic (that produces heat) oxy-reduction reaction between a metallic oxide and alumina or another reducing reagent.

After having applied a heat source for a few seconds to the waste + reagents mixture, the reaction proceeds through the reacting volume as a combustion wave, without the need of further energy input.

The innovative treatment

Waste collection, safe management and transport

OPTIONS

Landfill for toxic materials	Conventional thermal treatment	SHS combustion
Low energy, land consuming, fast, does not destroy fibers	*Energivore, long lasting treatment, quite good neutralisation of fibers*	*Very low energy, fast treatment, destroys and changes composition of fibers*

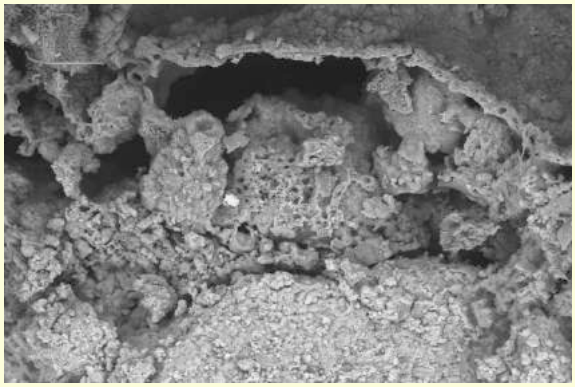
Inert waste / second material

The final bag of ACW waste treated by SHS

Managing and treating this hazardous waste

Area 51, the confined room for decomissioning at Vico, where the prototype 2 was installed and run

The prototype 2 inside Area 51: left side, the reaction chamber, right side, the mix and charge apparatus



ACW after SHS treatment: fibers have disappeared and composition has changed

The results of FIBERS

Both prototypes achieved the goal. We optimized the parameters to achieve **complete conversion** of the asbestos to mineral grains in all the cases.

The SHS process in comparison with conventional thermal treatments, due to **fast reaction time, low activation energy,** particularly advantages the asbestos neutralisation and positively reflects into time and costs of the process.

FIBERS in numbers

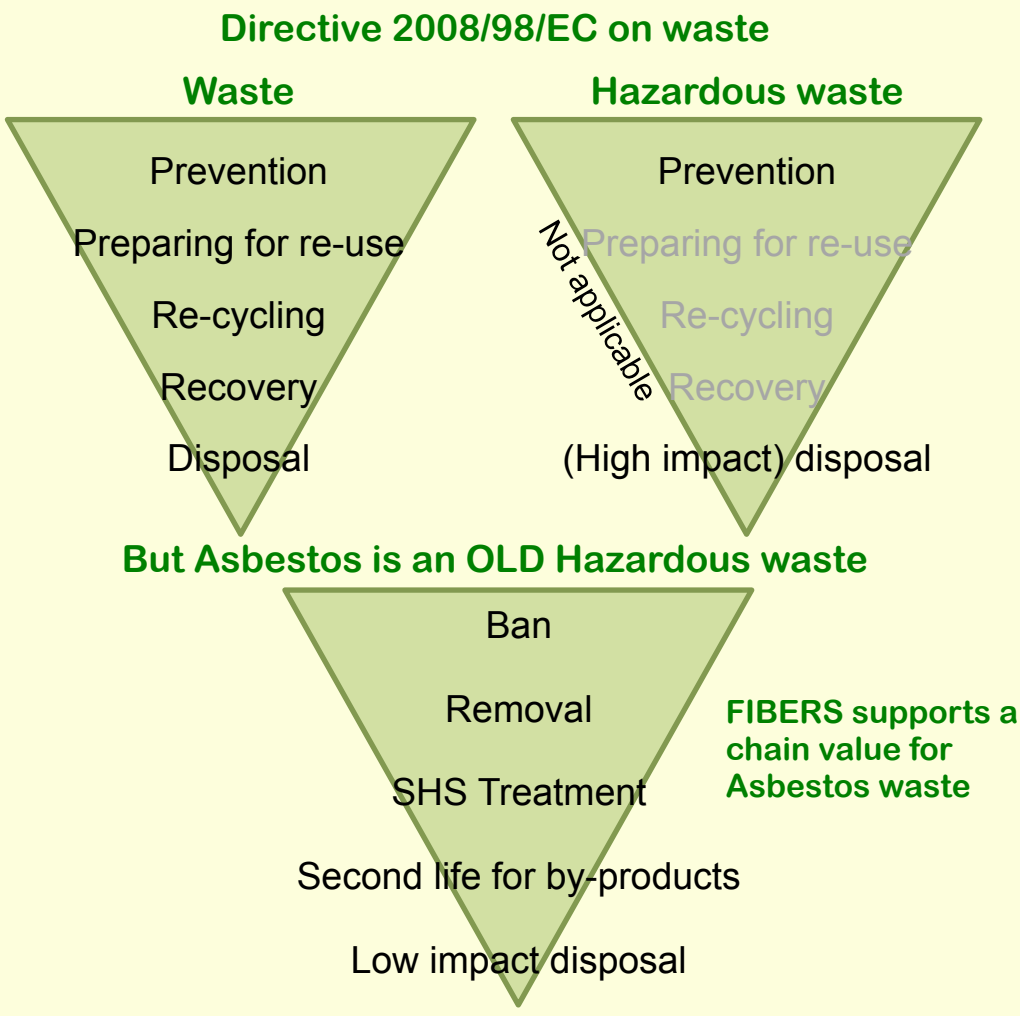
FIBERS IN ACTIONS…

3 partners (**1** public, **2** companies)
2 medium scale prototypes, **1** large scale prototype
50 samples, **3** reagents characterised by Scanning Electron Microscopy before SHS
50 samples, **3** reagents characterised by XR powder diffraction before SHS in prototype 1
108 pellet combustions, **108** movies, **108** optical analyses, **108** SEM EDS analyses, **108** XRPD characterisations, after SHS in prototype 1
75 samples characterised by Scanning Electron Microscopy before SHS in prototype 2
75 samples characterised by XR powder diffraction before SHS in prototype 2
240 kgs treated waste in prototype 2,
100 optical analyses, **20** movies, **100** SEM EDS analyses, **100** XRPD characterisations, after SHS in prototype 2
40 thermo-gravimetric analyses, **10** toxicological tests

DISSEMINATION

9 national congresses, **10** international congresses, **1** presentation conference, organisation of **1** international workshop, **1** video, **3** scientific fairs, press releases, **2** showcases

FIBERS and the waste hyerarchy



What comes after?

FIBERS demonstrated the neutralisation of ACW by SHS

A long term fallout is the decreased need for landfill dedicated to hazardous waste

FIBERS represents an innovative tool for a sustainable asbestos waste cycle.

OUR HORIZON:

- To polish the process costs, by substituting reagents with waste
- To transfer the SHS process to suitable waste
- To demonstrate our technology to stakeholders
- To interact with institutions for the fate of combustion products and to promote mobile plants

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Laurina,
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Project leader

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Life FIBERS

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