Paper Number: 4598

Innovative Burning and Reuse of Asbestos Fibers by Self-Propagating High Temperature Synthesis: the Development of an Innovative Technique for the Treatment of Asbestos Containing Waste from the Laboratory Scale to the Implementation of Prototype Plants

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Following the dismissal of asbestos in industrial and civil uses, increasing amounts of fibre-bearing wastes represent a priority problem. This type of waste will further increase as the European Parliament, in March 2013, approved a resolution (2012/2065INI) adopting a common strategy for the total elimination of the asbestos still remaining in European buildings, machinery, tubing, trains and ships by 2028.

Within the project LIFE12 ENV IT 000295 FIBERS "Fibers innovative burning and reuse by Self-propagating High temperature Synthesis (SHS)" co-funded by the European Commission, the University of Genoa has developed an apparatus and a technique for triggering the breakdown reaction of chrysotile by means of an alumino-thermic reaction in a process of combustion synthesis well known as Self-propagating High temperature Synthesis or SHS. This approach yielded interesting results and allowed the development of an efficient method for inerting natural asbestos fibres and man–made products carrying fibres at the scale of some grams.

The experiments were based on the reagent couple Fe_2O_3/Mg. The varying parameters were: 1) different Asbestos-Containing Waste (ACW) massive (Eternit, linoleum) and friable asbestos; 2) ACW abundance respect to reactants; 3) size of the pellet.

The reactions were implemented in two different configurations: a) in discontinuous batches, allowed us to obtain data for the development and fine-tuning of the reaction, b) with continuous feeding, for setting the process parameters towards the industrial scale-up. Before and after the combustive reaction all samples were characterized by SEM-EDS and XRPD analysis.

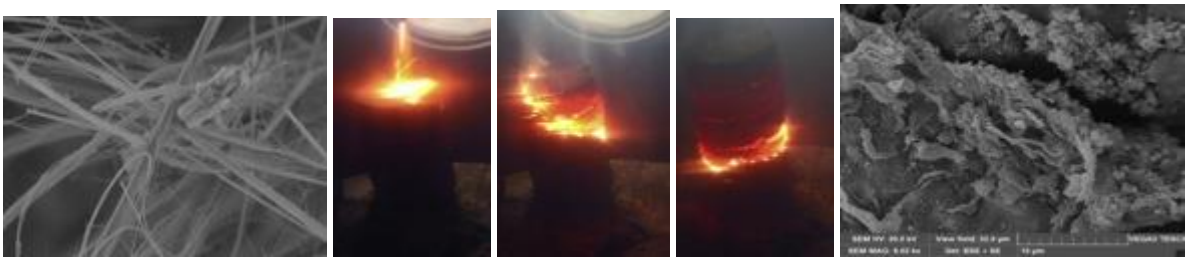

Figure 1: SEM microphotographs before and after SHS thermal treatment. The reaction is triggered by an oxyacetylene torch for a few seconds and then propagates in the sample itself without any other external input of energy

All experiments demonstrated effective destruction of the fibrous habit of chrysotile, turning its composition to stubby olivine grains. We optimized the parameters to achieve complete conversion of the asbestos to mineral grains in all the cases. The efficiency of the SHS reaction in the discontinuous and continuous configurations was highlighted by the characterization of the post-combustion material under SEM-EDS and XRPD that verified the absence of fibres within the limits established by the regulations. The SHS process in comparison with conventional thermal treatments, due to fast reaction time, low activation energy, particularly favours the asbestos inertization that positively reflect into time and costs of the process. Finally, the product of this transformation is able to be re-used, e.g. as abrasive, or refractory material; this represents the end of waste status and a second life as secondary raw material.