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Hydrothermal process development for the treatment of asbestos containing waste

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In France, the maximum industrial production of asbestos was 150 000t.year^{-1} between 1973 and 1975. In France, there are currently two types of waste management for waste containing asbestos: landfilling and vitrification by plasma torch. With the storage of thousand tons waste by year, most sites will be soon saturated. Despite its performance, the vitrification process is energetically expensive.

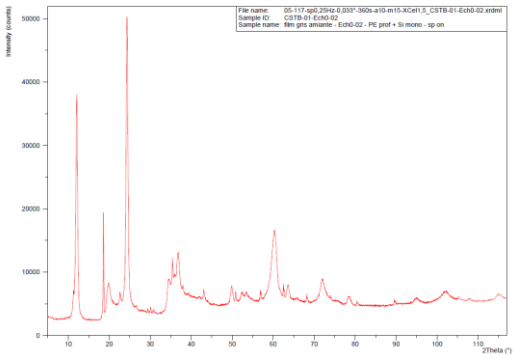
Nowadays hydrothermal process is a mature technology used for the treatment of organics wastes, for instance by wet air oxidation. However, its application for mineral waste treatment is not developed, because technical difficulties. Ball and Taylor (1961) realised the first study on chrysotile denaturation by hydrothermal process. Sigon *et al* (2006) claimed a patent for degradation of asbestos in non-hazardous material by using supercritical water as only reagent. Finally, Anastasiadou *et al* (2010) established the hydrothermal conversion of chrysotile into forsterite in supercritical condition (temperature 700°C and pressure 2.4MPa) during 1h. Due to the presence of the mineral phase, it is necessary to reach high temperature. The objective is either to degradate the organic phase (glue for instance) and to change the morphologic form as well as the crystalline phase of asbestos. An example is given in equation 1 for chrysolite.

$$Mg_3(OH)_4Si_2O_5 \Rightarrow Mg_2SiO_4 + MgSiO_3 + 2H_2O \qquad \text{(Eq. 1)}$$

The aims of this work is to experimentally treat asbestos containing waste. First, an experimental assessment method is developed to qualify the performance of hydrothermal process. Then, a parametrical study is realized to determine influence of temperature, pressure, treatment duration, concentration and variety of asbestos (Table 2).

Figure 1. Experimental apparatus

The result obtained show a total degradation of chrysotile, crocidolite varieties, and fibrocement (containing chrysotile), under these hydrothermal conditions: T≥720°C, P≥25 MPa, t≥1h, C≥ 0.02 mg.ml^{-1}. Different analytical methods (X ray diffraction, particle morphology …) allow to characterise the final product obtained.
For instance, 120mg of chrysolite was treated at 740°C and 25MPa during 6h. The analysis (Figure 2) indicate that there is no more chrysolite and the formation of forsterite and clinoenstatite. A modification of the aspect of the fibers is also observed (Figure 3).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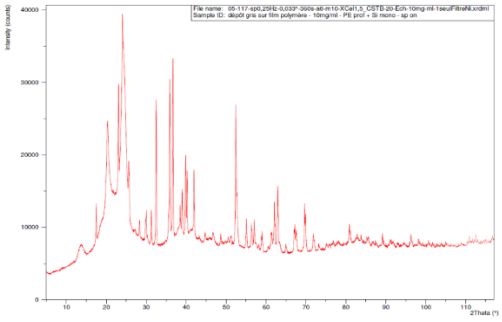
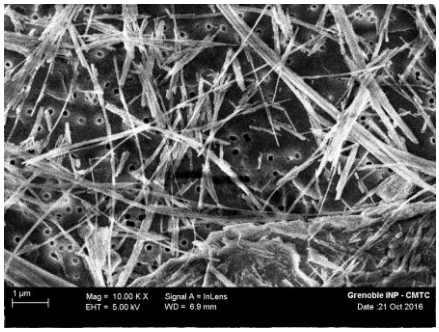

(b)

Figure 2. X ray diffraction analysis before (a) and after (b) treatment



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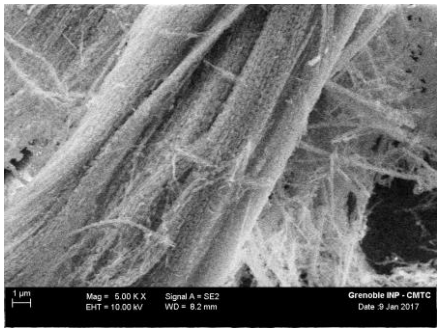

(b)

Figure 3. MEB analysis before (a) and after (b) treatment

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