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Reuse of deactivated cement-asbestos waste as inorganic filler in elastomers and epoxy resins

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Asbestos minerals, namely chrysotile and fibrous amphiboles, have long been used as components in construction materials, as for instance the cement-asbestos (CA) slates used in roofing, exploiting their capability to increase mechanical strength. As well known, asbestos minerals have been recognised toxic and banned almost worldwide. Current remediation approaches include confinement, encapsulation and removal (followed by disposal in controlled landfills). A more attractive solution, strongly recommended by the EC, is detoxification and reuse, in a perspective of circular economy.

In the present contribution we explored the possibility to reuse thermally treated and deactivated CA powder (a mixture of glass and Ca-Mg silicates typical of cement – details in Vergani et al. 2021) as filler in: i) flour-elastomers (FKM type, characterized by high resistance to oil and temperature) and bi-component epoxy resins (bisphenol-A, epichlorohydrine based resins) used in flooring. For each application, different formulations (different proportions of conventional raw materials and deactivated CA powder) have been prepared and tested according to conventional quality test protocols and SEM micro-textural observations.

As regard the reuse in epoxy resin, the inert CA powder was used either as unique inorganic filler (up to 30 wt%) or admixed to conventional ones (barite), in varying proportions (up to 10 wt%). Mechanical tests and SEM observations have shown encouraging results for all formulations, suggesting feasible reuse in this field.

The application of the inert CA powder as filler in fluor-elastomers in substitution of wollastonite (~22 wt%) or barite (~7 and ~14 wt%), has given some controversial results. Although rheological properties such as cure kinetics, viscosity and scorch temperature are comparable to the standard reference samples, some important physical-mechanical properties worsen because of compatibilization and dispersion problems. As demonstrate by SEM observations, the CA powder tends to agglomerate, and similarly to the coarser particles saved from ball-milling – the grain size distribution of the CA powder is tri-modal with peaks at ~35-40, ~4-5 and ~0.7-0.8 μm – separate from the elastomer, adding porosity with detrimental effects on breaking load, elongation at fracture and related M50 and M100 modules.

At the moment, in a perspective to keep the fine fraction low and to reduce the coarse particles, alternative milling procedures, including microwave and ultrasonic treatments and sieving, are evaluated.

Reference: Vergani et al. (2021) J. Mater. Cycles Waste. https://doi.org/10.1007/s10163-021-01320-6

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