
Grinding of Chrysotile in Hydrocarbons, Alcohol, and Water

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Abstract: The change of the properties of chrysotile after ball milling in organic liquids (aromatics, alcohols, silicone oils) or water was studied by gas adsorption, electron microscopy, X-ray powder diffraction, infrared spectroscopy, differential thermal analysis, zeta potential measurements, and chemical analysis. Grinding in low viscosity organic solvents leads initially to a rapid defiberization of the asbestos bundles and to a fragmentation of the isolated fibrils. Finally, amorphization and agglomeration occur causing a drastic decrease of the specific surface area of the ground material. Grinding in water brings about a defiberization, but much more slowly than in organic solvents. Moreover, prolonged grinding in water does not significantly alter the structure of chrysotile. The efficiencies of the organic solvents, considered as grinding aids that induce fracture of the fibrils, are related to the environmental stress cracking of brittle solids (Rehbinder theory). Hence, the pertinent properties of the organic liquids are their viscosity and their cohesion energy (solubility parameter). Solvents chemisorbed on the surface of the ground chrysotile reduce the surface energy of the fracture surface and prevent aggregation. Water does not react according to Rehbinder's theory, but appears to form a protective layer around the fibrils. This hypothesis was verified by dry grinding defiberized asbestos (rapid amorphization) or by disturbing the stability of the water coating by coadsorbing alcohol on the solid surface. Alternatively, the resistance of the fibrils to fracture may be explained by Westwood's theory that grinding in water is equivalent to grinding in an alkali medium, wherein the surface charge of the chrysotile becomes negligible, and the mechanical stability of the fiber reaches a maximum.

Key Words: Amorphization • Asbestos • Chrysotile • Defiberization • Grinding • Morphology

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