

UNUSUAL APPLICATION OF CHRYSOTILE ASBESTOS: THE ELIMINATION OF USED OIL EMULSIONS

Key Words—Adsorption, Asbestos, Chrysotile, Oil emulsion, Surface treatment.

The elimination of used cutting oil emulsions represents a difficult problem: cutting oil is a complex mixture of oil, dispersive agents (anionic and nonpolar), and stabilizing agents (anti-bacteria, anti-oxygen). It is generally employed as a 5% water emulsion. Presently, the most common method for the elimination of used cutting oil emulsions is based on a discontinuous procedure which encompasses the rupture of the emulsion by acid followed by the recovery of the released supernating oil. An alternative solution is offered by silica (or diatomaceous earth) treated with a coupling agent that possesses a quaternary amine group as the reactive end group. The positive charge of this group neutralizes the surface negative charge of the dispersed oil droplets and brings about their coagulation. The released oil is adsorbed on the organophilic part, constituted by the aliphatic chain, of the coupling agent.

Chrysotile asbestos can do as well if it has received an adequate treatment that increases its surface potential. Moreover, treated chrysotile asbestos would be less expensive than treated diatomaceous earth. The increase in positive surface charge can be obtained by treating chrysotile asbestos with aluminum trichloride. During this treatment, a possible exchange (Papirer *et al.*, 1976) occurs of bivalent magnesium ions of the chrysotile structure and trivalent aluminum ions. As a consequence, the surface charge is necessarily increased.

Further, a simple adsorption of partially hydrolyzed aluminum trichloride can lead to a similar result.

The increase in surface potential of such materials can be assessed by a measurement of the zeta potential before and after treatment with $AlCl_3$, or by checking the rupture ability of anionic stabilized emulsions.

EXPERIMENTAL

One gram of Canadian chrysotile (Black Lake, Quebec, grade 5R) having a specific surface area of 15 ± 2 m²/g was dispersed in 40 ml of toluene to which 5 ml of a solution (80% toluene + 20% nitrobenzene) containing 10^{-3} moles of $AlCl_3$ and 5 ml of HCl (37%) had been added. After a 2-hr treatment, the fibers were filtered and washed with a toluene-nitrobenzene mixture to eliminate excess $AlCl_3$. Finally, the solid was dried at 100°C.

Five grams of an industrial cutting oil preparation was dispersed in 100 ml of water forming a very stable emulsion. The treated chrysotile was added to this emulsion, and the amount of chrysotile and the time required to obtain a clear supernatant solution were recorded. In another run, the quantity of oil absorbed by the treated chrysotile, as a function of contact time, was determined.

Zeta potentials of the asbestos were measured by M. Nardin (Laboratoire de Physico-Chimie des Interfaces, Ecole Nationale Supérieure de Chimie, Mulhouse, France) by the streaming potential method. Eight grams of chrysotile was dispersed in 2 liters of demineralized water. At equilibrium, the pH of the solution was equal to 9.0 ± 0.1 , whereas its resistivity was close to 42 μS .

RESULTS

The amount of Al derivatives fixed on chrysotile eventually ball milled in the presence of water is given in Table 1. Appreciable quantities of Al were retained by chrysotile, especially on samples with higher specific surface areas. The surface potential measurement of the initial chrysotile is close to 80 mV, whereas after treatment the value is several hundreds of millivolts, about 300 mV. Indeed, the expected zeta potential increase was confirmed by this direct determination. The emulsion rupture ability of the treated chrysotile is shown in Table 2. Experiments were performed taking as a variable the weight of treated chrysotile added to the suspension containing a known weight of oil. When a sufficient amount was employed, both rupture and the absorption of the released oil occurred (untreated chrysotile is ineffective). How efficient this oil absorption can be is illustrated by the results of Table 3. It takes less than a few minutes to absorb 99.9% of the initial oil.

Table 1. Amount of Al derivatives fixed as a function of the specific surface area of the chrysotile.

Surface area (m ² /g)	15	20	40
Al ³⁺ (mmole/g)	0.85×10^{-3}	1.85×10^{-3}	3.20×10^{-3}

Table 2. Rupture capacity of oil emulsions.

Asbestos content (wt. %)	Aspect of the "solution"
0.005	Emulsion
0.2	Emulsion
0.4	Clear (after 24 hr)
0.5	Clear (after 5 hr)
0.6	Clear (after 40 min)
0.8	Clear (after 20 min)
1.0	Clear (immediately)

Table 3. Kinetics of oil absorptions.

Time (min)	2.5	7.0	15.0	25.0	35.0	45.0	60.0
Oil recovered ¹ (g)	4.939	4.943	4.956	4.957	4.958	4.958	4.959

¹ Weight of oil absorbed by the treated chrysotile (from an emulsion containing 5 g).

CONCLUSION

This study points to a potential application of surface-treated chrysotile for the solution of environmental problems provoked by the disposal of used cutting-oil emulsions.

Centre de Recherches sur la
Physico-Chimie des Surfaces Solides
C.N.R.S.
24, Avenue du Président Kennedy
68200 Mulhouse, France

EUGÈNE PAPIRER

REFERENCE

Papirer, E., Dovergne, G., Siffert, B., and Leroy, P. (1976) Surface modification of chrysotile asbestos under the influence of aluminum trichloride: *Clays & Clay Minerals* **24**, 101–102.

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