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Biodurability of talc

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ABSTRACT

Dissolution rates of a well-characterized sample of powdered talc were measured in solvents that mimic fluids found in the human lung. These experiments found that talc dissolution rates were the same for pH controlled aqueous solvents, phosphate buffered saline solution, and modified Gamble's solutions. Variation of solvent chemistry, including the addition of organic chelators and proteins at intercellular fluid concentrations, does not markedly affect the measured dissolution rate of talc at 37 °C. The data further indicate that the dissolution mechanism for talc in aqueous solutions is independent of pH over the range of 2 to 8. The dissolution rate at 37 °C, determined by measuring the silicon release rate per unit surface area of talc in a mixed-flow reactor system, is 1.4 (±1.0) $\times 10^{-11}$ mol Si/m^2·s. Application of a geometric shrinking particle model using this dissolution rate results in an estimated lifetime (upper limit) of approximately 8 years for a 1 μm talc particle under pulmonary conditions. Talc dissolves considerably faster than quartz, but slower than chrysotile and olivine in the body. These data can be used to place constraints on the role of particle dissolution in the disease models associated with airborne respirable mineral particles.