

"Asbestos-Fiber" Concentrations in Talc

1. Number of Chrysotile Fibers in 99.99% Pure Talc.

1.1 Talc that is 99.99% pure may contain up to 0.01% chrysotile fibers by weight.

1.2 Therefore, one mg of talc can contain as much as 0.1 μg of chrysotile fibers:

1 mg x 0.01% chrysotile fibers = 0.1 μg of chrysotile fibers.

1.3 The size and shape criteria applied to asbestos fibers states that the fibers must be 5 μm in length or longer and have a length to width ratio of 3:1. This means that a chrysotile fiber would be counted if it were 5 μm long and 1.7 μm wide.

A chrysotile fiber that is 5 μm long by 1.7 μm wide, would have a volume of:

$$\text{volume} = \text{length} \times \frac{(\text{width})^2}{2} \times \pi$$

$$\text{volume} = 5 \mu\text{m} \times \frac{(1.7 \mu\text{m})^2}{2} \times \pi$$

$$\text{volume} = 11.349 \mu\text{m}^3 = 11.3 \mu\text{m}^3$$

1.4 The weight of a single chrysotile fiber can be calculated from its volume and density (2.5 g/cm^3).

volume x density = weight

To convert the density from g/cm^3 to $\mu\text{g}/\mu\text{m}^3$:

$$\frac{2.5 \text{g}}{\text{cm}^3} \times \frac{10^6 \mu\text{g}}{\text{g}} \times \frac{1 \text{cm}^3}{(10^4 \mu\text{m})^3} = 2.5 \times 10^{-6} \frac{\mu\text{g}}{\mu\text{m}^3}$$

Then the weight of a single chrysotile fiber is:

$$11.3 \mu\text{m}^3 \times 2.5 \times \frac{10^{-6} \mu\text{g}}{\mu\text{m}^3} = 28.3 \times 10^{-6} \mu\text{g}$$

1.5 To determine the allowable number of chrysotile fibers in talc divide the allowable weight of chrysotile fibers by the weight of a single chrysotile fiber:

Allowable wt/wt of single fiber = no. of fibers

$$0.1 \mu\text{g} / 28.3 \times 10^{-6} \mu\text{g}/\text{fiber} = 3,534 \text{ fibers}$$

1.6 The above calculations show that a 99.99% pure talc can contain as many as 3,500 chrysotile fibers per mg instead of the 100 chrysotile fibers cited in the proposed standard.

2. Number of Amphibole Fibers in 99.9% Pure Talc.

The calculations below follow the same outline presented for chrysotile fibers in talc.

2.1 Wt. Percent allowable amphibole fibers: = 0.1%

2.2 Wt. of amphibole fibers in one mg of talc.

$$1 \text{ mg} \times 0.10\% = 0.001 \text{ mg} = 1.0 \mu\text{g}$$

2.3 Volume of an amphibole fiber.

(Amphibole fibers may be lath-like instead of cylindrical, therefore, their volume is computed from;)

$$5 \mu\text{m} \times 1.7 \mu\text{m} \times 1.7 \mu\text{m} = 14.5 \mu\text{m}^3$$

2.4 Wt. of a single amphibole fiber (density taken as $3.3 \text{ g}/\text{cm}^3$ or $3.3 \times 10^{-6} \frac{\mu\text{g}}{\mu\text{m}^3}$)

$$14.5 \mu\text{m}^3 \times 3.3 \times 10^{-6} \frac{\mu\text{g}}{\mu\text{m}^3} = 47.9 \times 10^{-6} \mu\text{g}$$

2.5 Allowable number of amphibole fibers in pure talc;

$$1.0 \mu\text{g} / 47.9 \times 10^{-6} \mu\text{g} = 20,876 \text{ fibers}$$

2.6 The above calculations show that a 99.9% pure talc can contain as many as 20,000 amphibole fibers per mg instead of the 1000 amphibole fibers cited in the proposed standard.

3. Discussion

The calculations above were based on the presumption that all the chrysotile or amphibole fibers in a hypothetical talc sample were 5 μm long. It is very unlikely that this would occur in practice. However, it may not be valid to cite any percentage purity for a given number of mineral fibers without knowing their size distribution. For example, the proposed standards for purity and number of fibers calculates to a weight average length of 16 μm and 14 μm respectively for chrysotile and amphibole fibers.

Perhaps the simplest way of resolving the (obviously unintended) contradiction is to drop the percentage purity values and rely solely on the number of fibers in a given weight.