Asbestos fiber disintegration to nanosize range

M. Klán and J. Hovorka

Institute for Environmental Studies, Faculty of Science, Charles University in Prague, Albertov 6, Prague 2, CR
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Presenting author email: mirek.klan@gmail.com

Asbestos fiber occurrence and emissions into the ambient air is probably solved problem and is nothing new (WHO, 1987). Despite the conformity in the mining minimization and manipulation with this dangerous carcinogenic material are often at many places high concentration of asbestos fiber in the ambient air, even in the highly economically advanced and developed countries. One example is the city of Pilsen and its surrounding. The first valid observation of asbestos fiber actinolite limit exceedance was from the year 2002 and it was randomly observed during measurements of the impact of asbestos remediation work. Thereafter five-year long research followed and it was proven that respirable actinolite fibers are highly emitted to ambient air during mining and aggregate processing with high content of the asbestos mineral actinolite by construction works, winter road strewing, pavement dusting, dusty roads etc. (Klán, 2013).

Actinolite $Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$ is classified in the group of calcium amphibols which forms part of asbestos minerals. In the Pilsen area is occurred in Proterozoic metamorphosed altered basalts called spilite. Spilite mining in the Pilsen area represents according to inquiry more than 1 million tons of aggregate per year. Fine fraction is a significant part which is often used in the mixtures.

Asbestos fibers are formed by the mechanical abrasion of the rock, from the materials which are not in the fiber form. Actinolite is most often crumbled in the ratio 1/7-8 (width/length). In the Pilsen area are often fibers 7-14 µm long and around 1-2 µm thin.

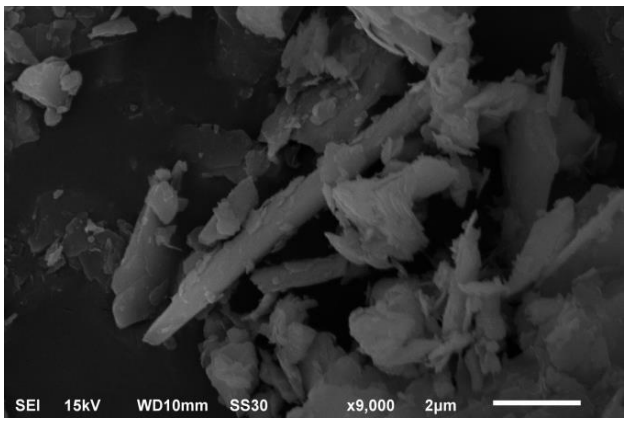

Fig 1: Actinolite fiber (in the middle) on the filter in Pilsen, SEM

Actinolite asbestos fiber distribution and its number concentration in the Pilsen ambient air are not sufficiently explained yet.

According to previous single measurements, asbestos fiber number concentration is around 1000 fibers/m^3 depending on the dustiness and the source proximity. Fibers long or longer than 5 µm and with 3 µm diameter and length-diameter ratio 3:1 are considered as an asbestos fiber for number concentration evaluation.

With transmission electron microscopy (TEM) we found that nanostructure of the fiber asbestos material actinolite are disintegrated by the mechanical abrasion to 10 nm width and 100 nm long nanoparticles, with width-length ratio 1/7-10.

Unlike spherical nanoparticles (eg. combustion emissions), asbestos actinolite nanofibers generally do not form aggregates and chains.

The present result shows higher asbestos fiber actinolite occurrence in the ambient air of the Pilsen area and they can disintegrate into nanoparticles.

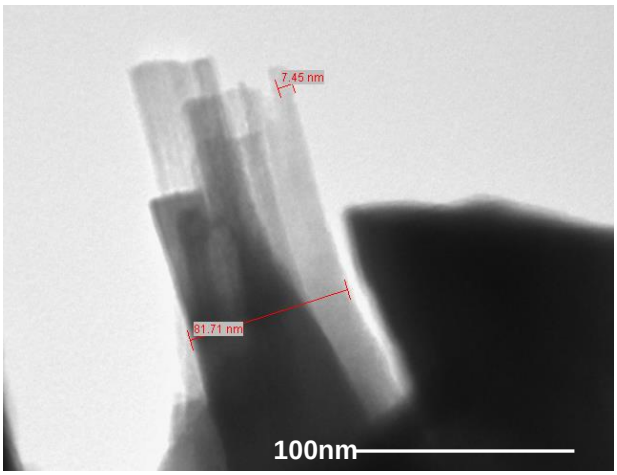

Fig 2: Nano-structure of the disintegrating aktinolite fiber in Pilsen, TEM

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Klán, M., Havlíček, D. and Plocek, J. (2013) Asbestos – fibrous particles of mineral actinolite in ambient air of the Pilsen district, *Ochrana ovzduší*, **45**, 24–27

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