# SOME FACTS ABOUT FLOOR COVERINGS

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For thirty years, the asbestos laboratory of the Institute for work and health has been analysing materials to determine whether they contain asbestos. The laboratory carried out a statistical analysis of the results from its collection of samples analysed between 2000 and 2009. We chose to study floor coverings as these are frequently brought for testing. In the period mentioned, we analysed more that 1'800 floor coverings. Just under half of the samples contained asbestos (48%), mostly chrysotile (81%) or anthophyllite (18%).

Our analytical methodology followed semi-quantitative method U.S. EPA-600. In chrysotile-containing floor coverings, the average content in tiles was approximately 1wt% and in linoleum was approximately 20wt%. Anthophyllite floor coverings, usually two-layer linoleums, had a 2-3wt% content.

The ASEMPOT study carried out by the institute in 2004 allowed us to improve the accuracy of these results. The floor coverings were analysed by FT-IR following NIOSH protocol 7602 for silica, but adapted for asbestos. These results showed that the proportion of asbestos contained in the samples was well above that determined via optical microscope. For tiles we obtained an average of 10% chrysotile content and for two-layer anthophyllite linoleum the percentage content went up to approximately 6%.

Measuring asbestos exposure during demolitions shows potential exposures ranging from 10'000 to 500'000 fibres/$m^3$, with peak values at 8Mio fibres/$m^3$ in extreme cases. The ASEMPOT study simulated demolitions in a test chamber. The results obtained showed similar values, as depending on the sawing, cutting or scraping done to the floor coverings, exposure ranged from 8'000 to 990'000 fibres/$m^3$.

It is useful to analyse all floor coverings in buildings built or renovated before 1995. Burdensome protective measures, necessary during the demolition of such floor coverings, are also therefore totally justified: these materials are not inoffensive when being destroyed.

## INTRODUCTION

Due to awareness of asbestos in rough-cast paint and tiling glue, the asbestos laboratory of the Institute for work and health (IST) of Lausanne has been analysing material for asbestos, developing also analysing methods, for thirty years. The laboratory carried out a statistical analysis of all the results of sample materials analysed between 2000 and 2009, in order to determine asbestos content in different materials.

Currently, standard methods of measuring asbestos concentration are optical or electronic. However, results are non-homogenous between different laboratories: the uncertainties on wt% are big. For this reason, the IST laboratory has been working on an alternative technique using FT-IR (see method). Comparisons with the PLM method are presented here.

The Swiss threshold limit (VME) for the workplace is 10,000 fibres/$m^3$ [1], while the general ambient air concentration for asbestos in Switzerland is less than 300 fibres/$m^3$ [2]. Favre (2001) [3] and ASEMPOT (ASbestos EMission POTential) (2004) [4] have measured asbestos exposure during demolitions.

BULK BUILDING MATERIAL STATISTICS

Floor coverings are the most frequently analysed materials (~20%), together with wall coverings (13%), (including plaster and rough-cast paint), insulation materials (13%) (including flocking, foam,…) and suspended ceilings (12%) (figure 1a).

44% of floor covering samples analysed by the IST laboratory between 2000-2009 contained asbestos, mainly chrysotile (87%) and anthophyllite (10%). The remaining 3% were combinations of chrysotile, anthophyllite, actinolite and tremolite (figure 1b). It is interesting to note that over the last 9 years the laboratory has found no crocidolite in floor coverings.

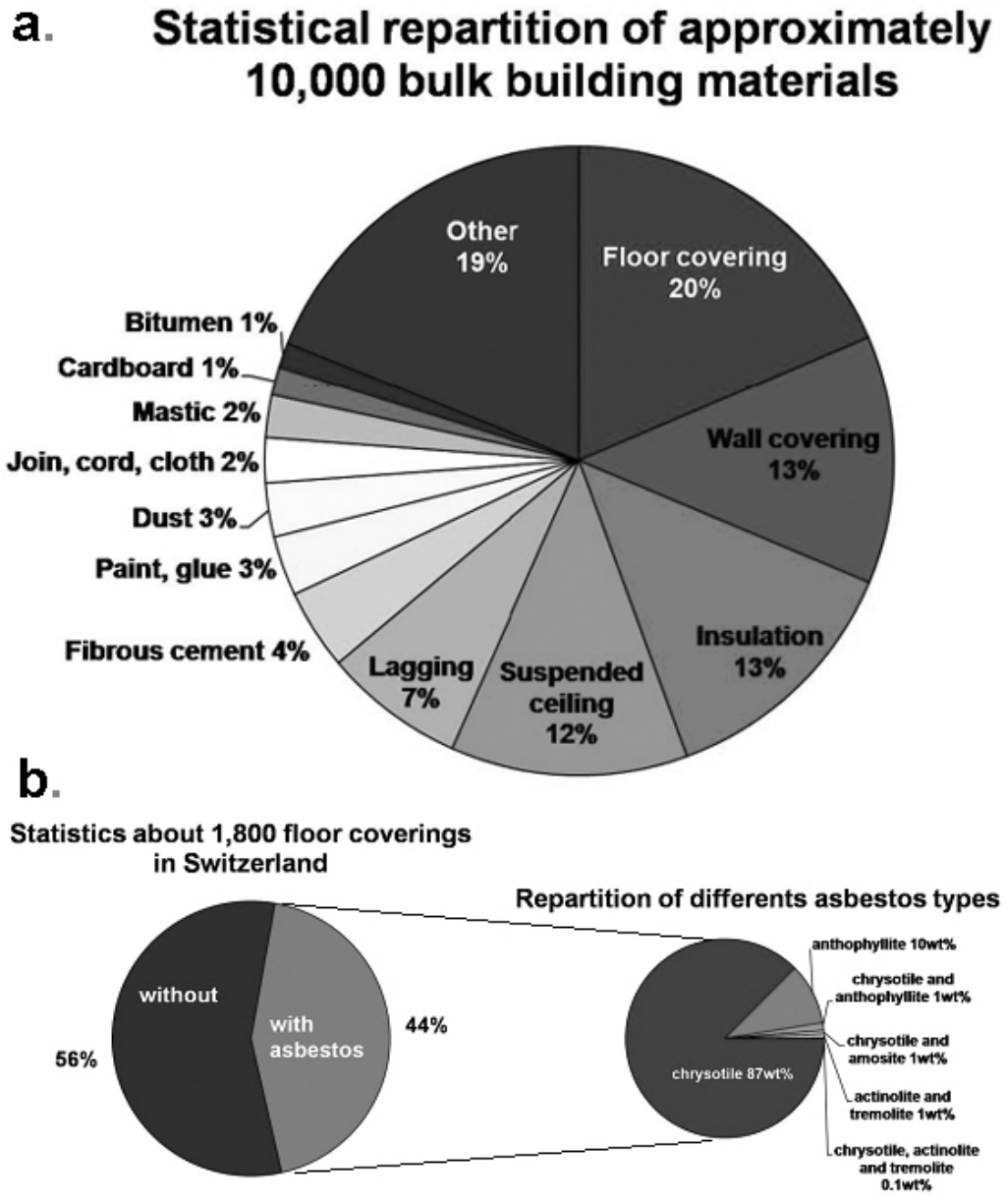
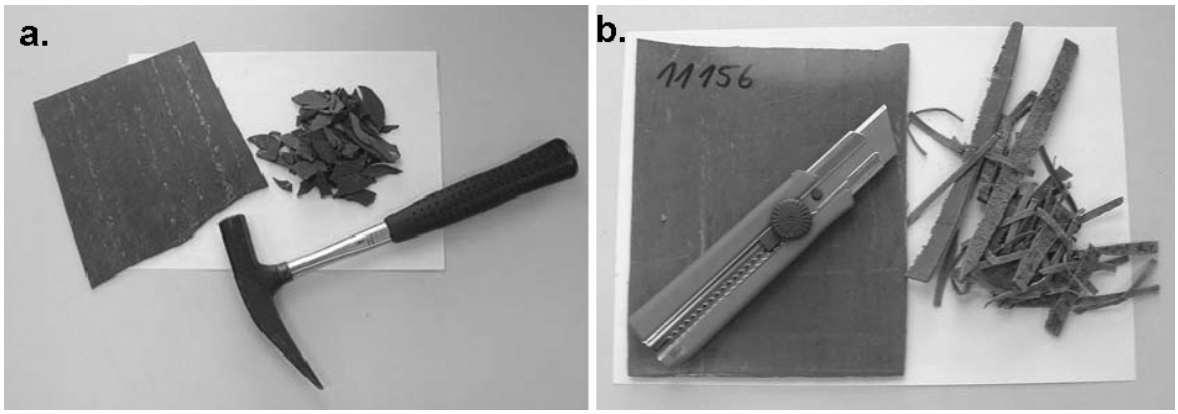



**Figure 1a.** Statistical repartition of approximately 10,000 different bulk building materials in Switzerland, analysed by the IST Laboratory of Mineralogy, 2000-2009.

**Figure 1b.** *Left:* Percentage of floor coverings with and without asbestos, of 1,800 bulk building materials analysed. *Right:* Different kinds of asbestos found in the 44% of asbestos bearing floor coverings.

Using an optical microscope method, the average fibre content found in floor covering tiles containing chrysotile (picture 1a) was approximately 1wt% (figure 1b). In linoleum, about 20wt% was found. Anthophyllite floor coverings (picture 1b), usually two-layer linoleum, had a 2-3wt% content.




**Picture 1a.** Chrysotile bearing floor covering
**Picture 1b.** Anthophyllite bearing floor covering

COMPARISON OF PLM AND FT-IR METHODS

Polarized Light Microscopy (PLM):

The Polarized light microscopy follows semi-quantitative method U.S. EPA-600/R-93/115 [5]. It is used to determine the optical properties of fibres: specific crystallographic orientations, colours, relief, crystal shape and crystal dimensions. LOI and acid dissolution are used in order to isolate asbestos. This method is semi-quantitative, with an omnipresent human factor, and involves the use of calibrated visual areas and point counting.

Fourier Transform Infrared Spectroscopy (FT-IR):

The Fourier transform infrared spectroscopy method is based on the absorption of an infrared ray by the sample.

Analyses were carried out with a Fourier Transform Infrared Spectrometer. The infrared ray is focused on the sample, with a wave length between 400 and 4,000 $cm^{-1}$ (dependant on radiation intensity). Absorption is proportional to the absorbent phase/molecule concentration. It is measured and compared to standards. This is a simple method and easy to work with.

The ASEMPOT study, carried out by the Institute in 2004, allowed us to improve the accuracy of these results. Floor covering samples were analysed by FT-IR following NIOSH FT-IR protocol for Silica [6], but adapted for asbestos.

PLM and FT-IR comparisons:

We analysed 4 different chrysotile bearing black tiles using PLM and FT-IR methods. Comparisons between results were surprising: FT-IR asbestos estimations where 13-16wt%, against only approximately 3wt% using PLM (figure 2). Also 6 two-layer anthophyllite bearing linoleums where analysed using both methods. Results were similar, with ~6wt% for FT-IR and ~2wt% using PLM.

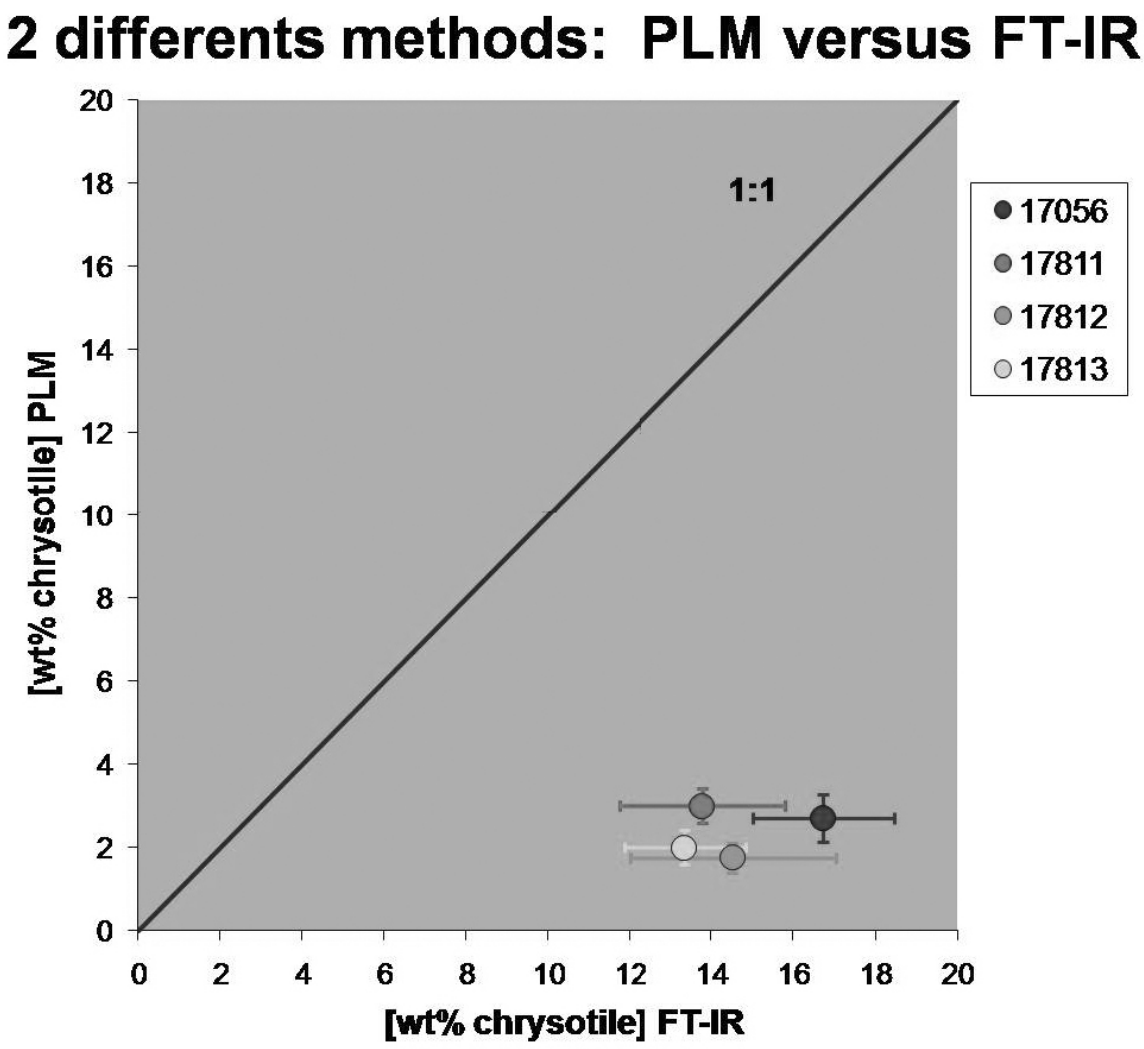



**Figure 2.** Comparison between 2 different methods of analysis: PLM versus FT-IR. *PLM:* all the samples are an average of 4 people's results. *FT-IR:* 17511, average of 5 results. 17056 and 17812, average of 6 results. 17813, average of 21 results.

AMBIANT AIR ASBESTOS DURING DEMOLITION

Ambient air asbestos during demolition is measured, after room air pumping, using a SEM (VDI method [7]). Favre (2001) study [3] measuring asbestos exposure during demolitions, showed potential exposures ranging from 10,000 to 500,000 fibres/$m^3$, with peak values of 8 million fibres/$m^3$ in extreme cases. The ASEMPOT study simulated demolitions in a test chamber. The results obtained showed similar values, depending on the destruction method (sawing, cutting or scraping) used on the floor covering, with exposure values of between 8,000 and 990,000 fibres/$m^3$.

CONCLUSIONS

An analysis of asbestos content should be part of the great care taken in the removal or destruction of all floor coverings in buildings built or renovated before 1995.

All available protective measures should be used during demolitions. It is important:

- to make sure workers are protected (protection suit, particle/fibre mask (P3-type))
- to make sure materials are wet to reduce dust formation
- to ensure good air change

Asbestos bearing materials, particularly floor coverings, are not inoffensive when being destroyed. Therefore monitoring the air in buildings during renovation work is very important.
IST will carry out further analyses of standard artificial material with precisely known fibre concentrations, to better understand and reduce the worrying differences in results between the PLM and FT-IR methods.

ACKNOWLEDGEMENTS
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