



Enabling a better working world



The potential for airborne asbestos from soil contamination

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Procedures for Investigation:1

- **Hazard identification** – establishing contaminant sources;
- **Hazard assessment** – analysing the potential for unacceptable risks (what pathways and receptors could be present, what pollutant linkages could result and what could the effects be);
 - **i.e. Ability to release respirable airborne fibres which give rise to human exposure**

The potential for airborne asbestos release to air depends on:

- The presence of asbestos and amount
- A soil-air interface,
- The form of the asbestos: ACM's, fragments of ACM's, bound or unbound fibres, bundles of fibres, individual fibres in soil.
- Moisture content.
- The degree of disturbance
- The current condition of the ACMs
- How much of each form is present
- The type of asbestos fibre etc.

Forms of asbestos

- Each may have a combination of:
 - Visible fragments of manufactured asbestos containing materials (ACMs) usually bound in a matrix);
 - Large visible bundles of loose fibres or woven products;
 - Fine unbound fibres too small to be visible.

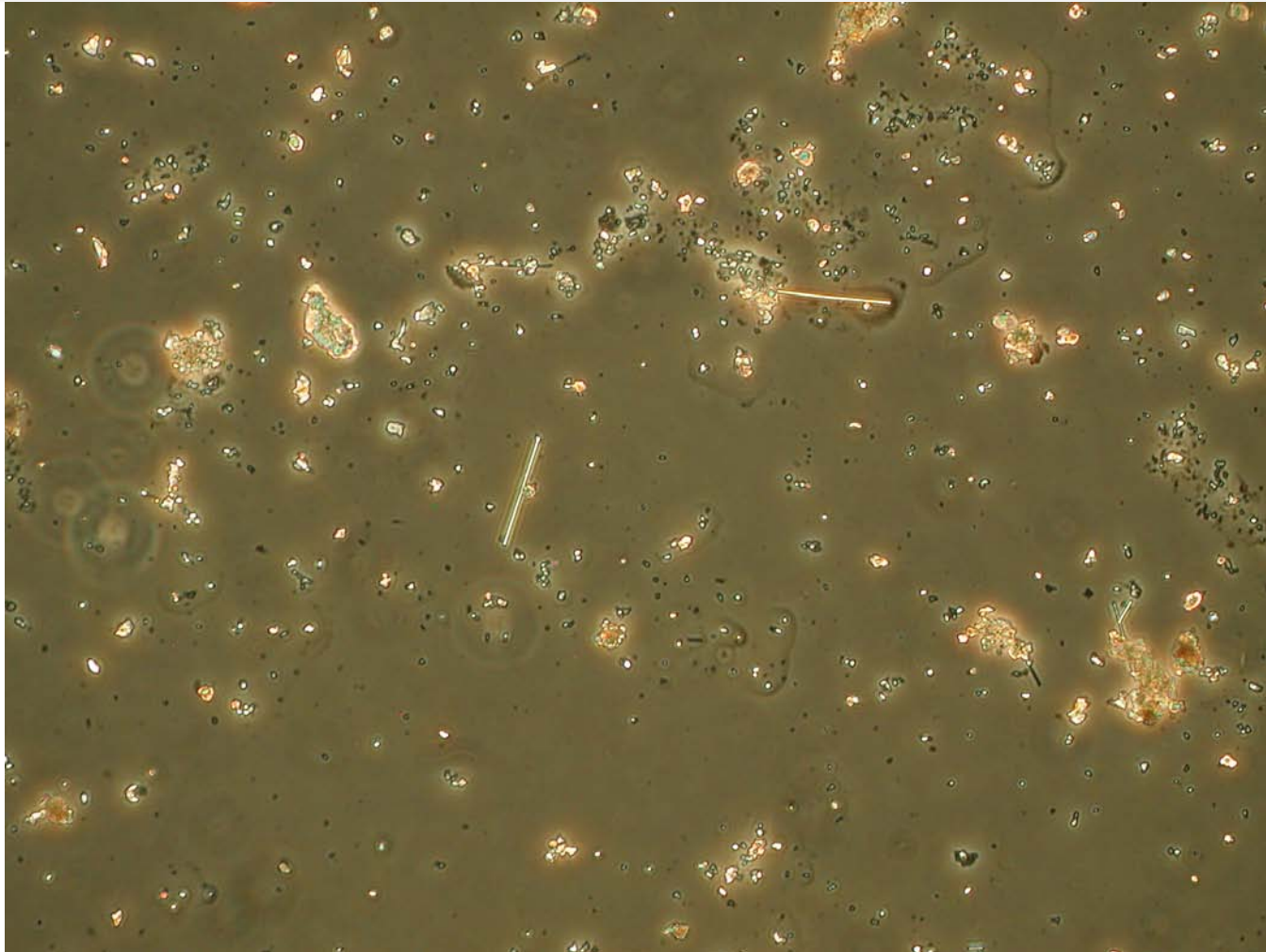
Example of bound fibres / AC



Bundles of crocidolite fibres



Example of fine unbound fibres in soil using PCM (0__10µm)



How likely is asbestos to be present?

- Samples collected for analysis from brownfield sites have been reported to be unexpectedly contaminated with asbestos. Some sites/samples have only fine asbestos.
- Need better data – SOBRA collecting “self reporting” data. (a few % of soil samples have detectable asbestos)
- However, soil samples examined at laboratory usually represent only a tiny fraction of the surface area so representative sampling (cone and quartering) is essential (borehole sampling is a more limited sample).

Searching representative Lab samples

- Macroscopic analysis of representative samples in a tray by picking suspect fragments of ACMs should detect $>0.01\%$ of asbestos in soil by surface area (or mass if weighed).
- A careful stereo-microscopy search will detect $>0.001\%$ if fragments of ACMs and bundles of asbestos fibres are present.
- Use conventional PLM to identify as needed.
- Report number / weight to give ~ amount

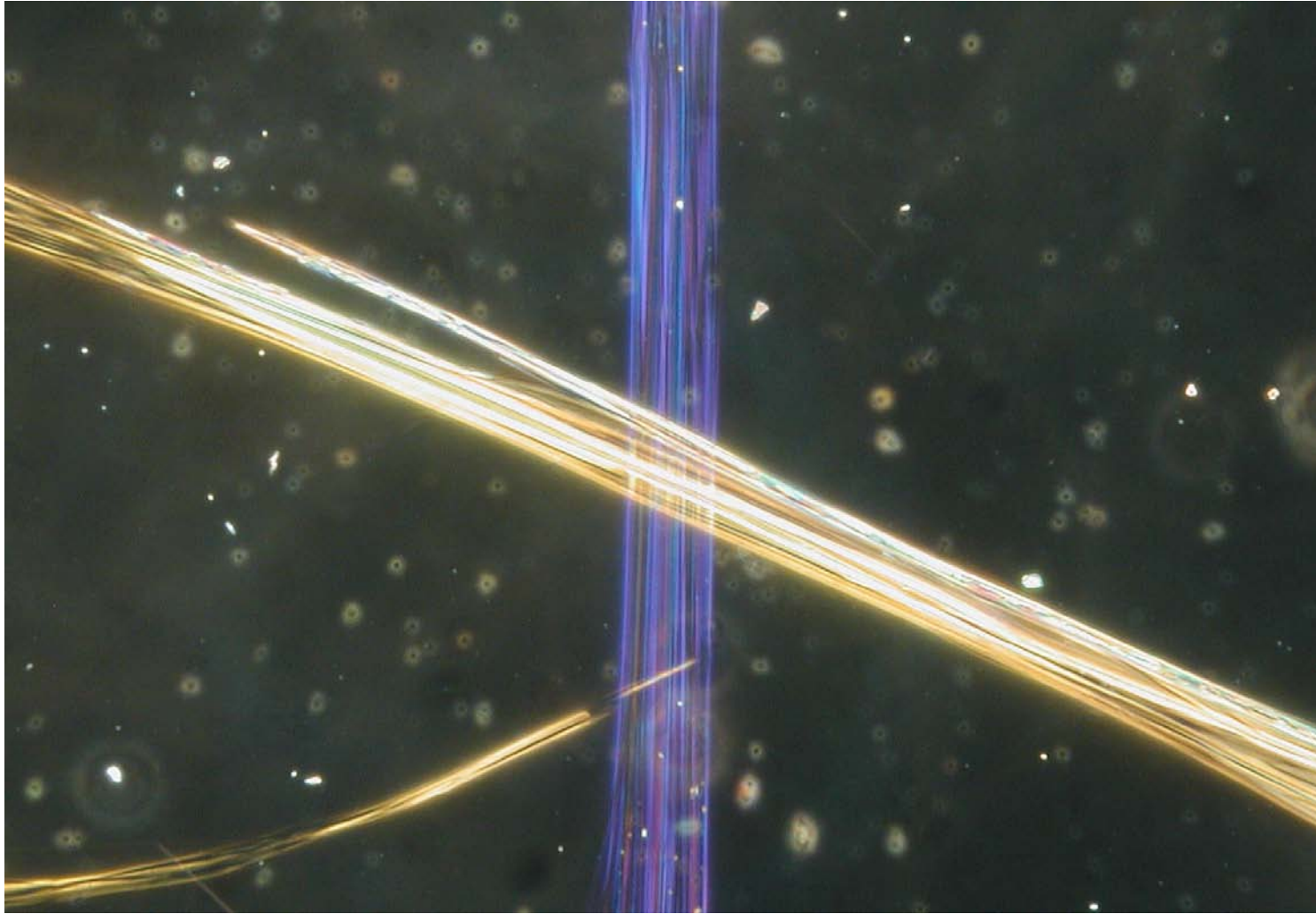
Macroscopic assessment



Stereo-binocular microscopy



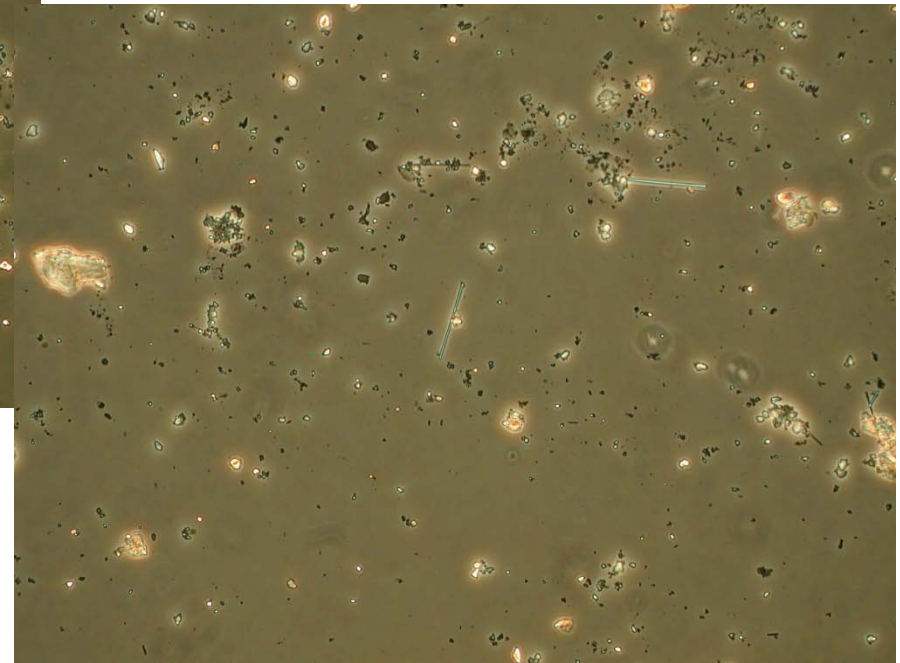
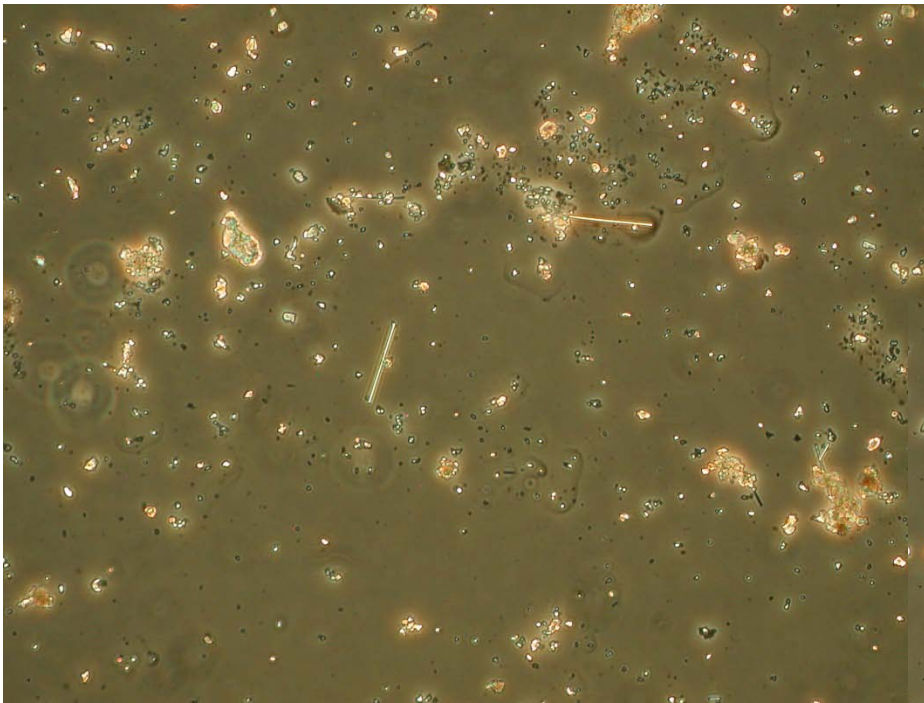
PLM : Dispersion staining



Quantification of fine fibres

- The shaking of the soil in water is a simple release test, to assess how many fine respirable fibres are available for potential release from the soil matrix.
- Can use drop mounts but using an aliquot filtered onto a MEC membrane filter is also used for quantification eg HSE RR33/1996 and the EA Blue book method.
- Mass concentration assays use short settlement times but large particles may obscure fibres.

Drop mount in air and matching RI Liquid





**HEALTH & SAFETY
LABORATORY**

Dustiness testing:

- Measures the propensity of the material to release airborne dust.
- It is a comparative measurement.
- Carried out by applying a standard set of measurement conditions and selecting a defined fraction (e.g respirable).
- European Standard EN15051 method
- Range of dustiness values extend over 5 orders of magnitude.

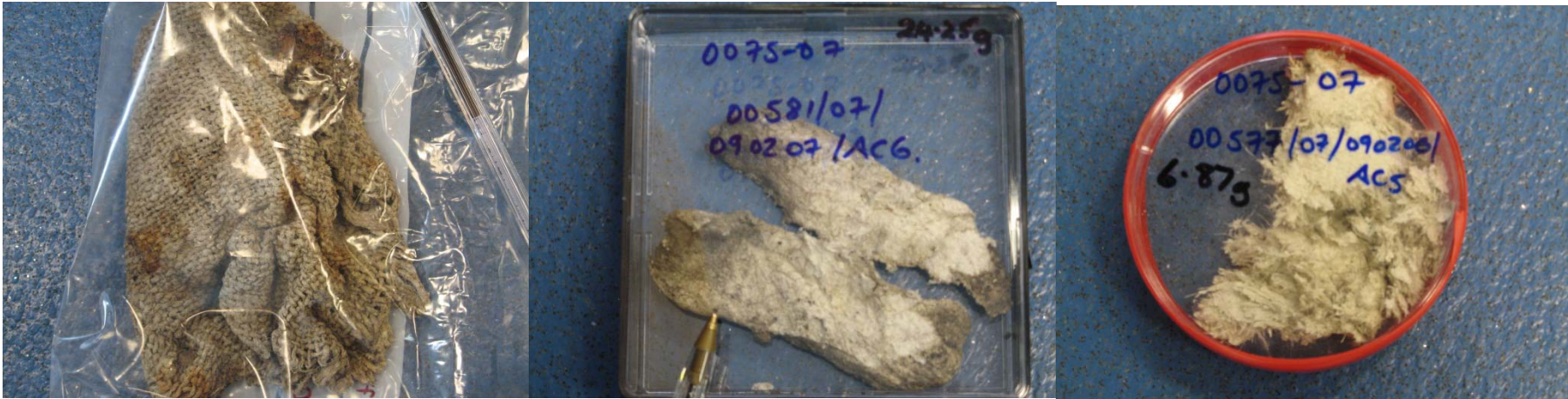
HSE MK 2 Rotating drum dustiness test



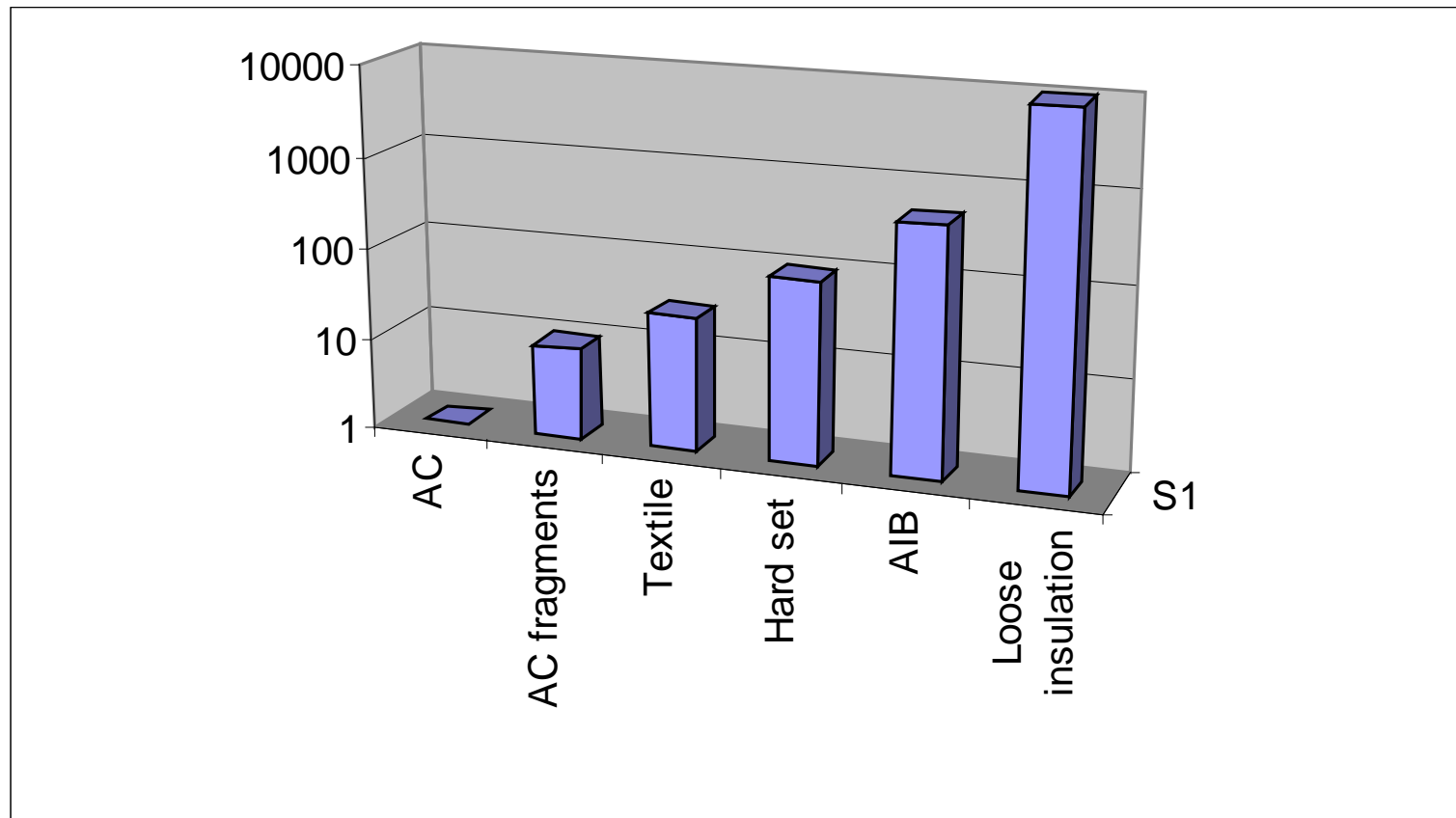
Other bench scale methods

- Old superfund US EPA vertical elutriator system with a rotating pipe.
- RIVM 1 m² tray/ cabinet with air blown across soil.
- New EPA method/s?

Waste ACMs picked up and dried for testing



Relative release of PCM fibres in dustiness tester.



On-site “Activity based” test methods

- Based on simulation of a representative or worst case activity, US EPA favoured this approach and have a SOP for 10 different activities.



STANDARD OPERATING PROCEDURES

ACTIVITY-BASED AIR SAMPLING FOR ASBESTOS

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- SOBRA has a tent and rake scenario

- 7.6.1 **ATV Riding**
- 7.6.2 **Child Playing in the Dirt**
- 7.6.3 **Gardening/Rototilling**
- 7.6.4 **Weed Whacking/Cutting**
- 7.6.5 **Digging**
- 7.6.6 **Lawn Mowing**
- 7.6.7 **Walker with Stroller**
- 7.6.8 **Jogging**
- 7.6.9 **Two Bicycles**
- 7.6.10 **Basketball Scenario**

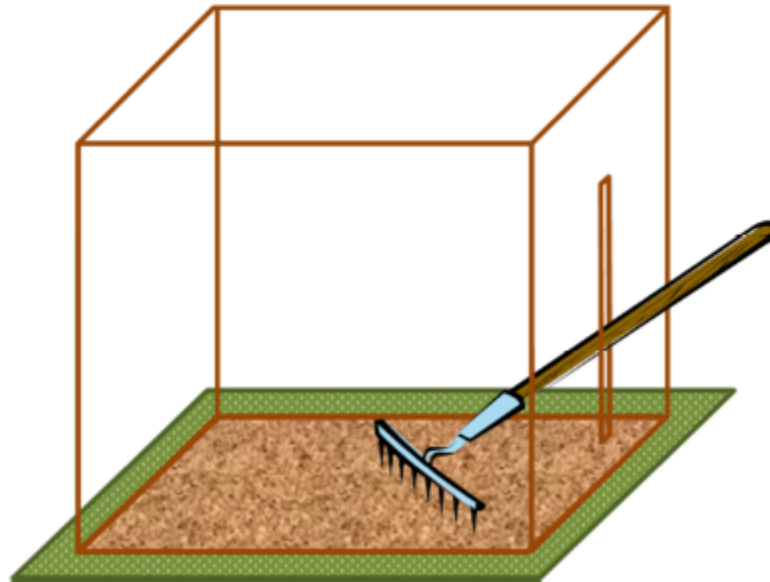
Simulation of peak release



SOBRA: Field test method

Procedure Outline:

The generic activity-based sampling involves the raking of a minimum 1m x 1m square of exposed bare soil using an ordinary garden rake within a temporary enclosure, as illustrated below:



Activity based sampling

- Activity – based field test are likely to be more realistic of peak exposure if:
 - You live in a dry areas / semi desert.
 - You have a good summer.
 - Or use some in-place drying methods.
- Unlikely to know how much asbestos is actually present in the areas being disturbed (until after the simulation test).
- Uses a larger soil sample than bench scale test.

Environmental sampling

- Represents a range of realistic “normal” daily activities.
- Personal and static sampling can be used – but analytical sensitivity depends on volume of air sampled onto the filter.
- Have to take account of weather conditions.
- Use analytical EM to identify fibres.

Questions

- Do you need to test the potential for airborne asbestos from visible fragments?
- Or is the visible presence enough?
- Can we rely on past observations (e.g. RIVM, 2003) to give a practical threshold?

RIVM, 2003: Summary of airborne fibre measurements at 100 sites (1)

- Increased fibre concentrations in the air in excess of the maximum permissible release (MPR) level (0.1 f/ml) are only measured in respect of heavily contaminated soils with unbound asbestos (at least 10,000 mg/kg_{dw} (*>1% dry weight*)).
- In such situations even minor soil activity combined with dry weather (not *worst case* conditions) is sufficient for fibre concentrations in the air in excess of the NR level (1,000 fibre equivalents per m³ of air (*0.001 f/ml*)).

RIVM, 2003: Summary of airborne fibre measurements at 100 sites (2)



- For less heavily contaminated soils, in which principally *bound* materials $<0.1\%$ *dry weight* and in one single instance unbound products $<0.01\%$ *dry weight* are present, no asbestos fibres are encountered in the air in any of the instances, even in respect of activities such as digging, tipping and sifting.

Environmental exposure UK

- Studies have been carried out in the UK to measure airborne emissions during dry periods when there was substantial use of asbestos cement waste tracks.
- The average emissions during a 4-day dry period gave 0.0004 f/ml and assuming all were chrysotile asbestos the risk within 2 m of the track for 6 hours exposure per day over the whole lifetime was assessed as below the 1 in 10,000.
- However, when wet, airborne emissions are much lower or ND.

Summary of typical fibre concentration measurements and limits.

Fibre concentration (f/ml)	Activity	Fibre concn (f/m ³)
1000	Install and remove dry spray	1 billion
100	Milling raw asbestos/install	100,000,000
10	Early Manufacture/Install /remove AIB dry	10,000,000
1	Controlled removal	1,000,000
0.1	EU workplace control limit (WCL)	100,000
0.01	UK Clearance Limit after removal /New NL WCL	10,000
0.001	WHO recommendation for environmental limit Realistic LOQ for PCM light microscopy	1000
0.0001	New NL Max Permissible 100% Amphibole Current realistic AS for single samples by EM	100
0.00001		10
0.000001	New NL negligible risk 100% amphiboles	1