Variability in UK Laboratory Methods for the Identification and Quantification of Asbestos in Soil

Discussion Paper by the SoBRA asbestos sub-group

February 2021

Introduction

This paper has been prepared by members of the SoBRA asbestos risk assessment working group to document the findings of a survey of UK laboratory methods undertaken in 2018-2019. This paper forms one part of SoBRA's efforts to support the wider objectives of the Joint Industry Working Group[1] and support industry in the risk assessment and risk management of asbestos in soil. SoBRA identified in 2013[2] that understanding what is being reported in laboratory results and improving that reporting to best support risk assessment is a key component of the risk-based management process.

It might be expected that asbestos testing methods for soil should be relatively harmonised since the publication of the SCA "Blue Book" method in 2017[3] [note the method was withdrawn by SCA in October 2020 due to concerns with method validation]. Measurement error is an important consideration in the appraisal of data used to support risk assessment. Field sampling error can be high for asbestos where fragments of asbestos containing materials are scattered and mixed within made ground, and SoBRA recommended the use of larger sample sizes and on-site detailed inspection to mitigate this[4]. However, it was not known what influence the laboratory method had on reported results and it was evident to the working group members that laboratories were not following the same analytical procedures nor reporting in the same way.

This paper summarises the responses from ten UK-based laboratories that kindly responded to our survey in November 2019. The information from each laboratory has been anonymised. The survey comprised 50 questions on Stages 1, 2 and 3 as defined in the "Blue Book" method. It is designed to complement a similar survey of UK laboratories undertaken by the AGS and reported in February 2019[5].

The three "Blue Book" stages are summarised below.

[1] Joint Industry Working Group on Asbestos in Soil and Construction & Demolition Materials (www.claire.co.uk/asbestos)
[2] Requirements for further research in to the release of asbestos from soil, SoBRA, October 2013
[3] SCA (2017) The quantification of asbestos in soil (2017), Methods for the examination of waters and associated materials, Standing Committee of Analysts, April 2017 [Withdrawn in October 2020]
[4] SoBRA (2015) Soil Sampling Protocol for Asbestos in Soil, SoBRA, April 2015
[5] Variability in asbestos analysis in soil, Barry Mitcheson, AGS Magazine, February 2019 (https://www.ags.org.uk/magazine/ags-magazine-january-february-2019/)

Stage 1: The determination and identification of presence or absence of asbestos using stereomicroscopy, plus higher magnification polarised light microscopy (PLM) analysis for fine fibres (see HSG 248)

Stage 2: The removal of asbestos containing material (ACM) and fibre bundles with identification and gravimetric analysis to determine percentage by weight.

Stage 3: The dispersion and collection of free fibres followed by fibre identification, counting and measurement of fibres to determine percentage by weight.

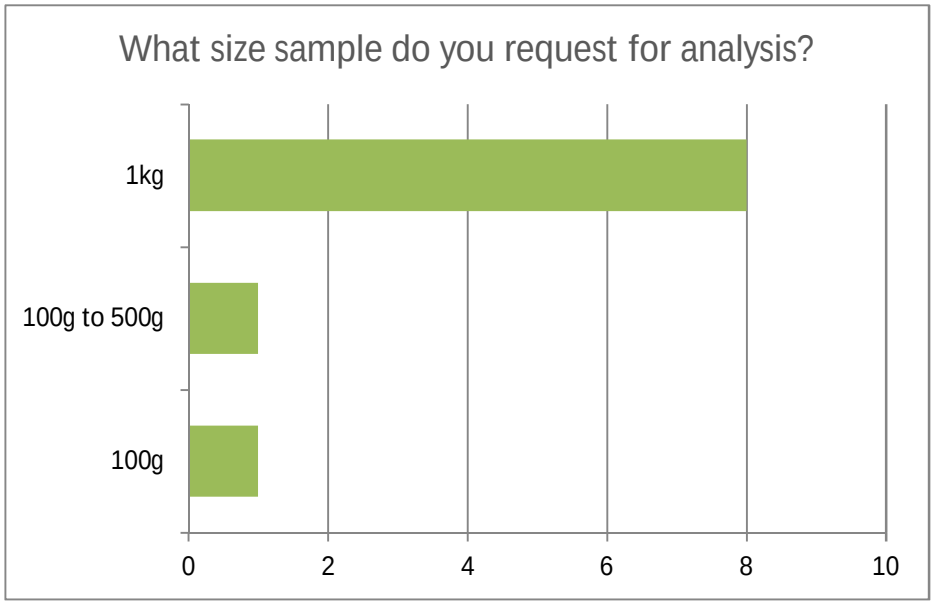
Survey Results

This section summarises the results from what are considered to be the most pertinent questions and responses. These are primarily related to sample size, sample preparation, and time taken for sample inspection/analysis.

Blue Book methodology:

Is the laboratory method in accordance with the SCA Blue Book method? 30% yes, 70% no.

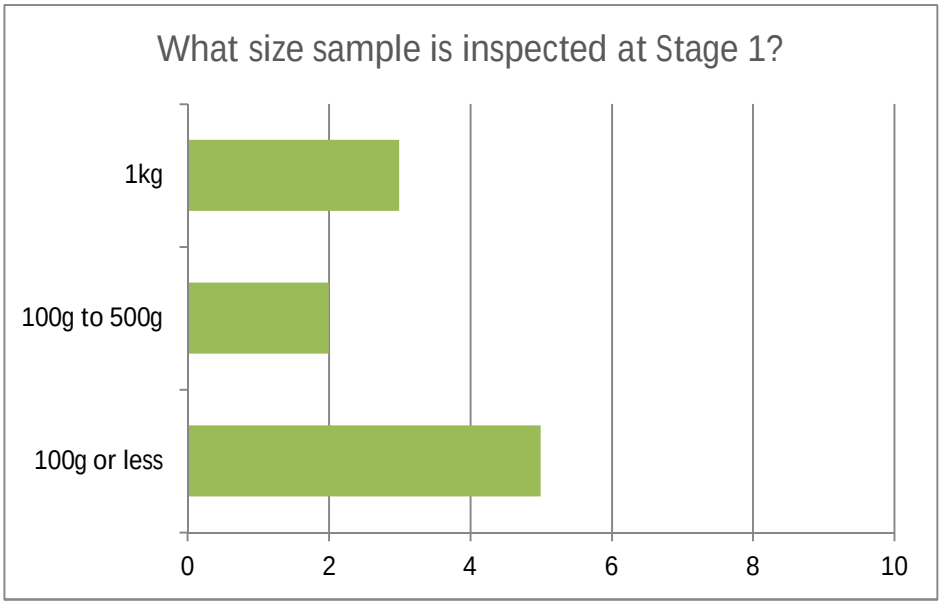
Sample size:



Sample preparation prior to Stage 1 asbestos identification:

Answers ranged from “none” to “cone and quartering”, “drying”, “crushed”, and “sieved”. Sieving, drying, and crushing of samples could have a substantial impact on the ability to identify asbestos compared to visual inspection of an “as received” sample. Of the responses for this question, those for sieving and drying, 30% of responses said yes to sieving, and 80% said yes to drying.

Sample size inspection at Stage 1 asbestos identification:



The laboratories do appear to be consistent in the use of a three-step approach to asbestos identification as set out in HSG248[6] (i.e. initial visual inspection (HSG248 A2.15), detailed inspection under stereo microscope (HSG248 A2.19, and finally further sub-sample "pinch samples" as microscope slide preparations (HSG248 A2.23).

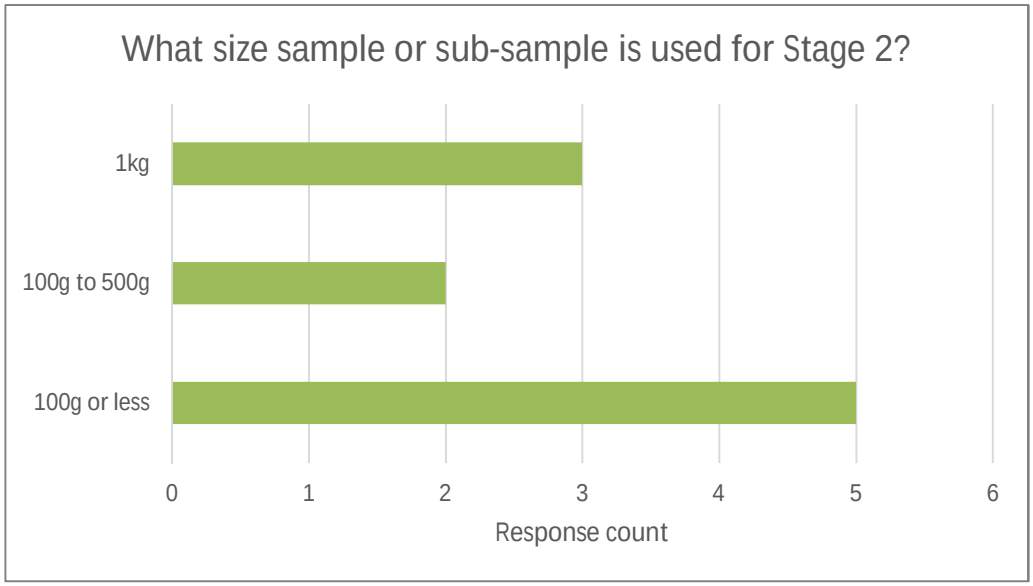
Reporting at Stage 1 asbestos identification:

Only 20% of responses indicated that they would routinely provide comment on the condition of the asbestos identified (i.e. weathered, degraded, disaggregated, not in original form) in addition to identifying the presence or absence of the three principal types of asbestos, and the form of that asbestos. The principal cause of this omission in relation to asbestos condition appears to be the absence of any guidance on how these terms should be applied. Descriptors used by the laboratories are those defined in HSG264[7] and included in Appendix 4 of SCA "Blue Book" method (noting that these two sets of descriptors are not identical).

The asbestos contents for each listed asbestos containing material are also not identical – specifically for asbestos cement (listed as 50% asbestos content in the "Blue Book" method and between 15% and 50% for different product types in HSG264). 70% of laboratories responded that they use HSG264 for asbestos content, 30% of laboratories responded that they use the SCA "Blue Book" method Appendix 4 for asbestos content.

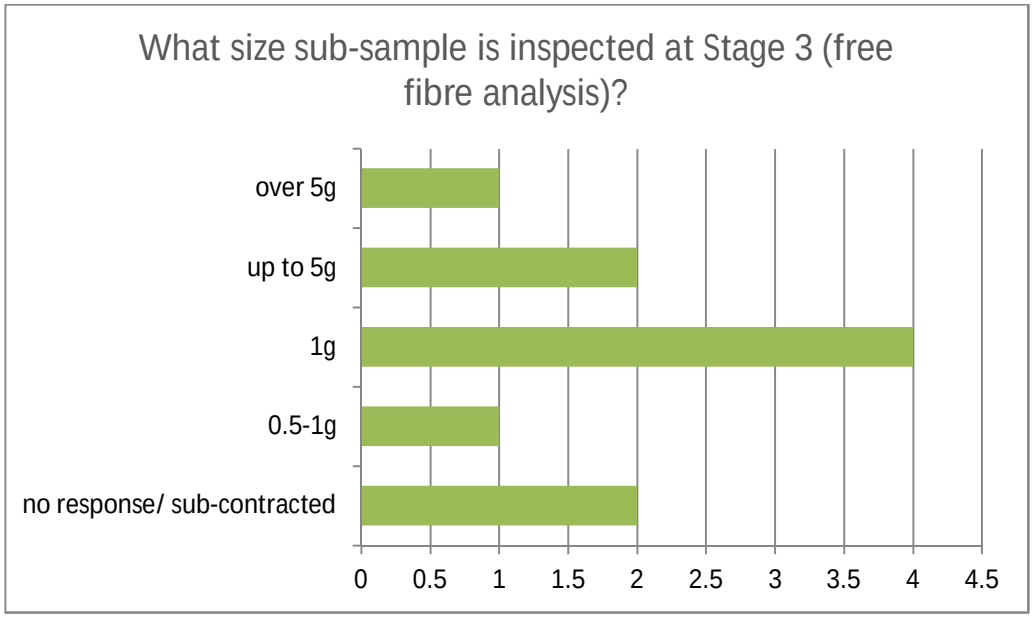
[6] HSE (2005) Asbestos: The analysts' guide for sampling, analysis and clearance procedures.
[7] HSE (2012) Asbestos: The survey guide.

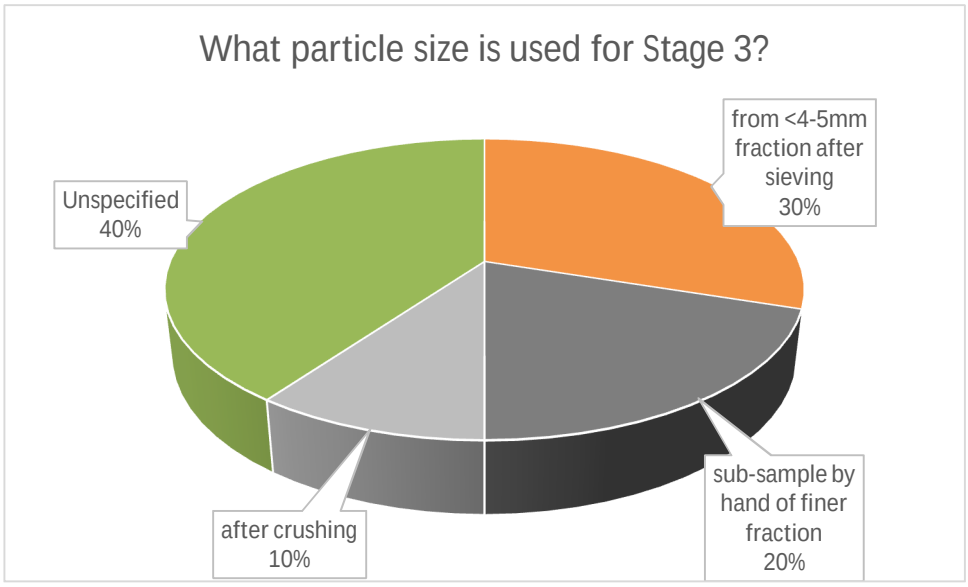
Sample size inspection at Stage 2 gravimetric analysis:



Sample size inspection at Stage 3 free/dispersed fibre analysis:

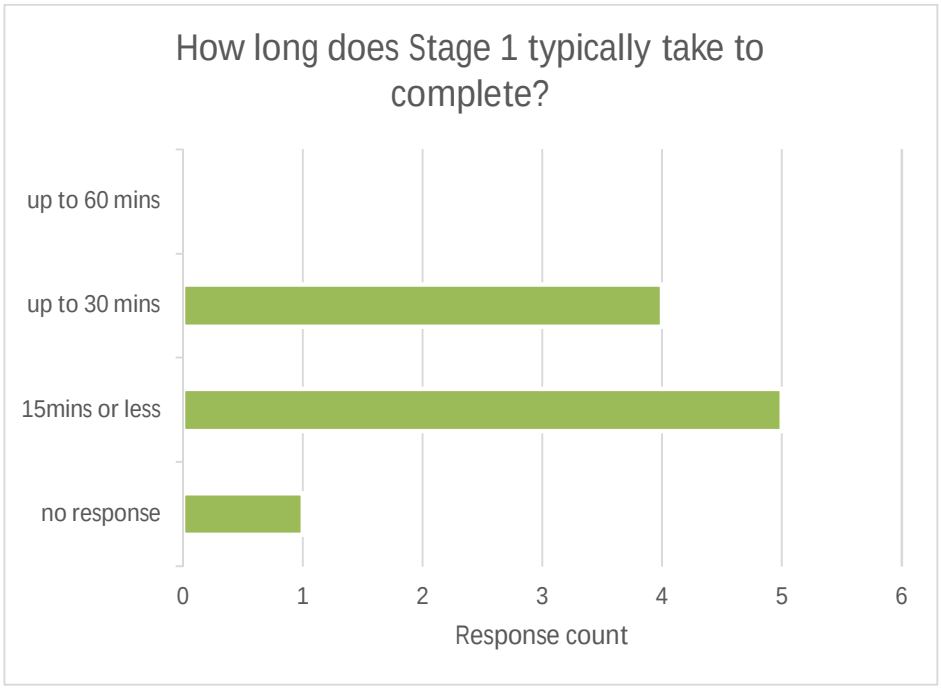
80% of laboratories use the same sub-sample from Stage 2 for Stage 3.

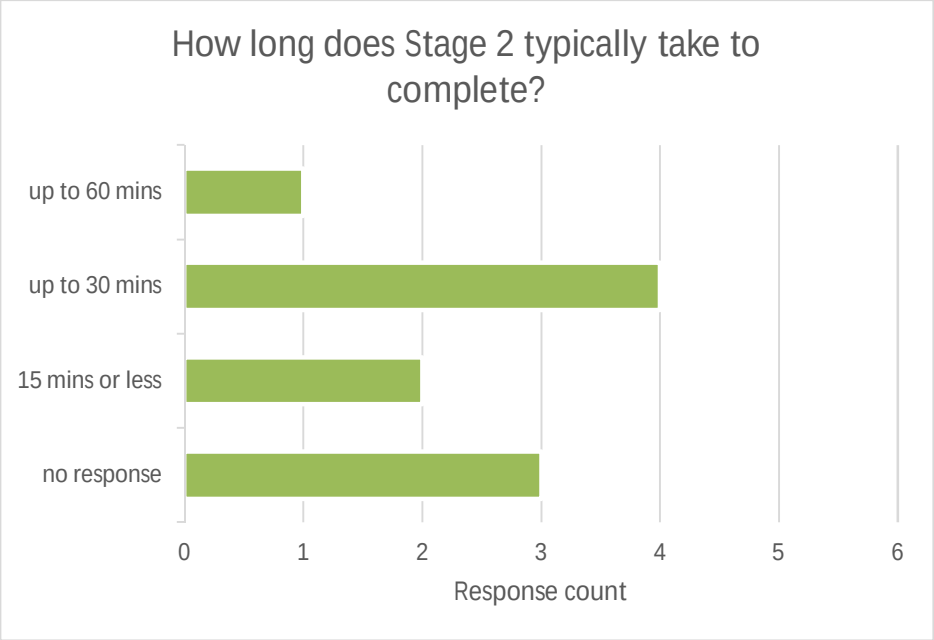


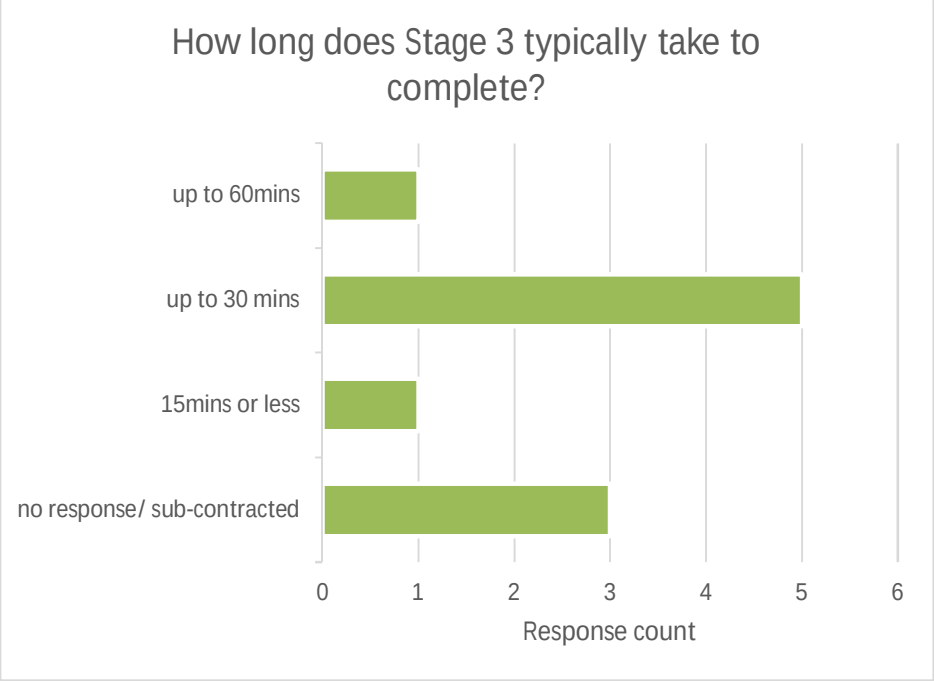


One particular element of the methods that is also likely to influence the results is the time spent inspecting the samples.

Duration of sample inspection:







Accreditation and proficiency:

100% of the responses confirmed that the laboratories participate in the HSL's Proficiency Testing Scheme Asbestos in Soil Scheme (AISS[8]).

70% of the laboratories responded that they held UKAS accreditation for Stage 1 identification.

[8] https://www.hsl.gov.uk/proficiency-testing-schemes/aiss

60% responded that they held UKAS accreditation for Stage 2 and/or Stage 3 quantification.

Reporting Requirements:

A number of the survey questions were specifically focused on the reporting of results. Current reporting appears to be focused on compliance with HSG248 and/or the SCA "Blue Book" method. Typically, laboratories identify asbestos type at Stage 1 and do not provide further asbestos type breakdown at the quantitative stages (i.e. Stage 2 and Stage 3). A small number of laboratories did respond that they could provide asbestos type differentiation at quantification if required. No laboratory reports the detection limit for Stage 1. All laboratories report quantitative results as %wt/wt and with a limit of quantification of 0.001%wt/wt. No laboratory routinely reports at what sub-stage within Stage 1 asbestos was detected (i.e. during visual inspection using stereomicroscopy or during higher magnification PLM microscopy). and therefore when the sample inspection stopped.

No laboratory routinely provides photographic evidence of the asbestos identified in the sample, but a number responded that this could be provided on request.

AISS Results

SoBRA has undertaken a preliminary review of the AISS results for the period December 2013 to November 2019. Overall:

Qualitative results
On average:

- 9% of qualitative results were incorrect
- 2% of labs reported false positives for samples containing no asbestos
- 2% of labs reported false negatives
- 9% of labs reported the wrong type of asbestos – most commonly relating to mixtures of asbestos types in a single sample (e.g. they only reported one type or one of the IDs was incorrect)

Quantitative results – based on Jun 2016 to Nov 2019 only as AISS stats used in reporting changed in 2016

- The % variation of the median result to the actual concentration varied from -100% to +50% (where a negative % is an over estimation of the concentration compared to the actual sample and a positive % is un underestimation)
- The average variation was -12%
- Average % of results designated as satisfactory was 76%
- Average % of results designated as questionable was 11%
- Average % of results designated as unsatisfactory was 13%

Overall, the AISS results indicate room for improvement. The percentages of incorrect qualitative results (9%) and incorrect asbestos type (9%) s is too high, and the percentage of quantitative results that are not satisfactory (13%) is too high. The scheme is run with purposefully manufactured test

samples, not real-life samples which might be expected to be subject to greater errors compared to the AISS test samples and correspondingly a higher percentage of incorrect results.

It is noted that the AISS group reports include more non-UK labs than UK labs: Round 22 (November 2020) for instance, included 27 UK labs, 30 from the rest of Europe and 5 from the rest of the world. It would be helpful if the reported results were split for UK and non-UK laboratories to understand the proficiency of laboratories in the UK as it is unlikely that soil samples collected in one country would be sent for analysis in another country.

SoBRA recommendations

The SoBRA recommendations for laboratory reporting of asbestos in soil results are as follows and are based on the requirement for risk assessment to be supported by clear, unambiguous laboratory data:

Stage 1:

Step 1 – visual inspection

1. Sample preparation carried out and proportion of as received sampled visually inspected at Step 1.
2. Mass of sampled screened.
3. Types and forms of asbestos identified. This should be for all types and forms identified.
4. Estimated detection limit for Step 1.
5. Confirmation of whether Steps 2 and 3 below were carried out.

Step 2 – detailed inspection under x20-x40 stereomicroscope

6. Sub-sampling method.
7. Mass of sub-sample.
8. Types and forms of asbestos identified. This should be for all types and forms identified.
9. Estimated detection limit for Step 2.

Step 3 – pinch samples under x80-x500 magnification (PLM)

10. Sub-sampling method.
11. Number and mass of sub-samples.
12. Type and form of asbestos identified. This should be for all types and forms identified.
13. Estimated detection limit for Step 3.

Stage 2:

14. Sub-sampling method.
15. Mass of sub-sample.
16. Report indicative size range of fragments identified.
17. Report masses individually for each type and form of asbestos identified.

18. Report masses in unit of mg/kg (not %wt/wt).
19. Photographs of identified fragments – either in sample or as extracted. Photograph to be taken through microscope lens with scale ruler. Single photograph of cumulative fragments extracted that make up the gravimetric result is acceptable.

Stage 3:

20. Sub-sampling method.
21. Mass of sub-sample.
22. Report indicative number and size range of fibres identified for each asbestos type.
23. Report masses individually for each type of asbestos identified.
24. Report masses in unit of mg/kg (not %wt/wt).

Definitions used in reporting:

The definitions in Appendix 4 of the SCA "Blue Book" method have been updated in the 2019 re-draft. It is recommended that the definition of "loose fibrous asbestos debris" is clarified to be debris not readily identifiable as coating or insulation, and the definition of "asbestos sheeting/board debris" is clarified to be debris not readily identifiable as asbestos insulating board (AIB) or any other board type.

Vague definitions such as "asbestos debris" should be avoided. Of relevance to the risk assessment is the friability of the asbestos - is the asbestos in a bound or unbound form, is it weathered/degraded or fully/partially disaggregated?

It is recognised that guidance is required for laboratories to be able to make such differentiation correctly and consistently.

Alternative/additional laboratory methods

The SoBRA survey and the recommended reporting requirements outlined above have both focused on the currently most common asbestos in soil laboratory analytical approach (i.e. a staged qualitative and quantitative analysis utilising polarised light and phase contract optical microscopy (PCOM)). The differentiation of asbestos type at the quantification stages may require the use of scanning electron microscope (SEM) or transmission electron microscope (TEM) methods, similar to the requirements in other countries. There are other laboratory test methods that focus less on the reporting of the mass of asbestos present in the sample and focus more on the potential for airborne asbestos fibres. Two such methods that have been developed, or are in the process of being developed, by UK laboratories are:

- Respirable fibre count per unit weight of sample (this can be used to estimate airborne fibre numbers in association with airborne soil particles)

- Dustiness tests (modified HSL drum tests designed to estimate the releasibility of asbestos fibres and provide normalised fibre to dust concentrations akin to those reported by Addison et al 1988[9]).

Current Developments

The SCA is understood to be re-drafting the withdrawn SCA "Blue Book" method - the current draft is dated 2019 and it is not known whether further changes to this draft are likely or when it might be published.

ISO and CEN are considering whether to produce standards for the testing of asbestos in solid matrices. The programmes for ISO TC190 and CEN TC444 are yet to be confirmed.

HSG248 has been redrafted by the HSE and is awaiting publication.

Limitations

This discussion paper has been developed by members of the SoBRA asbestos-in-soil sub-group acting in a voluntary capacity, and details the views of the individual members, not those of their employers. It is provided freely on the SoBRA website to help promote discussion on what should constitute good practice in assessing the health risk from asbestos-contaminated soil in the UK. Users of the paper must satisfy themselves that the content is appropriate for the intended use and no guarantee of suitability is made.

Feedback

Feedback on this paper is welcomed and should be submitted to SoBRA at info@sobra.org.uk.

[9] Addition, J, Davies LST, Robertson, A, Wiley, RJ (1988). The release of dispersed asbestos fibres from soil. IOM Historical Research Report TM/88/14.