

SELECTION CRITERIA AND QUALITY CONTROL ISSUES FOR AN OCCUPATIONAL HYGIENIST TO CONSIDER WHEN DEALING WITH AN ANALYTICAL LABORATORY



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1. ABSTRACT

Good communication between the occupational hygienist and the laboratory analyst is a prerequisite to an effective sampling strategy in a workplace assessment. The compatibility of samples taken in the field with the test methods being used by the laboratory is an issue often overlooked by inexperienced hygienists. The choice of analytical method, the detection limit, any interferences, sample stability, sample size, transport and storage need to be discussed with the laboratory prior to sending off the samples for testing. The hygienist needs to know how competent the laboratory is. Issues such as accreditation, methods of analysis, participation in external quality assurance programs, blanks, duplicates, divided samples, spiked samples and resubmission of old samples need to be addressed by the occupational hygienist.

2. INTRODUCTION

The quality and reliability of analytical data today is of the utmost importance. An occupational hygienist will spend a great deal of time and effort in taking samples in order to give a risk assessment of a particular workplace. These samples are then sent off to the laboratory to be analysed. The results of such analyses are used to make decisions on what actions are to be taken. This can be a costly exercise, to get the results and costly if the wrong decisions are made. Therefore, the selection of the analytical laboratory can be critical.

Occupational Hygienists tend to govern their selection of laboratories using the following criteria:

- * The laboratory claims to be able to do the analyses requested;
- * Cost;
- * The laboratory is NATA accredited for the analyses requested;
- * Sample analysis turn around times;
- * Previous track record.

A laboratory applying for NATA accreditation is visited by at least two assessors, one from NATA and the other(s) an expert in the particular tests for which accreditation is sought. The team examines all aspects of the laboratory's operation including the qualifications and experience of the staff; quality, calibration and maintenance of instruments; accommodation; laboratory practice including sample handling, quality control recording and reporting; and the test methods used. Accreditation is granted only for the particular analyses assessed, and one should ensure that the NATA-accredited

laboratory is actually accredited for the analyses required. The laboratory is reassessed at least every two years. NATA accreditation is important as it is seen by hygienists as providing an assurance that a laboratory is sufficiently competent to perform the analyses and generate reliable analytical results.

Costs of laboratory analyses amongst NATA accredited laboratories can vary by 100% or more. Basically there are laboratories and there are laboratories. “Oils ain’t Oils” and the cheaper laboratory may not be the best, even although it is NATA accredited.

3. QUESTIONS TO ASK THE LABORATORY

In order to ensure that you receive the service you require ask the laboratory the following questions:

- * Is the laboratory NATA accredited for the actual analyses that your require?
- * Is the laboratory currently participating in any external quality assurance schemes? Many countries run inter-laboratory testing schemes and some of these are international (eg. WASP, Wolfson, NIOSH, PAT). They involve the distribution of control samples to laboratories by an outside agency. The material is then assayed and the results returned to the coordinating body for statistical analysis. Commonly, the means or reference values ± 2 standard deviations are used as the outer limits, but other criteria may also be used. Ask to see the results of the last few months of the scheme. These schemes provide a retrospective check of accuracy and precision and their importance as such cannot be over-emphasised.
- * Is the laboratory using standard methods (eg. NIOSH, HSE, OSHA, NHMRC, SA) and have these standard methods been verified? It is all very well that these international organisations have validated the methods, but the individual laboratory should verify the method in its own laboratory before adoption.
- * If the method of use is not a standard method but an “in house” method, has the laboratory validated it and to what extent. Method validation should include an estimate of accuracy, precision and robustness of the method.

Accuracy may be tested by analysing known concentrations of the analyte, eg. by adding standard (known) amounts of solvent to charcoal tubes, desorbing it and analysing by gas chromatography. The recovery of the analyte is the percentage of added analyte which is recovered (determined) in the analysis. Sometimes the combined sampling and analytical procedure can be validated by generating a known concentration of gas in air (eg. by permeation tubes or by dilution of the pure gas using flow meters). If known gas concentrations cannot be generated, it may be possible to check the method against another well validated method by collecting a series of simultaneous samples and comparing the results obtained by the two methods. Precision may be determined by analysing a sufficient number of replicate samples to enable the calculation of the standard deviation or coefficient of variation (CV) of the method. Usually several concentrations over the analytical range are selected. The measurement range is an indication of the useful operating range of the method; at the lower end, this involves an estimate of the limit of detection (LOD) and the limit of quantitation (LOQ). The robustness of a method can be tested by introducing minor reasonable variations in the method to see what happens. It should be noted that at present there is no standard way of calculating accuracy, precision and detection limits in analytical

laboratories. Therefore, these values themselves will vary depending on the way in which they were calculated.

Ask the laboratory what QC practices they employ for your particular analysis. For example, do they use a Standard Reference Material for calibration? What is the purity of the standard used for calibration? Is the instrument calibrated for each run? Are spiked samples run with the samples? Are any commercially available QC standards run with the samples? Are any samples analysed in duplicate? Are any previously analysed samples run? Are any laboratory reagent blanks run? Are any matrix blank run? How are the QC control limits set? How are the result acceptance/rejection criteria and corrective actions set?

4. CHECKING THE LABORATORY'S PERFORMANCE

To check the laboratory's performance you should:

- * With each batch of samples include a number of field blanks. Some laboratories analyses blanks without cost. Perhaps include a field blank with the samples which is not identified as a blank.
- * Where possible, divide some samples in two and submit them as independent samples.
- * Submit spiked samples eg. charcoal tubes spiked with a known volume of solvent.
- * Duplicate air samples should only be submitted if they are collected from exactly the same location over exactly the same time period.

The hygienist should maintain a healthy scepticism at all times. Do the results make sense? For example, it is not unknown for a laboratory to return a result which corresponds to more than the saturation vapour pressure of the substance being analysed; or for the metals analysed on a filter to be found to weigh more than the total weight of dust collected. If the hygienist has any doubts at all about the analytical results, he or she should ask the analyst for the raw data so that he or she can check such things as calibration graphs and calculations. The hygienist should ask the laboratory manager or supervisor to check the raw data and calibrations.

5. COMMUNICATION WITH THE LABORATORY

Communication with the laboratory is of utmost importance. The choice of sampling and analytical method should be decided on before going into the workplace for sampling.

- * What is the purpose of the sampling (eg. Is it to test compliance with an exposure standard? If so, is it the STEL or TWA?)
- * Does the analytical method cover the concentration range of interest? Some analytical methods may not have sufficiently low detection limits to measure short term exposures.

- * What other substances are likely to be present in the sample and will they interfere with the proposed analytical method? (eg. the determination of formaldehyde by the Australian Standard method, using chromotropic acid, has a large negative bias if phenol is present in the air sample. This should be communicated to the laboratory so that appropriate steps can be taken to overcome this interference.)
- * Will the collected sample be stable until the analysis can be done?
- * How should the collected sample be transported and stored? (eg. For the analysis of isocyanates in air it is necessary to keep the collected samples in the dark. As a rule of thumb, all samples collected should be kept cool or at least no hotter than room temperature. At no time should samples be left on the front seat of a car!).
- * Will the proposed sample size overload the collecting medium. Sampling flow rates need to be considered in such situations.
- * Is the proposed sampling method compatible with the proposed analytical method? It is simply not good enough to look up a published method, such as from NIOSH, and assume there will be a laboratory which is following that method. It is best to check with the laboratory which sampling method is applicable.

Before selecting a laboratory ask to visit the laboratory if possible to get an overall impression of the place and to actually see the type and condition of the equipment which will be used to do the analysis you require. It is generally considered, at the end of the day, that the major contribution to the accuracy of an analysis is the skill, training and experience of the analyst who performs the test. However, this is very hard for the occupational hygienist to assess.

6. CONCLUSION

Selection of a good, reliable laboratory for analyses is not easy. NATA accreditation does not necessarily equate with competence in all tests. Cost of analyses can be totally misleading. Communication with the laboratory about the methodologies, QC/QA procedures and the skill and experience of the staff are the only way of finding a solution to this dilemma. This communication between the hygienist and the laboratory, gives awareness of the others requirements, limitations and objectives, and should result in more meaningful test results and good recommendations to workplaces around Australia.