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Preface

On-site analysis is continuing to progress as a practical method of dealing with environmental incidents, site remediation and lately, counter-terrorism. The last issue of the *Journal of Hazardous Materials* which was dedicated to on-site analysis was published three years ago. Since that time, more progress has been made to move the laboratory to the field. This trend is taking place primarily by the development of new portable technologies, portable either in vehicles or carried by people. Some development is taking place by the movement of existing laboratory instruments or techniques into the field.

The benefits of on-site analysis are many. The primary benefit is the reduced cost of cleanup. This is particularly true where intensive cleanup procedures are being used. An example of this is the excavation of contaminated soil. Removal of excess soil could cost thousands or dollars as could the shut down of site work until sample analysis results arrive from the laboratory.

On-site analysis is necessary for many substances or mixtures which do not lend themselves to sampling, storage and transport. Many gases and gas mixtures fall into this category. Examples of this include emissions from chemical warehouse burns and chemical warfare agents. Often, analysis of these materials off site is not useful simply because of the longer time this entails.

Another important benefit to on-site analysis is the significant improvement in the length of time of response. There is a real example of the cleanup of a PCB-contaminated site a few years ago. This site was being cleaned up by heavy machinery and depth of removal was controlled by analytical results from a laboratory with a 2 or 3 day turn around. There was an on-site test kit, but because the technique was new, the results were only used for test purposes. The procedure used was to excavate material and remove it to a warehouse for further treatment until the appearance of the soil changed. Samples were then taken of the soil remaining at the site and sent to the laboratory to determine the PCB content. In 2 or 3 days the results were available and work continued. During this time the equipment and operators waited for the results. The excavation lasted about 1 month and about twice the material was taken that was needed to be taken. As it turns out, the experimental on-site analysis method yielded similar results to the laboratory method. Use of the on-site data could have saved millions of dollars.

Another advantage is the lesser expense of on-site analysis. The field unit often can process the same samples at a fraction of the laboratory cost. The field samples require less handling, shipping, storage and work-ups. Furthermore, the field procedures often require the use of less consumables and much less processing time. An example of this is

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the PCB analysis cost from the above example. At the time this cleanup was conducted, the laboratory cost was about US$ 250 per sample and that of the field sample, about US$ 50.

There are, of course, several disadvantages to using field procedures. The biggest disadvantage is that most field procedures are not accepted as being in compliance with standards such as set by The International Standards Organization (ISO), The Environmental Protection Agency (EPA), The National Institute for Occupational Health and Safety (NIOSH), and The American Society for Testing and Materials (ASTM). This means that controlled sites may not be able to use these procedures. Analysts may also not wish to use the procedures because of possible legal actions. Only 'standard' procedures would stand up in court. The full acceptability of field procedures will be a long time in the future.

The second disadvantage of on-site methods is the reliability of such measurements. Often field methods do not have built-in checks such as the simultaneous analysis of surrogate standards. Often there are no quick or easy means to run a calibration standard. When any of these are the case, the reliability of field measurements is questioned. Reliability of field methods must be continually improved by including calibration procedures such as running standards and blanks between samples.

What is the future of on-site analysis? Since the last special issue, there has been slow progress. Several new units for on-site analysis have been marketed in the past few years. Sometimes the sales have been disappointing. While the reasons vary, the biggest problem appears to be the acceptance of field methodologies to the potential customers. Manufacturers who have been hurt by the poor sales of this equipment have often backed out of the market entirely.

A recent development which has been opposite to the trend described above, is that of the many new instruments for chemical counter-terrorism. Many of these are selling very well. This surge may continue for a few years. It is interesting that many of these instruments were languishing until their potential for counter-terrorism was noted.

The requirements for on-site analysis are first that the method is reliable. The method need not be highly accurate, but should never result in a false negative. Extensive testing is needed to ensure that this result occurs with a particular method over the many possible situations. Users must also understand the limitations and interferences involved in a field method. Secondly, the field method must be rugged—irrespective if the technique involves a portable kit or a vehicle-mounted unit. The rigours of the field are often underestimated. Thirdly, the field method must be easy to use, especially for those carried by hand into the field. Field conditions often do not allow users to carry our complex and demanding procedures. Finally, the methods must have a satisfactory accuracy. For field use, order-of-magnitude accuracy is sometimes sufficient. Users must also clearly understand the accuracy limits within the context of the samples they are analysing.

Field analytical techniques are being developed at a slow pace. Laboratories will still be needed for confirmation and precise quantitation for most field contamination situations. Field tests continue to focus on giving quick, rough but reliable estimations.

This issue of the *Journal of Hazardous Materials* highlights a number of developments in field analysis. Hopefully, this issue will also promote communication among developers and users of this new technology.

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