Summary

Papers in this publication fall into four categories within the general areas of sampling and calibration: General Topics; Indoor Air Measurement; Ambient Air Measurement; and Workplace Atmosphere Measurement. The following is a summary of the papers for each category.

General Topics

This category includes two papers that discuss the basic principles of sampling and calibration that are important no matter what kind of measurements are made. *Kratochvil* emphasizes the fact that measurements are not made of an atmosphere but of samples considered to be representative of it. Such samples must be of unquestionable integrity and statistically related to the atmosphere of concern in order that valid scientific inferences can be made from the measurements. The paper goes on to present guidelines for the development of valid sampling plans and procedures to estimate the extent of sample variability.

The general principles of calibration are discussed by *Taylor* who reminds us that measurement is simply a comparison of unknowns with knowns that must match the former in all essential respects if valid data is to result. The paper discusses various approaches to calibration and ways to evaluate and minimize calibration uncertainty.

Indoor Air

An overview of indoor air monitoring is presented by *Levin*. Because this is an area of recent concern, there are many unsolved problems of sampling and calibration and each building monitored presents its own set of problems, due to specific design and occupancy considerations. The need for standardization to achieve comparability of data is emphasized.

The paper by *Fortmann et al.* discusses important details of monitoring of buildings, including the selection of sites, and the actual sampling and measurement procedures to be used. *Sterling et al.* discusses the important relation of ventilation to providing an acceptable environment and how air circulation can cause or aggravate contamination problems from both external and internal sources.

The important subject of sampling for microbiological contamination in indoor air is discussed by *Fradkin.* Consideration must be given to what and where to sample as well as how to sample. The latter is of special importance since improper sampling techniques can destroy or change the viability of organisms and vitiate the results.

Ambient Air

Although ambient air has been analyzed for many years, still there are unresolved problems of sampling and calibration resulting from the introduction of new measurement techniques, the need to measure exotic constituents, and the lowering of limits of concern of well-known constituents.

The first paper, by *Rook*, describes how estimates of precision and accuracy can be made from statistically analyzing calibration data. A paper by *Puzak and McElroy* discusses the important question of calibration traceability to the U.S. Environmental Protection Agency (EPA) for State and local laboratories. Unless such is achieved, the compatibility of measurement data obtained for national ambient surveillance and legal enforcement is open to questions of both technical soundness and legal defensibility.

Gases provided by specialty gas manufacturers provide the basis for calibration of most monitoring measurements. *Denyszyn and Sassaman* point out the precautions that must be observed to produce reliable mixtures and techniques that may be used to verify their limits of reliability.

Both theoretical and practical considerations in the use of permeation tubes to produce calibration gases are discussed by *Mitchell*. Various aspects of the preparation and verification of the composition of dilute gaseous mixtures are discussed by *Fried and Sams*. *Dorko and Hughes* describe various approaches that may be used to produce and verify the composition of reactive gas mixtures used to calibrate monitoring instruments.

Workplace Atmospheres

Workplace atmospheric sampling is conducted to investigate sources of contamination and to assess levels of exposure to industrial materials. The development of the strategy employed requires the cooperative input of industrial hygienists, physicians, toxicologists, analytical chemists, safety engineers, and process engineers. *Norwood* discusses all of this and presents a rationale for sampling based on traditional approaches with the use of statistical methods to aid in selection of sample size and data interpretation. The use of computer simulation in the design of sampling strategies is also discussed.

Melcher reviews the important question of laboratory and field validation of passive monitors. Information is presented for the selection of sorbents for pump and tube collection and for solvent and thermal desorbtion for analysis of collected material.

A comprehensive guide for industrial hygiene sampling, developed by the U. S. Army Industrial Hygiene Agency, presented by *Belkin and Bishop*, should be generally useful when measuring worker exposure. The important aspects of specificity and accuracy of detector tubes, used extensively for surveys of potential problems, are reviewed by *McKee and McConnaughey*.

Isocyanates have been sampled by impingers, solid sorbents, and coated-filter techniques. The paper by *Dharmarajan et al.* evaluates these techniques from the point of view of collection efficiency. The concluding paper by *Podolak et al.* discusses the collection and analysis of airborne hexamethylene diisocyanate, using impregnated filters. The importance of removing excess reagent from the coated filters, prior to analysis, is emphasized.

Final Remarks

Advances in analytical methodology have provided opportunities for better understanding of atmospheric phenomena and for the identification and control of contaminants. However, such measurements must be made reliably using advanced concepts of quality assurance and they are critically dependent on relevant samples and adequate calibration.

Sampling is a discipline in itself, involving knowledge of the subject area of concern, and measurement and statistical expertise. Because measurement is a comparison process, adequate calibration is essential, reliable calibrants must be used, and appropriate calibration procedures must be implemented, if measurement data are to be meaningful.

It is the hope of ASTM Committee D-22 and the authors of these papers that the 1985 Boulder Conference will have been useful in providing an increased awareness of the importance of sampling and calibration and in advancing the state of the art in these important areas of measurement.

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