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A RECOMMENDED PROGRAM OF ENVIRONMENTAL HEALTH FOR CHAMPLIN PETROLEUM COMPANY
Corpus Christi, Texas

By

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<u>NOTICE</u>

The information herein is presented in good faith and, while it may not be complete in scope, it is believed accurate and reliable. No representation, guarantee or warranty is made as to its completeness.

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INDUSTRIAL HYGIENE PROGRAM

Industrial hygiene has been defined by the American Industrial Hygiene Association as, "that science and art devoted to the recognition, evaluation and control of those environmental factors or stresses, arising in or from the workplace, which may cause sickness, impaired health and well being, or significant discomfort and inefficiency among workers or among the citizens of the community." With this definition as a point of reference, the industrial hygiene program for Champlin Petroleum Company is discussed with the objective of establishing the responsibility which the industrial hygiene function has for implementing.

GOALS

Preservation of health and safety of all employees of the Champlin Petroleum Company is to be the prime interest of all supervision of the company.

This is to be accomplished through a program of monitoring of environment; health evaluations through physical examinations; and a training program to inform all employees of potential exposures, hazards and methods to control these hazards.

PROGRAM DIRECTION

The individual responsible for the plant industrial hygiene program should be qualified by training and experience. Time and funds should be allocated each year for professional training of industrial hygienists. A program review should be done by a professional industrial hygienist every six months.

MONITORING PROGRAM

The industrial hygiene monitoring program for Champlin Petroleum Company has as its primary objective, the routine assessment of environmental conditions to which workers are exposed. A monitoring program is comprised of three distinct tasks: an initial comprehensive industrial hygiene investigation; routine sampling, that is, the monitoring program per se; and the on-going interpretation of data collected as a result of the monitoring program.

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INITIAL SURVEY

It is important that an on-going monitoring program be implemented on the basis of priorities established as a result of a thorough and in-depth industrial hygiene investigation of the various production operations. Preferably this initital survey should be conducted by the most highly qualified industrial hygienists within the company. In companies which do not have an industrial hygiene department or those companies in the process of establishing one, it would be desirable to obtain the services of consulting industrial hygienists. In any event, as a direct result of the initital survey, the priorities for and scheduling of the specific aspects of the routine sampling program should be developed. For this routine sampling effort a frequency of from six months to several years, depending upon hazard potential and legal requirements, for resurveying of specific observations is reasonable.

The initial survey at Champlin Petroleum Company should include, accroding to priority:

1. Noise
2. Benzene (May include toluene, ethyl benzene, etc.)
3. Metals (Welding fumes, chromates, catalists, etc.)
4. Lead
5. Others

NOISE

Noise evaluations should be made by two methods. Area sruvey and personal dosimetry. Areas should be monitored first. This would include all areas in which employees spend time during the work shift. Any area where the sound levels exceed 85 decibels on the A scale should also be evaluated with a Frequency Analyzer (Octave band analyzer). This will assist in making engineering correction or help in the selection of proper hearing protection.

After the survey is complete, the estimated time that each employee spends in each area is recorded. Then an evaluation of the employee's exposures can be made according to proper procedures such as "ACGIH Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment".[1]

After the Area Survey

If results of the area survey have been evaluated and found to be 50% of the prescribed limits or more, then personal dosimetry should be done. These should be divided so that 25% of the total employees are monitored every three months with everyone being monitored annually.

All monitoring results should be evaluated by the industrial hygienist and the industrial physician to determine if more control measures are necessary.

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BENZENE

(May include other aromatics which can be collected at the same time)

Benzene levels should be determined for two different reasons. One is the Time Weighted Average (TWA), the second is for peak concentrations.

The TWA may be obtained using a psssive dosimeter. This requires no pump or calibrations and samples can be collected by anyone with little training. These monitors are disposable, light and easy to use. They can also detect many other chemicals at the same time.

The peak concentrations must be taken on the spot. These are usually obtained using a high volume pump and a jumbo charcoal tube. Sample time is for only the exposure period when the employee has the highest potential for exposure. These areas have usually been determined previously by using detector tubes or direct reading ppm analyzers.

All exposure levels should again be compared by the industrial hygienist and the industrial physician.

METALS

(Welding fumes, chromates, etc.)

Metals and metal fumes can be collected by pulling a measured amount of air through a special filter pad. These pads can then be analyzed. The levels may then be determined. Metals and metal fumes of concern are chromium, lead, tim, beryllium, antimony, copper, zinc, arsenic, nickel and, on occasion, many others.

Again evaluations should be compared with health results of individuals by the industrial hygienist and the industrial physician.

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CARBON MONOXIDE

Carbon monoxide levels should be monitored in all areas using fuel fired fork lifts or tow motors, in areas using welding or cutting on organics.

These are measured with direct reading instruments.

ORGANIC LEAD

The ~~tetra-ethyl~~ lead area should be evaluated on a routine basis by the industrial hygienist. This is a very important area to keep under control.

OTHER AREAS FOR MONITORING

Radiation	Total particulate
Heat	Light
Ventilation	

Each of these will require special types of monitoring equipment and some special training in use of each.

TRAINING RECOMMENDED

550 Course, Industrial Hygiene, NIOSH, Cincinnati, OH

Radiation Training, Texas Nuclear Corp., Austin, TX

Ventilation, Texas A & M University, College Station, TX

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ROUTINE SAMPLING EFFORTS

It is anticipated that in the years to come, the requirements from both a professional and legislative standpoint for routine documentation of environmental conditions in the workplace will become more and more demanding. The record keeping requirements which are being established as proposed rulemaking and promulgated as official health standards make it necessary to provide and maintain this documentation on a sustained basis. This tremendous increase in demand for documentation of conditions, i. e., routine sampling, when viewed in light of the fact that there are less than one thousand practicing industrial hygienists in all of American industry makes it clear that for the near future at least, the professional industrial hygienists will not be sufficient in number to provide the necessary manpower for the sampling needs. In addition, with increasing emphasis on occupational health aspects of American industry, the demands for direct input of the industrial hygienists's knowledge and skill in areas other than sampling will continue to increase. Thus it is likely that, in most companies, a significant portion, if not all, of the routine monitoring will be conducted by individuals trained to do this monitoring. Obviously, it will remain a requirement that these individuals be trained adequately, either academically or by experience, in the science of industrial hygiene monitoring. Thus, for example, a quality control chemist at an operating unit of a petroleum refining company after proper training and orientation can be given responsibility for the routine sampling efforts administered under the general guidance and direction of the corporate industrial hygiene function.

INTERPRETATION OF DATA

Perhaps the most critical aspect of the total industrial hygiene monitoring porgram is the valid interpretation of the data collected on a continuing basis. This interpretation of data can and should be done in several relevant ways. Results of the sampling programs as they characterize worker exposures and general indices of environmental conditions in the workplace can be evaluated by:

A. The industrial hygienist to determine the significance of data in relation to occupational health standards.

B. The occupational physician, in conjunction with periodic physical examinations of the work force, to establish, where applicable, cause-and-effect relationships between contaminants and medical and/or clinical indices of the health status of the workers.

C. Engineering personnel as documented evidence of the appropriateness and degree of effectiveness of various control mechanisms installed in the workplace.

THE INDIVIDUAL DIRECTING THE INDUSTRIAL HYGIENE PROGRAM MUST HAVE ULTIMATE RESPONSIBILITY FOR INTERPRETATION OF THE EVNIRONMENTAL DATA COLLECTED AS A RESULT OF THE MONITORING EFFORTS.

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PERSONNEL, EQUIPMENT AND FACILITIES

The requirements for adequate personnel, equipment and facilities necessary to sustain the monitoring program vary somewhat with the various options for organization of the overall occupational health effort; however, the following guidelines appear reasonable and should prove useful in estimating program requirements:

A. Each major operating unit of a petroleum refining or petrochemical company should staff on-site a knowledgeable industrial hygienist or industrial hygiene technician.

B. For each active field industrial hygienist, approximately four support personnel generally are required. These may include, at least on a part-time basis, a chemist or analyst, a technician, a mechanic or maintenance man and a secretary.

C. The manpower effort required for comprehensive surveys by experienced industrial hygienists varies directly with the capacity of the plant and the number and complexity of processing operations. Work records have shown the field survey time requirements to vary from five man-days for a 25,000 B/SD refinery to about 30 man-days for a 95,000 B/SD refinery. However, a plant of about 50 percent greater capacity (135,000 B/SD), but containing a wider variety of processing operations, required about 60 man-days of field work to accomplish a survey of all environmental stresses.

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On this basis, the field time requirements for a survey of a refinery of 2-3 hundred thousand B/SD capacity could consume many man-months of industrial hygiene work and is best performed by a team effort. In several large refining and petrochemical complexes, the field survey time needs require the full time services of one or more industrial hygiene personnel at that one location.

D. For each man-day of effort devoted to field investigation of a variety of stresses, the necessary related activities indicated in the following table are likely to require the indicated expenditure of effort. See Table I.

E. All sampling and monitoring equipment necessary for the practicing industrial hygienist or sampling technician to accomplish the requirements of the monitoring program should be provided and maintained in good working condition. It is recommended that, for each active field investigator, the following equipment be provided: See Table II.

F. Facilities for the industrial hygiene program should be made available at each place of activity. These facilities should be located in a quiet and relatively clean, i.e., un-contaminated area of the production location. There should be adequate office space for all full time members of the industrial hygiene function which includes ready access to a selective relevant library and should include adequate space and facilities for maintenance, repair, calibration and storage of sampling equipment.

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TABLE I

DESCRIPTION OF ACTIVITY	PREPARATION TIME IN DAYS (Man-days per man-day of field investigation) 1 DAY Survey	5 DAYS Survey	30 DAYS Survey
Preparation, literature review, calibration of equipment, etc.	0.5	0.5	0.1-1.5
Travel to and from site	variable	variable	variable
Laboratory analyses	2.0-3.0	1.5-2.5	1.0-2.0
Calculations and interpretstion of data	0.5-1.0	0.5-1.0	0.25-0.75
Preparation of report and findings	1.0	0.5-1.0	0.25-0.50

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TABLE II
RECOMMENDED EQUIPMENT FOR MONITORING REQUIREMENTS

EQUIPMENT	NUMBER
Anemometer with attachments	1
Bubble meter	1
Calibration equipment	as needed
Charcoal tubes	as needed
Cyclone separators for dust sampling	6
Detector tube kit	1
Direct-reading instruments	
Carbon monoxide meter	1
Combustible gas indicator (sensitive type)	1
*Mass monitor	1
*Mercury detector	1
Filters of various matrices (Membrane, glass, fiber, etc.)	as needed
*Gas chromatograph	1
Heat stress equipment (WBGT test meter)	as needed
High volume air sampler	3
*Infrared detector	1
*Light meter	1
Midget impingers	12
Oxygen indicator	1
Passive dosimeters	as needed
Personal (Batter-operated)monitoring pumps and chargers	8-12
Radiation survey meter	1
Reagents, miscellaneous	as needed
Rotometers	as needed
Sound level meter and calibrator	1
Stop watch	1
*UV-radiation meter	1

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*Optional

GENERAL CONSIDERATIONS FOR EVALUATION OF THE OCCUPATIONAL ENVIRONMENT

The purpose of this section is to discuss ways in which the magnitude of chemical and physical stresses can be evaluated. One form of evaluation is qualitative in nature and requires the use of one or more of our senses without taking any actual measurements. Often this kind of inspection and evaluation of a work situation can be very beneficial. Another form of inspection, a quantitative survey, involves actual collection and analysis of samples which represent actual exposures of workers. This type of inspection is most desirable, and necessary in many cases, particularly when the purpose of the sampling is to determine compliance with occupational health standards or to form the basis for designing engineering controls.

PRELIMINARY SUBJECTIVE SURVEY

An experienced professional in the field of occupational health and safety often can evaluate, quite accurately and in some detail, the magnitude of chemical and physical stresses associated with an operation without the benefit of any measurement. In fact, the professional uses this qualitative evaluation every time he makes a survey whether it is going to be the total effort of his work or a preliminary inspection prior to actual sampling and analysis of potential stresses. This same approach, i.e., a qualitative evaluation of an operation, can be used by anyone associated with an operation, from the worker to the professional investigator, to ascertain some of the potential problems associated with work activities.

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The first step in evaluating the occupational environment is to become as familiar as possible with particular operations. The person evaluating the operation should be aware of the types of industrial processes, the chemicals, raw materials, by-products and contaminants encountered, what protective measures are provided, how engineering controls are being used, how many workers in addition to the individual operator are exposed to contaminants generated by specific job activities and so on.

The variety of chemical and physical agents which are capable of producting occupational illnesses is increasing steadily. New products are constantly being introduced which require the use of either new materials or combinations of older substances. This is particularly ture in the petroleum and petrochemical industries where new "space age" chemicals and products and their necessary processing operations are being developed. Therefore, it is becoming increasingly important that the responsible industrial hygienist develop and maintain a list of the chemical and physical agents encountered. This list should include the composition of the products and by-products and as many of the associated contaminants and "undesirables" as possible. Very often this requires a bit of detective work on the part of the industrial hygienist to obtain complete information on the composition of various commercial products. However, in most instances the desired information can be obtained from information provided by the supplier of the product. At the very least, the labels which are provided on the drums or on other containers of the material should be read carefully. However, oftentimes these labels do not give complete information and further investigation of the composition of the materials is necessary.

After this inventory of stresses is obtained it is necessary to determine the toxicity of the chemical substances. Information of this type can be found in reference books on toxicology and industrial hygiene.

During a qualitative evaulation many potentially hazardous operations can be revealed visually. Operations which produce large amounts of dusts and fumes can be spotted at this time, although this does not necessarily mean they are the most hazardous. It must be emphasized that the dust particles which cannot be seen by the unaided eye are normally the most hazardous since they are more likely to be drawn into the lungs. Often, concentrations of respirable dust must reach extermely high levels before they are visible. Thus, the absence of a visible cloud of dust does not mean necessarily that a "dust-free" atmosphere exists. However, in most operations the activities which generate dust can be spotted visually and are likely to warrant implementation of additional controls.

In addition to the sense of sight, the sense of smell can be used to detect the presence of many vapors and gases. Trained observers are able to estimate rather closely the concentration of various gases and solvent vapors present in the workroom air. For many substances the odor threshold concentration (that is, the lowest concentration that can be detected by its smell), is greater than the generally permissible safe exposure level. In these cases, there is an indication of excessive levels if the substance can be detected by the odor. However, it should be recognized that many substances, most notably hydrogen sulfide, can cause olfactory fatigue, that is an anesthesis of the olfactory nerve endings, to the extent that even dangerously high concentrations cannot be detected by odor.

Although it is usually possible to determine the presence or absence of potentially hazardous physical agents at the time of the qualitative evaluation, it is not possible to evaluate the potential hazard without the aid of special instruments. In most cases, the sources of such physical agents as radiant heat, abnormal temperatures and humitities, excessive noise, improper or inadequate illumination, ultraviolet radiation, microwaves and various forms of radiation can be noted.

The final item in the qualitative evaluation is an inspection of the types of control measures in use in a particular operation. In general, for most activities in a petroleum refinery or petrochemical plant, these control measures would consist of shielding from radiant or ultraviolet energy, local exhaust and general ventilation provisions, respiratory protection devices and other personal protective measure. General guides to the effectiveness of these controls would include the presence or absence of accumulated dust on floors, ledges and work surfaces in general, whether the ductwork for the ventilation systems is in good condition, that is, without holes or badly damaged sections of ductwork, whether or not the fans for ventilation systems appear to provide adequate control of contaminants generated by the processes and the manner in which personal protective measures are accepted and used by the individual worker.

STRATEGY FOR REPRESENTATIVE QUANTITATIVE SURVEYS

Although the information obtained during a qualitative evaluation or inspection of industrial activity is important and always useful, only some type of measurement can show the actual level of chemical or physical agent associated with a given operation. It should be emphasized at this point that the actual strategy used for any given air sampling program depends to a great extent on the purpose of the study. The specific objectives of any sampling program may include one or more of the following:

A. To provide a basis whereby unsatisfactory or unsafe conditions can be detected and the sources identified.

B. To assist in designing controls.

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C. To provide a chronicle of changes in operational conditions.

D. To provide a basis for correlating disease or injury with exposure to specific stresses.

E. To verify and assess the suppression of contaminants by methods designed to do so.

F. To document compliance with health and safety regulations.

These objectives can be condensed into two major categories: sampling for industrial health engineering surveillance, testing or control; and sampling for health research or epidemiologic purposes.

A sampling program for engineering purposes should be designed to yield the specific information desired. For example, one might need only single samples before and after a change in ventilation to determine whether the change has had the desired effect.

Industrial hygiene applications are directed at predicting the health effects of an exposure by comparing sampling results with hygienic guides, determining compliance with health codes or regulations, or defining as precisely as possible environmental factors for comparison with observed medical effects.

Regardless of the objective, or objectives, of the study, the investigating industrial hygienist must, in order to implement the correct strategy for the sampling program, answer the following questions:

1. Where should the samples be taken?
2. Whose work area should be sampled?
3. For how long a time period should the samples be taken?
4. How many samples should be taken?
5. Over what period of work activity should the samples be taken?
6. How should the samples be taken?

The considerations which go into answering each of these questions are discussed below. The importance of adequate field notes must be emphasized. Notes describing the time, duration, location, operations underway and all other factors pertinent to the sample and the exposure or condition which it is intended to define, should be made while the sample taken is at the sampling site. Forms with labeled spaces for essential data help to avoid the common failure to record needed information.

WHERE SHOULD THE SAMPLE BE TAKEN?

There are basically three general locations in which the air samples can be collected: at the operation itself, in the general workroom air or at the worker's breathing zone. The choice of sampling location is directed by the type of information desired and may actually include a combination of the three types of sampling. Most frequently, the purpose for sampling is to determine the level of exposure of a worker or group of workers to a given contaminant throughout a work day. In order to determine this sort of information it is necessary to collect samples at the worker's breathing zone as well as the areas adjacent to his particular activities. In those cases where the purpose of the survey is to determine sources of contamination or to evaluate engineering controls, a strategic network of area sampling sites would be appropriate.

WHOSE WORK AREA SHOULD BE SAMPLES?

Obviously, the answer to this question is closely related to the first one. In general, samples are collected in the vicinity of workers directly exposed to contaminants generated by their own activities. The breathing

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zone of workers in nearby work areas, but not directly involved in the activities which generate the contaminant, workers remote from the exposure but who have either complained or have reason to suspect that the contaminants have been drawn into their work areas also might be included.

FOR HOW LONG A TIME PERIOD SHOULD THE SAMPLE BE TAKEN?

In most cases the length of the sampling time is determined by the time it takes for an amount of the material to be collected sufficient for accurate analysis. The duration of the sampling period is, therfore, based upon the following considerations: the sensitivity of the analytical procedure, the acceptable concentration of the particular contaminant in air and the anticipated concentration of the particular contaminant in the air being sampled.

There is one other consideration. The sampling period should represent some identifiable period of time of the operator's exposure, usually a minimum of one complete cycle of his activity. This is particularly important when activities are non-routine or of a batch-type nature which is characteristic of many operations in the refinery or petrochemical plant. Exceptions to these would be the highly automated and enclosed operations where the processing is done automatically and the operator's exposure is relatively uniform throughout the workday. In some cases it is desirable to sample the worker's breathing zone for the duration of the full work shift.

Evaluation of worker's daily time-weighted average exposures is usually best accomplished, when analytical methods will permit, by allowing the worker to work his full seven or eight hour shift with a personal breathing zone sampler attached to his person. The concept of full-shift integrated personal sampling is much preferred to that of short term or general area sampling if the results are to be compared to standards based on time-weighted average concentrations. When methods that permit full-shift integrated sampling are not applicable, time-weighted average exposures can be calculated from alternative short term or general area sampling methods.

The first step in calculating a worker's or group of workers' daily time-weighted exposure is to again study the job descriptions obtained for the persons under consideration and ascertain how much time out of each day they spend at various tasks. Such information is usually available from the plant personnel office or foreman on the job. In many situations the investigator must take time studies himself to obtain the correct information. Even though this information was obtained from plant personnel, it should be checked by the investigator because in many situations, job activities observed by the investigator and those described by plant personnel do not agree. From this information and the results of the environmental survey, a daily eight-hour time-weighted average exposure can be calculated. This assumes that a sufficient number of samples have been collected or readings obtained with direct reading instruments under various plant operating conditions to give a true picture of the exposure.

Where sampling for the purpose of comparing results with airborne contaminants whose toxicological properties warrant short term and ceiling limit values, it is necessary to use short term or grab sampling techniques to define peak concentrations and estimate peak excursion durations. For purposes of further comparison, the time-weighted average eight-hour exposures can be calculated using the values obtained by short term sampling.

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HOW MANY SAMPLES ARE NEEDED?

The number of samples collected depends to a great extent upon the purpose of sampling. For example, two samples may be sufficient to estimate the relative efficiency of control methods, one sample being taken while the control method is in operation and the other while it is off. On the other hand, several dozen samples may be necessary to accurately define the average daily exposure for a worker who performs a variety of tasks. For any given task the number of samples depends to some extent upon the concentration encountered. If the concentration is quite high a single sample may be sufficient to warrant further action. If the concentration is somewhat near the acceptable level, a minimum of three to five samples usually is desirable for each operation being studied.

It is important to realize that there are no set rules regarding the duration of sampling or the number of samples to be collected. These decisions usually can be reached quickly and reliably only after much experience in conducting such studies.

OVER WHAT WORK PERIOD SHOULD THE SAMPLE BE TAKEN?

The answer to this question also depends on the type of information desired and the particular operations under study. If, for example, the operation continues for more than one shift, it is usually desirable to collect air samples during each shift. The airborne concentrations of toxic chemicals or exposure to physical agents may be quite different for each shift. It is well to mention at this point that it is usually desirable to obtain samples during both summer and winter months, particularly in plants located in areas where large temperature variations occur during different seasons of the year. In such areas there is generally more natural ventilation provided to dilute the airborne contaminants during the summer months than during the winter.

HOW SHOULD THE SAMPLE BE TAKEN?

In general, the choice of a particular sampling instrument or instruments depends upon a number of factors:

1. The portability and ease of use
2. The efficiency of the instrument or method
3. The reliability of the equipment under various conditions of field use.
4. The type of analysis or information desired
5. The availability of the instrument
6. The "personal choice" of the industrial hygienist based on past experience and other factors.

No single, universal air sampling instrument is available today and it is doubtful if such an instrument will ever be developed. In fact, the present trend in the profession is toward development of a greater number of specialized instruments

The sampling instruments used in the field of industrial hygiene are generally classified by type as follows:

1. Direct reading
2. Those which remove the contaminant from a measured quantity of air
3. Those which collect a volume of air

These three general methods are listed in order of their application and preference in use today.

Regardless of the sampling instrumentation selected for use in conducting industrial hygiene surveys, it is critical and imperative that the actual performance characteristics are known. This requires that various types of calibration be done on a periodic basis or at any time that the performance of the device is questioned. Calibrations should always be of prime concern, because all samples collected are analyzed and evaluated based on primary calibrations.

Methods of calibrating the various instruments are found in The Industrial Environment-Its Evaluation and Control[2], which is an essential volume for use.

STATISTICAL ASPECTS OF INDUSTRIAL HYGIENE SAMPLING

Traditionally, industrial hygiene monitoring includes measurement of environmental conditions or worker exposures and the subsequent comparison of that measurement (or weighted average of such measurements) to some reference level, index of acceptable exposure, industrial hygiene standard, or legal regulation. Such comparisons can be made with peak or ceiling concentrations of airborne contaminants or with time-weighted average levels depending upon the purpose of the survey and definition of acceptable exposure judged most appropriate.

Historically and, to some extent, even today the use of statistics in industrial hygiene sampling and interpretation of results has been sparse and generally inadequate. All to frequently, decisions are made on the magnitude of exposure levels based on too few samples which may or may not be representative of actual worker exposure. A disproportionate amount of attention has been exerted in the past in development and promulgation of occupational health standards without regard to proper usage of these indices and the implicit requirements for the design, execution and interpretation of an industrial hygiene study based on these parameters.

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DESIGN OF AN INVESTIGATION

In deciding to do an industrial hygiene study, the investigator must first decide precisely what he wishes to learn. He probably knows his general ultimate objective but he must pose his questions very specifically: What does his study mean? In making such a definition he realizes that he needs to assess and predict and thus, he is faced with the question of what information is available or could be available upon which valid conclusions can be based. In order to derive the information he desires he will deal with what we term "samples". To obtain the information he wants, he must then obtain a series of samples which is sufficiently representative and large enough to be considered useful and reliable.

COMPARISON OF SAMPLING RESULTS WITH ACCEPTABLE EXPOSURE LEVELS

There are two points of view an investigator can take when evaluating the results of an industrial hygiene study. The first of these is to assess the confidence level associated with a decision that the worker exposure now under study exceeds the comparative standard. The second point of view is to assess the level of confidence associated with a conclusion that the worker exposure lies within an acceptable range. Specific examples of this dichotomy of views might well be found in the case of an OSHA investigation. The compliance officer has the burden of proving noncompliance; therfore, he is interested in a level of occupational exposure that must exceed the applicable standard quantitatively by a margin of 95 percent, that noncompliance exists.

The opposite viewpoint might well be taken by the company under investigation. Here the interest should be on determining the level of occupational environmental samples (or the weighted mean of a group of samples) that, although less than the comparative standard, must be lower than the acceptable limit by sufficient margin to say, with 95 percent certainty that overexposure does not exist.

Such considerations follow in a straightforward manner from the application of simple statistical decision-making tests and procedures. Unfortunately, such procedures do not detect and usually do now allow for analysis of highly inaccurate results. That is, there are certain underlying assumptions which are used to apply well-known statistical methods to this situation. It goes without saying that suitable and accurate calibrations and quality control programs for analytical tests are critically important so that the environmental data can be corrected accordingly before the statistical evaluation takes place.

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REPORTS AND RECORD KEEPING

Information developed during the surveys is of little value unless a report is written and distributed to the proper people. A report should be brief and to the point, containing the following:

1. Title of report
2. Author of report
3. Summary
4. Introduction
5. Methodology
6. Results
7. Discussion
8. Conclusions
9. Recommendations
10. Any special conditions, information or limitations

Keep the reports separate. Don't try to put two reports together. (Reason: If asked to show the report to other authorities, only show what is asked. If two reports are together, this would be giving more information than requested.)

Send copies of report to all the plant management that have a need to know. The general manager should always be included. On many occasions the air control section should receive a copy since they may not have knowledge of chemicals being released in those areas.

Keep copies for as long as required by authorities; usually twenty years.

LABORATORIES RECOMMENDED FOR SAMPLE ANALYSIS

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S & B Engineers, Inc.
7825 Park Place Blvd.
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Analytical Consulting Services
6251 Corporate Drive
Houston, TX 77036
Phone (713) 995-8080

*For metals only

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REFERENCES

1. "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1979". American Conference of Governmental Industrial Hygienists, Publications Office ACGIH, POB 1937, Cincinnati, OH 45201

2. The Industrial Environment - Its Evaluation and Control. U. S. Department of Health and Welfare, Superintendant of Documents, U. S. Government Printing Office, Washington, DC 20402

3. Statistical Methods for the Determination of Noncompliance With Occupational Health Standards. Leidel, N. A. and K. A. Busch, U. S. H & W (HEW NIOSH 75-159).

4. OSHA Safety and Health Standards (29 CFR 1910). U. S. Department of Labor, Superintendant of Documents, U. S. Government Printing Office, Washington, DC 20402.

5. Documentation of the Threshold Limit Values. American Conference of Governmental Industrial Hygienists, POB 1937, Cincinnati, OH 45201

6. Industrial Ventilation, A Manual of Recommended Practice. American Conference of Governmental Industrial Hygienists, Committee on Industrial Ventilation, POB 16153, Lansing, MI 48901.

7. Introduction to Radiological Monitoring, A Programmed Home Study Course. Staff College, Defense Civil Preparedness Agency, Battle Creek, Michigan.

8. Industrial Hygiene Sampling Manual. Hager Laboratories, Inc. Denver, Colorado.

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9. "Development of Performance Criteria for Protective Clothing Used Against Carcinogenic Liquids". DHEW (NIOSH 79-106). U. S. Dept. of Health and Welfare, Public Health Service, center for Disease Control, National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, Cincinnati, OH 45202

10. "Engineering Control of Welding Fumes". U. S. Department of Health and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Division of Laboratories and Criteria Development, Cincinnati, OH 45202.

11. "Criteria for a Recommended Standard Occupational Exposure to..." (Noise, Benzene, Toluene, Ethyl Benzene, Heat, Light, Chlorine and any other chemical in your plant). May be obtained from the U. S. Government Printing Office in many U. S. cities.

E A / NIOSH [illegible]