PLAINTIFF'S EXHIBIT

ATT-248

GENERAL PRINCIPLES

Charles P. Lichtenwalner

General Principles

Solving occupational health problems has traditionally been performed by a profession called industrial hygiene. With the vast geographic area covered by the Bell System, it has become necessary to establish expertise in this field with the safety supervisors in the operating telephone companies.

The industrial hygienist approaches occupational health problems in three phases: 1) *Recognition* of the problem, 2) *Evaluation* of the environmental factors, and 3) Application of *Control* measures. As can be seen from the goals and objectives, this course will deal primarily with recognition and evaluation.

Recognition

Recognition may be the easiest part of the process when only one substance is present or there is specific concern over a particular material. However, in many cases, such as employee complaints in new buildings, recognition of the particular substance for evaluation and control may be the most difficult phase. Some common techniques for dealing with recognition of occupational health hazards include: 1) Medical department notice of frequent health complaints from a specific area, 2) Employee complaints, 3) Review of chemicals and materials purchased, 4) Perusal of stockroom shelves, 5) Observation of processes and equipment used, and 6) A survey or "walk-thru" to determine materials, products, sources of air contaminants, types of physical agents, and control measures currently in use.

Evaluation

An evaluation is generally conducted in two phases; first an environmental survey is performed, then the results are compared with standards or criteria.

To conduct an environmental survey, samples are collected which must be representative of a worker's exposure. Recognition has already determined WHAT is to be sampled. Now the question of WHERE, WHO, and WHEN must be answered.

WHERE - Two different locations called "area" or "personal" are taken depending upon whether the samples are collected in a specific area or, are attached to the employee and taken close to the exposed part of the body. For the case of air contaminants, personal samples are collected as close as feasible to the "breathing zone."

WHO - Samples collected under the maximum exposure conditions are called "worst case." Ideally, all employees would be sampled, but in practice, this is seldom possible so individuals are chosen who are "representative" of a larger group who perform the same job tasks.

WHEN - The time when samples are started depends on whether worst case or representative samples are being collected. The duration or HOW LONG a sample is collected is often a crucial factor. For some sampling techniques, the sensitivity of the method used for analysis will determine the maximum and minimum sampling times. In general, samples which are less than 15 minutes are called "short term" or "grab" samples. They are particularly appropriate if the environmental insult has a "ceiling" or "peak" exposure level. Longer term samples are sometimes called "integrated" samples.

LLA 001437

Toxicology I (General Principles)

1. Introduction to Toxicological Principles
2. Terminology
3. Role of Biotransformation in Carcinogenesis
4. Molecular Mechanisms of Mutagenesis, Carcinogens and Teratogenesis
5. Testing Methodology & Quantitive Risk Evaluation

Toxicology II (Telecommunications Health Concerns)

1. Lead
2. Asbestos
3. Polychlorinated Biphenyls (PCB's), Dioxins & Dibenzofurans
4. Plastics & Combustion Toxicology
5. Indoor Air Pollution Concerns (Volatile Organic Compounds)

Concluding Remarks

Issue: Short-term, acute exposure standards
How should you interpret toxicologic data?

Exposure Criteria

Frank X. Worden

The development of and proper utilization of exposure criteria is both an art and a science. It ranges from the days when miners recognized the need for a means to determine if the air in the mine was safe to breathe to the development of instrumentation to measure constituents in the air in a concentration in parts per billion.

The bird with a significantly smaller breathing system was overcome and died when it encountered environments where the amount of oxygen was not adequate to support life. As the miners saw the bird keel over, he abruptly changed his direction to evacuate the mine.

Since those days, the toxicologist has developed more sensitive methods to dose various species of animals, to monitor changes caused by the dose, and to work with the pathologist in sacrificing some exposed animals to determine the effects of the chemicals on various organs and body systems. These studies, in part, have led to the formulation and development of threshold limit values promulgated by the American Conference of Governmental Industrial Hygienists.

These threshold limit values are based in some cases on animal toxicity studies; in others on the extrapolation of the toxicity of known materials to chemicals with similar structures; industrial experience and guesstimates.

Threshold limit values are not fine lines between a safe and unsafe environment but are a time-weighted average exposure that normally all workers can be exposed to day after day without any adverse health effects. In some cases they are based purely on health effects while in other cases they are based on odor. The American Conference of Governmental Industrial Hygienists publishes a book entitled "Documentation of the Threshold Limit Values." This book is used as a ready reference by industrial hygiene engineers to determine the basis for a given threshold limit value. This book contains a bibliography on the papers evaluated by the Committee in determining the threshold limit value.

The Federal Government has promulgated many exposure criteria in the OSHA regulations. Some of them have been predicted on the basis of what is the existing instrumentation to measure those materials, what is its reliability, reproducibility and lowest sensitivity. The government cannot promulgate a standard and specify a given atmospheric concentration as being the proper exposure limit if there is not a reliable instrument available to measure it at the concentration.

It is important to be aware of the limitations of the exposure criteria that is utilized every day in establishing whether or not a given work environment is safe for its occupants. Some chemical suppliers have conducted toxicity studies on their chemicals while others know very little about the toxic effects of their chemicals. It is important to solicit as much information as you can obtain from suppliers to assist you in formulating a recommended exposure criteria. The exposure criteria developed by following this methodology is often referred to as a guesstimate.

Another thing to remember is that the threshold limit values are established for about 500 chemicals and physical agents by the American Conference of Governmental Industrial Hygienists. These scientists realize that many work environments involve exposing employees to more than one chemical or physical agent. They have established the following formula to a mixture of air contaminants:

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Sampling for Air Contaminants

P. A. Huggins

The primary purpose of monitoring airborne contaminants is to determine if employee exposures are in compliance with appropriate Occupational Safety and Health Administration (OSHA) exposure limits. OSHA exposure limits include eight (8) hour Permissible Exposure Limits (PEL), eight (8) hour Action Levels (AL), ceiling limits and peak exposure concentrations. Definitions of these exposure limit terms and exposure limits for potential Bell System air contaminants are attached.

In each case the exposure limit is given in terms of an amount of contaminant per unit volume of air.

The expressions commonly used to denote exposure limits are given in metric units. They include the following:

mg/m^3 - Milligrams of a contaminant per unit volume of air (cubic meters).

$\mu g/m^3$ - Micrograms of a contaminant per unit volume of air (cubic meters).

$fibers/cm^3$ - Number of fibers per unit volume of air (cubic centimeters). This expression is used almost exclusively for asbestos.

The term mg/m^3 can be converted directly into the expression parts per million (ppm) but only when the contaminant is a gas or vapor. PPM can then be converted into a percent in air value if desired.

In order to obtain results that can be used to assess compliance, we must select a sampling method which will reflect an employees exposure over the time period specified by the exposure limit. Usually this is accomplished by using a personal sampler, which will sample in the operator breathing zone (OBZ) over a 7-8 hour period.

The personal sampler generally consists of a portable air pump and a contaminant collection device. Using this instrumentation allows one to determine the amount of a contaminant in a given unit volume of air.

The amount of contaminant is obtained from analytical results. It is important that the results are in the units specified in the appropriate exposure limit (e.g., mg or μg or fibers, etc.).

The volume of air sampled can be calculated flow rate from the pump flow rate and the total time the pump was operated as shown below:

$$\text{Volume Air Sampled} = \text{Pump Flow Rate} \times \text{Time Sampled}$$

The pump flow rate is determined by prior pump calibration and is generally expressed in liters per minute (Lpm). The time sampled can be easily determined in minutes. Multiplying these values gives the total volume of air sampled in liters.

Once the amount of contaminant collected and the volume of air sampled is determined, the exposure concentration can be calculated readily as shown on the attached sample problems.

An 8-hour integrated sample which can be used to determine compliance with OSHA 8-hour PELs may be obtained by sampling, using one collection device over the full work shift. However, it is sometimes necessary or desirable to break up the sampling period using several collection devices over the full work period. In this case the average 8-hour exposure may be determined by calculating a time weighted average concentration (TWA). An example of a TWA calculation for three samples collected during personal monitoring for lead is also attached.

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Terminology Used in OSHA Safety and Health Standards (29 CFR 1910)

Permissible Exposure Limit - 8-Hour

This term is synonymous with the 8-hour time weighted average exposure limit. It represents the maximum 8-hour average exposure concentration which may occur in any 8-hour work shift of a 40 hour work week.

Action Level

An 8-hour time weighted average concentration of a contaminant in air (usually equal to 1/2 the PEL) at which some provisions of the standard apply. Medical monitoring is required for some contaminants when exposure exceeds the action level.

Ceiling Concentration

The maximum airborne concentration not to be exceeded during any 8-hour work shift. Ceiling concentrations may only be exceeded if a peak value is specified by OSHA.

Peak Exposure Concentration

A maximum concentration above the ceiling concentration to which an employee may be exposed for a brief period (usually 5-10 minutes). Acceptable peak concentrations are specified for only 21 compounds.

OSHA EXPOSURE LIMITS FOR POTENTIAL BELL SYSTEM AIR CONTAMINANTS

	8-Hour PEL	8-Hour Action Level	Ceiling Concentration	Peak Concentration
Asbestos	2 fibers/cm^3	0.1 fibers/cm^3	10 fibers/cm^3	-
Lead	50 µg/m^3	30 µg/m^3	-	-
Benzene	30 mg/m^3 (10 ppm)	-	80 mg/m^3 (25 ppm)	160 mg/m^3 (50 ppm)

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Calculation: Asbestos Concentration (fibers/cm³)

Sample problem: Calculation of asbestos concentration (fibers/cm³) from sampling and analytical data

Example: A sample was collected for 15 minutes at a flow rate of 2.0 Liters/minute. Optical examination of the filter revealed 18 fibers in 100 microscopic fields of 0.01 mm²/field. The total area of the filter was 855 mm².

1) Calculate volume of air sampled (in cm³)
remember: 1 Liter = 1,000 cm³

$$\text{Volume Air} = \text{flow rate} \times \text{time}$$

$$= \frac{2.0\text{L}}{\text{min}} \times 15 \text{ min}$$

$$= 30\text{L}$$

$$= 30\text{L} \times \frac{1000 \text{ cm}^3}{\text{L}}$$

$$= 30{,}000 \text{ cm}^3$$

2) Determine the number of fibers on total filter sample (most laboratories will give results directly in terms of fibers/filter)

$$\#\text{fibers/filter} = \frac{18 \text{ fibers}}{100 \text{ fields}} \times \frac{1 \text{ field}}{0.01 \text{ mm}^2} \times \frac{855 \text{ mm}^2}{\text{filter}}$$

$$= 15{,}390$$

3) Calculate asbestos fiber concentration (fibers/cm³)

$$\text{fibers/cm}^3 = \frac{15{,}390 \text{ fibers}}{30{,}000 \text{ cm}^3}$$

$$= 0.5 \text{ fibers/cm}^3$$

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Abbreviations

AL	- Action level. A concentration that is 50% of the TLV.
Bkgd	- Background radiation level in c/m or mR/hr.
c/m	- Counts per minute.
dB(A)	- Decibels measured by a sound level meter set on the A scale.
d/m	- Disintegrations per minute.
Fibers/cm^3	- Number of fibers per cubic centimeters of air. Asbestos concentrations in air are usually expressed in fibers/cm^3. Equivalently, it is sometimes written as fibers/cc.
GM Counter	- Geiger-Muller radiation counter tube.
Hz	- Hertz. 1 Hz = 1 cycle per second.
LEL	- Lower Explosive Limit.
LFL	- Lower Flammable Limit. The lower limit of flammability of a gas or vapor. Expressed as percent of substance in air.
L_p	- Sound Pressure Level.
mg/m^3	- Milligrams contaminating substance per cubic meter air. Liquids and toxic solid concentration in air are usually expressed as mg/m^3. For some substances (e.g. lead) µg/m^3 is used. 1,000 µg/m^3 equals mg/m^3.
MPCL	- Maximum Permissible Contamination Level.
mR/hr	- Milli roentgens per hour
µg/m^3	- Micrograms contaminating substance per cubic meter air. See also mg/m^3.
mW/cm^2	- Milliwatts per square centimeter. Power density term used in the field of microwave radiation.
PEL	- Permissible Exposure Limit as defined by OSHA regulations.
ppm	- Parts of contaminating substance per million parts of air by volume. Gas and vapor concentrations in air are usually expressed in ppm.
SLM	- Sound Level Meter.
TLV	- Threshold limit value. It refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers can be repeatedly exposed day after day without adverse effect.

LLA 001443