DICTIONARY OF DANGEROUS POLLUTANTS, ECOLOGY, AND ENVIRONMENT

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Introduction

We realize today that we live in a constantly changing environment. In the past, however, we took for granted that the air we breathed and the water we drank would remain clear and clean. We believed that there would be enough oil and gas to last for at least several more generations. We increased our consumption of fossil fuels to such an extent that we created serious pollution problems. We were not particularly interested in what happened to industrial wastes that contaminated rivers, lakes and streams, and underground water supplies.

Suddenly, a new generation wondered whether their children would have a world fit to live in. This new generation has become involved in attacking the problem head-on. They have made it a point to become better informed as to the dangers of pollution, from whatever source, and as to the best methods of attacking this problem, which all of us face everyday.

The air you breathe can sometimes make you sick, create permanent injury, or even kill you. Scientific and medical studies have shown positive correlations between air pollution and increases in respiratory ailments, heart disease, and cancer. Just what role pollutants play in making people sick is not yet fully understood; no single disease, but a mixture of ailments are involved, and pollutants usually occur in varying combinations, rather than one at a time.

The atmosphere is a dynamic system. It steadily absorbs a range of solids, liquids, and gases from both natural and man-made sources. These substances may travel through the air, disperse, and react among themselves and with other substances, both chemically and physically. Eventually, whether or not in their original form, they may reach a sink, such as the ocean, or a receptor, such as a man. Some, such as helium, escape from the earth's atmosphere. Others, such as carbon dioxide, may enter the atmosphere faster than they return to their sinks and thus gradually accumulate in the air.

Clean air contains 78.09 percent nitrogen by volume and 20.94 percent oxygen. The remaining 0.97 percent of the gaseous constituents of dry air includes small amounts of carbon dioxide, helium, argon, krypton, and xenon, as well as very small amounts of other inorganic and organic gases whose concentrations may differ with time and place. Water vapor is normally present in air in concentrations of 1–3 percent. The air also contains aerosols—dispersed solid or liquid particles—which range in size from clusters of a few molecules to a diameter of a few tens of microns.

The greatest long-term need for deeper understanding of the air environment lies in the most crucial area: the modes of action and effect of pollutants on man, animals, plants, and inanimate objects. The acute toxicological effects of most air contaminants are reasonably well understood, but the effects of exposure to heterogeneous mixtures of gases and particles at very low concentrations are only just beginning to be comprehended.

A body of water, like an air mass, is a dynamic system, steadily absorbing a range of solids, liquids, and gases, both natural and man-made. Natural waters, moreover, normally team with living organisms, which can powerfully affect the course of events in a given water system. All of these substances may flow, disperse, and interact chemically and physically before they disperse, such as in the ocean or in a receptor such as a fish. En route from source to dispersion they may assume a variety of chemical and physical forms.

Determining the relative significance of man-made sources of water pollution is complicated by the fact that contaminants often enter water in complex mixtures of many substances whose specific chemical identification is largely unknown. For practical purposes, however, waste streams can be described in terms of certain collective characteristics. One of these characteristics is biochemical oxygen demand (BOD), which is a measure of the weight of dissolved oxygen consumed in the biological processes that degrade organic matter which enter natural waters. Another collective characteristic is the weight of suspended solids, only part of which is settleable in the waste stream.

The leading source of controlled man-made water pollution or pollutants in the United States is manufacturing and the second leading source is domestic wastes. Other sources include agricultural and urban runoff, acid mine drainage, watercraft, and livestock feedlots.

The main inorganic constituents of most wastes include ions such as sodium, potassium, ammonium, calcium, magnesium, chloride, nitrate, nitrite, bicarbonate, sulfate, and phosphate. The specific organic compounds in waterborne wastes are less well known.

The processes that degrade and convert substances in water to other chemical and physical forms are extremely complicated because of the effects of aquatic life, mainly microorganisms. Microorganisms may control the soluble concentrations of an element in water, notable examples being carbon, nitrogen and phosphorus, the major elements in cells. Microorganisms may convert organic compounds in the water partly into carbon dioxide, or convert dissolved carbon dioxide into organic compounds.

The human body is a complicated organism. Individuals vary widely in their reactions to bodily stress. They also vary widely in occupations and habits that help determine the amounts of pollution they are exposed to.

Our advanced industrial economy relies on thousands of substances which did not exist until the last four decades. These substances were developed because of their extraordinary properties of strength, durability, reactivity, conductivity, or toxicity. Everyone is exposed in one way or another to these substances with every breath of air, drink of water, and swallow of food.

The word "pesticide" is a general term that covers fungicides, herbicides, insecticides, fumigants, and rodenticides. The synthetic organic chemicals are the most important of these compounds, in terms of both rate of growth and potential for contaminating the environment. More than 300 organic pesticidal chemicals are in use in the United States in more than 10,000 formulations, but relatively few of them are used in large enough amounts and are sufficiently long-lived to offer potential environmental hazard.

Both among chemical classes and within classes, the properties of these pesticides can differ widely; their potential as environmental contaminants can vary accordingly. Among the properties that are important in the latter respect are the pesticide's tendency to vaporize, its tendency to dissolve in water and other solvents, and its degree of resistance to various degradation processes.

Pesticide residues in soils may pose several problems to agriculture. Conceivable effects of pesticide residues in soil are injury to crops grown in later years, production of illegal residues in crops that absorb them, or harmful effects on living organisms in the soil. The largest amounts of residues usually result from contamination after crops are sprayed or from applying pesticides directly to the soil. The most common pesticide residues in soils are those of the chlorinated hydrocarbon insecticides. Most other pesticides, such as the organophosphorus and carbamate types, decompose in the soil rapidly enough so that their residues disappear between crop seasons. Most herbicides decompose rapidly in soils, chiefly through the action of microorganisms. The persistence of pesticides in the soil depends on many factors such as soil type, soil moisture, soil temperature, wind or air movement, cover crops, soil cultivation, method of application to the soil, formulation, and soil microorganisms.

Pesticides may contaminate surface and groundwater because of aerial spraying, runoff from treated areas, percolation through soil to groundwaters, waste discharge by pesticide producers, misuse, and other means. Pesticide residues in water may reach humans through drinking water; however, there is no evidence at present to suggest that long-term consumption of such water would produce harmful effects.

To control toxic substances, we must predict their environmental behavior and effects. Every research tool available—epidemiology, toxicology, and chemical analysis—should be used to predict accurately the harmful biological effects of any chemical through any exposure route.

Since the supplies of oil and natural gas are being rapidly depleted, it is necessary to develop other possible sources of energy, e.g., solar, nuclear, coal, and geothermal. We have to learn to conserve the resources we have and to find ways to use waste through biomass conversion, recycling, and other methods.

Coal is this nation's most abundant energy resource, and its chemical conversion into gas offers several significant benefits. The gasification of coal to produce SNG is nearly twice as efficient as the burning of coal to produce electric energy. Reduced pollution is an advantage in that during the production of a given amount of energy, the emission of pollutants is significantly lower from coal gasification than from the combustion of coal. Coal gasification offers promise in helping to alleviate the national shortage of clean energy fuels, including natural gas.

Geothermal energy at present represents a very small fraction of the world total power production, and although geothermal power is expected to rise fairly rapidly during the next decade, the total power contribution from geothermal energy will remain a very small fraction of the total. Nevertheless, for certain developing countries geothermal power may represent an impressive contribution. Similar considerations apply to the use of geothermal energy for industrial and other purposes. The long-term prospects of geothermal energy are prodigious, for within the interior regions of the earth is a store of energy so vast that other energy sources which are now being used pale into insignificance when compared to it. The problem is to tap it, since Nature allows only a fraction of it to leak through near the surface.

Radioactivity in the atmosphere comes from both natural sources and human activities. Natural radioactivity is either of terrestrial origin, consisting mainly of radiative gases, such as radon and thoron, which are released from soils and rocks, or it is produced by the interaction of cosmic radiation with atmospheric constituents. Man-made radioactive contamination of the atmosphere results from the reactor fuel cycle; the use of nuclear energy as a source of propulsive power; the use of radioisotopes in industry, agriculture, medicine, and scientific research; and nuclear weapons testing.

Certain radioactive pollutants are highly persistent and when forced into the stratosphere during a nuclear weapons test, may fall out slowly. They cannot be made harmless by any means now known. Some of the pollutants can cause damage to various parts of the body and produce irreversible changes in genetic material.

It is difficult to assess all the possible effects of radioactive pollution on humans. The effects may be masked since they are the kind that might be produced by pollution or other factors. Because of this we presently must depend on statistical data. It might be several generations before scientists will have the evidence necessary to say that pollution probably does or does not produce certain effects.

Solar energy, the energy received by the earth from the sun, has provided directly and indirectly almost all the sources of energy for the earth since its creation. The human race and all animal and plant life upon the earth have always depended for existence on the sun's energy. The amount of energy reaching the earth's surface is so vast as to be almost incomprehensible. The human race has used solar energy for thousands of years for heating and a wide variety of applications; however, it is only now that we are making any real effort to develop the sun's full potential as an energy source. In the total energy picture, solar energy is one of the major alternative sources and offers promise of making significant and long-range contributions to the solution of our energy problems.

If we are to live in this world and participate in the decisions which effect our lives and the lives of our children, we should be better informed in the areas of ecology, environment, pollution, and energy. This environmental and ecology dictionary was developed for those working in industry, for the student who needs a comprehensive manual, and for the public who would like a better understanding of what is going on and the meaning of what is being discussed. To accomplish this, the *Dictionary of Dangerous Pollutants, Ecology, and Environment* covers the following areas: noise pollution, air pollution, water pollution, nuclear energy, geothermal energy, solar energy, solar design and construction, coal, coal gasification, waste control, biomass conversion, recycling, ecology, meteorology, and climatology.

This dictionary is possibly one of the most comprehensive volumes on these subjects and should be of interest to everyone who desires to see that this world becomes a better, safer, and healthier place to live.

List of Abbreviations and Acronyms

ABS	acrylonitrile butadiene styrene
ABS	alkylbenzene sulfonate
AHH	arylhydrocarbon hydroxylase
API	American Petroleum Institute
ASA	American Standards Association
BATEA	best available technology economically available
BNA	β-naphthylamine
BOD	biochemical oxygen demand
Btu	British thermal unit
CAG	Carcinogen Assessment Group
CAMP	continuous air monitoring program
cfm	cubic feet per minute
COD	chemical oxygen demand
COH	coefficient of haze
COP	coefficient of performance
DDM	diaminodiphenyl methane
DECC	diethycarbamoyl chloride
DMCC	dimethylcarbamoyl chloride
DO	dissolved oxygen
DOE	U.S. Department of Energy
EDB	ethylene dibromide
EIA	environmental impact assessment
EIS	environmental impact statement
EPA	Environmental Protection Agency
GAO	General Accounting Office
HEW	U.S. Department of Health, Education & Welfare
HMPA	hexamethylphosphoric triamide
Hz	hertz; one cycle per second
LC	lethal concentration
LD	lethal dose
LPG	liquefied petroleum gas
MAC	maximum allowable concentration
MHD	magnetohydrodynamics
NAPC	National Air Pollution Control Administration
NASN	National Air Sampling Network

NIOSH National Institute For Occupational Safety & Health
NTA nitrilotriacetic acid

ORD Office of Research & Development
(for the U.S. Environmental Protection Agency)
OSHA Occupational Safety & Health Administration
OTEC ocean thermal energy conversion

PAN peroxyacetyl nitrate
PBB polybrominated biphenyls
PBNA phenyl-β-naphthylamine
PCB polychlorinated biphenyls
ppb parts per billion
ppm parts per million
PSI Pollution Standard Index
psi pounds per square inch

RCRA Resource Conservation and Recovery Act

SIL speech interference level
SLP sound pressure level
SS suspended solids
STP standard temperature and pressure

TCE trichloroethylene
TLV threshold limit value
TOC total organic carbon
TOSCA Toxic Substances Control Act of 1976

A

ab. A prefix attached to the names of the practical electric units to indicate the corresponding unit in the cgs electromagnetic system, e.g., abampere, abvolt.

abatement. A measure taken to reduce or eliminate air or noise pollution, which may involve legislative proceedings and technological applications.

abcoulomb. The electromagnetic unit of charge. The charge which passes a given surface in one second if a steady current of one abampere flows across the surface. Its dimensions are therefore $cm^{1/2}$ g $m^{1/2}$, which differ from the dimensions of the statcoulomb by a factor which has the dimensions of speed. This relationship is connected with the fact that the ratio $2K_e/K_m$ must have the value of the square of the speed of light in any consistent system of units. It further follows that one abcoulomb $= 2.997\ 93 \times 10^{10}$ statcoulomb, the speed of light *in vacuo* being $(2.997\ 93 \pm 0.000\ 003) \times 10^{10}$ cm/s.

Abegg's rule. In a helical periodic system, if the maximum positive valence exhibited by an element is numerically added to its maximum negative valence, the sum will tend to equal eight. This tendency is exhibited especially by the elements of the fourth, fifth, sixth, and seventh groups.

absolute humidity. The weight of the water vapor found in a unit volume of air. In the metric system it is the number of grams of water vapor in a cubic meter of air.

absolute pressure. The total pressure exerted by a gas or liquid. The absolute pressure of a vacuum is 0 lb/in.^{2}, and that of the atmosphere, about 14.7 lb/in.^{2}.

absolute temperature scale. A temperature scale based upon the value of zero as the lowest possible value. Thus all obtainable temperatures are positive. The Kelvin and Rankine scales are absolute scales.

absolute unit. A unit based on the smallest possible number of independent units. Specifically, units of force, work, energy, and power not derived from or dependent on gravitation.

absolute viscosity. The force that will move 1 cm^2 of plane surface with a speed of 1 cm/s relative to another parallel plane surface from which it is separated by a layer of liquid 1 cm thick. This viscosity is expressed in dynes per square centimeter, its units being the poise, which is equal to 1 dyn s/cm^2.

absolute zero. The temperature at which a gas would show no pressure if the general law for gases held for all temperatures. It is equal to -273.16°C or -459.69°F.

absorber. (1) A black material which absorbs heat from sunlight. (2) An apparatus used in the process in which one material is employed to retain another. Absorbers are used to selectively remove a gaseous or liquid material from another gas or liquid. Usually the process is performed in cylindrical towers packed with an absorbing material. Devices used for sampling by absorption include the following: scrubber, impinger, packed column. This equipment includes spray chambers, mechanical contactors, bubble cap or sieve plate contactors, or packed towers. A spray chamber is an empty chamber through which a gas stream is passed through curtains of liquid spray. Bubble cap or sieve plate equipment requires that the gas be passed upward through a series of plates on which pools of absorbent are located. Bubble cap trays are used in bubble cap equipment, and porous or perforated plates in sieve plate equipment to support the liquid layers. Packed towers allow liquid absorbent to flow by gravity downward through a bed of packing material while the gas stream moves either concurrently or countercurrently through the tower. In each case, intimate gas–liquid contact is promoted over larger interfacial areas.

absorber plate. A black-painted, flat piece of metal which absorbs sunlight, transforms it to heat by absorption, and in turn radiates heat into the surrounding air and the cover. The absorber plate in a fluid-medium collector is usually constructed differently because it must contain the conduit or piping-circuit medium in the absorber. There are many different designs, with copper and aluminum being the two most commonly used metals.

absorptance. The ratio of the radiant flux absorbed by a body to that which is incident upon it.

absorption. (1) A process in which one material (the absorbent) takes up and retains another (the absorbate) with the formation of a homogeneous solution. The process may involve the physical solution of a gas, liquid, or solid in a liquid, or the chemical reaction of a gas or liquid with a liquid or solid. Absorption may also refer to the process by which molecules of a gas, vapor, liquid, or dissolved substance become attached to a solid surface by physical forces. (2) A process by which a soluble gas is transferred from a gas stream into a liquid. The gas may become physically dissolved in the liquid or may react with a dissolved constituent in the liquid. Absorption serves as a method both for recovering gaseous components and for purifying gas streams. In many air pollution control operations, soluble gaseous components to be removed constitute levels of 1% or less of the main gas. Gas absorption is a diffusional operation which depends upon the rate of molecular and eddy diffusion. Ultimately, the transfer must take place across a liquid–gas interface. The interface may be formed by the use of liquid films, gas bubbles, and liquid droplets.

absorption band. A band of wavelengths (or frequencies) in the electromagnetic spectrum within which radiant energy is absorbed by a substance.

absorption chiller. A refrigeration system used in the solar cooling of buildings, where sun-heated water, usually above 190°F, provides the operating energy.

absorption coefficient. (1) The ratio of the sound energy absorbed by a surface of a medium (or material) exposed to a sound field (or to sound energy incident on the surface). The stated values of this ratio hold for an infinite area of the surface. The conditions under which measurements of absorption coefficients are made are to be stated explicitly. (2) A measure of the amount of normally incident radiant energy absorbed through a unit distance or by a mass of absorbing medium; also, the maximum volume of gas that can be dissolved in a unit volume of water. The absorption coefficient of gases generally decreases with increasing temperature and salinity. (3) The fractional decrease in the intensity of an x-ray or gamma-ray beam per unit thickness (linear absorption coefficient), per unit mass (mass absorption coefficient), or per atom (atomic absorption coefficient) of absorber, caused by the disposition of energy in the absorber. The total absorber coefficient is based on the sum of the individual energies.

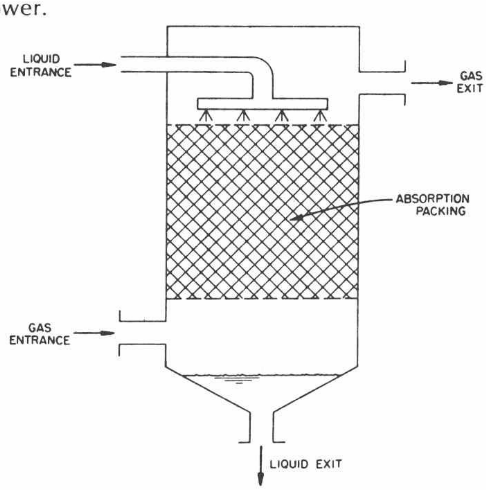
absorption coefficient, atomic. The linear absorption coefficient of a nuclide. It is equivalent to the nuclide's total cross section for the given radiation.

absorption coefficient, Compton. The fractional decrease in the energy of an x-ray or gamma-ray beam, caused by the deposition of the energy to electrons produced by the Compton effect in an absorber.

absorption coefficient, mass. The linear absorption coefficient per centimeter divided by the density of the absorber in grams per cubic centimeter. It is frequently expressed as *u/p*, where *u* is the linear absorption coefficient and *p* is the absorber density.

absorption equipment, floating bed scrubber. Essentially a floating-bed–sieve-tray arrangement. Low-density spherical packing is placed on the sieve tray so that the gas bubbles rise through the wetter sphere. This system is reported to be advantageous for use with gas streams containing particulate matter, as the fluidized character of the bed of spheres prevents the buildup of a particulate sludge.

absorption equipment, packed towers. A packed tower is usually a vertical, cylindrical shell packed with solid objects which maximize the gas–liquid interfacial area at low resistance to gas flow. Packing such as Raschig rings, Berl saddles, Pall rings, Intaloz saddles, and Tellerettes may be used. The liquid enters at the top of the tower and is distributed over the packing with spray nozzle, weirs, or perforated plates. The gas enters at the bottom of the tower.



Countercurrent packed absorption tower.

absorption equipment, plate or tray towers. Plate or tray towers contain horizontal plates or trays, usually in a cylindrical shell. Sieve plates and bubble cap plates are commonly used in plate towers. The gases flow upward and bubble through the perforations in the bubble cap or sieve plate. The liquid flows downward through an overflow plate. The gas is prevented from flowing up the liquid downflow by placing the pipe exit below the level of the pool of liquid on the plate. The bubbles provide the gas–liquid interfacial area through which the mass transfer occurs.

absorption equipment, spray towers. Spray towers have a much smaller gas–liquid interfacial area than packed or plate towers. The liquid is introduced through spray nozzles and flows countercurrent, crosscurrent, or co-current with the gas, depending on the design. The pressure drop through a spray tower is substantially less than through either packed or plate towers.

absorption equipment, Venturi scrubbers. A Venturi scrubber is a co-current process with the liquid entering in or near the Venturi throat and flowing with the gas into an entrainment separator. Because of the large pressure drops incurred (10–100 in. of water) and the co-current flow arrangement, Venturi scrubbers do not appear to be best suited for the removal of pollutant gases.

absorption factor. The ratio of the intensity loss by absorption to the total original intensity of radiation. If I_0 represents the original intensity, I_r represents the intensity of reflected radiation, and I_t represents the intensity of the transmitted radiation, the absorption factor is given by the expression $[I_0 - (I_r + I_t)]/I_0$.

absorption line. A minute range of wavelengths (or frequencies) in the electromagnetic spectrum within which radiant energy is absorbed by the medium through which it passes. Each line is associated with a particular mode of electronic excitation induced into the absorbing atoms by the incident radiation.

absorption rate. For surfaces, the energy absorbed per unit area per unit time, expressed in the same units as emissive power. It depends on the incident radiation and the surface characteristics of the body. An absorption rate may be considered for a band, a single wavelength, or the entire spectrum.

absorption ratio differential. The ratio of the concentration of an isotope in a given organ or tissue to the concentration that would be obtained if the same administered quantity of this isotope were uniformly distributed throughout the body.

absorption spectrum. The spectrum obtained by the examination of light from a source, itself giving a continuous spectrum, after this light has passed through an absorbing medium in the gaseous state. The absorption spectrum will consist of dark lines or bands, being the reverse of the emission spectrum of the absorbing substance. When the absorbing medium is in the solid or liquid state, the spectrum of the transmitted light shows broad dark regions which are not resolvable into lines and have no sharp or distinct edges.

absorptivity. The fractional part of the incident radiation that is absorbed by the surface in question. It also varies with the wavelength of the incident radiation and with the temperature of the body. Like the emissivity, it is a dimensionless number between zero and one and can be used as a coefficient of absorption. Also, the ratio of the radiation absorbed by any substance to that absorbed under the same conditions by a black body.

abvolt. The cgs electromagnetic unit of potential difference and electromotive force. It is the potential difference that must exist between two points in order that one erg of work be done when one abcoulomb of charge is moved from one point to the other. One abvolt is 10^{-8} V.

acceleration. (1) The time rate of change of velocity in either speed or direction (cgs unit, one centimeter per second per second). (2) A vector that specifies the time rate of change of velocity. Various self-explanatory modifiers such as peak, average, and rms are often used. The time interval over which the average is taken must be indicated.

acceleration due to gravity. The acceleration of free-falling body in a vacuum. The International Committee on Weights and Measures has adopted 980.665 cm/s^2 or 32.174 ft/s^2 as a standard or accepted value.

accelerator. (1) A machine for speeding up subatomic particles to energies running into the millions of electron volts. In an accelerator, basically, particles are accelerated by being attracted to an electrode of opposite charge. If protons are placed at the entrance of a hollow tube, with zero voltage at the entrance and five million volts at the exit, the protons are attracted to the negative end and acquire five million volts of kinetic energy in moving from the entrance to the exit of the tube. In cyclotrons and synchrotrons the particles are made to go in circles by imposing a magnetic field, which causes charged particles to bend their path. (2) In nuclear physics, a device for speeding up charged subatomic particles to energies high enough to smash the nuclei of target atoms; often called an atom smasher. Accelerators are used routinely to produce radioisotopes.

accelerator, linear. A device for accelerating charged particles employing alternate electrodes and gaps arranged proportionally in a straight line, so that when their potentials have the proper amplitudes and frequencies, particles passing through them receive successive increments of energy.

acclimation. The physiological and behavioral adjustments of an organism to changes in the environment.

acclimatization. The adaptation over several generations of a species to a marked change in the environment.

accretion. A process that increases the size of particles by external additions; a form of agglomeration.

accumulator. A small tank installed in the return pipe from the circulating pump in a liquid-type solar heating system. Allows for expansion and contraction of water with temperature changes, provides a convenient place for air to be purged from the system, and makes sure the pump will always be primed for starting.

acenaphthene. $C_{10}H_6(CH_2)_2$, a compound that occurs in the form of white, elongated crystals. It is irritating to the skin and mucous membranes and ingestion of large quantities can cause acute nausea and vomiting. Acenaphthene is an experimental neoplasm and one variation, 5-nitroacenaphthene, has been placed on the list of candidates for review by OSHA as a substance that may cause an increased incidence of benign or malignant tumors among workers exposed to it.

acetamide. CH_3CONH_2, a compound characterized by colorless crystals and a mousy odor. Exposure to the compound can result in irritation of the tissues in contact with the substance. The LD_{50} for experimental animals has been reported as 360 mg/kg. Acetamide has been identified as a carcinogen, and it has been included in a list of suspected occupational sources of cancer to be evaluated by OSHA.

acetanilide. C_8H_9NO, a compound of the aniline category, occurring as white, shining crystalline scales. Exposure to acetanilide can cause contact dermatitis, while skin effects such as eczematous eruptions can also occur through exposure by ingestion or inhalation. The oral LD_{50} has been established as 800 mg/kg in the rat and 1200 mg/kg in the mouse. Acute poisoning in humans has occurred from the ingestion of a few grams of the chemical. Cyanosis, anemia, and damage to blood-forming organs have been reported in patients using medications containing acetanilide. Alterations in red blood cells, with the hemoglobin being converted to methemoglobin or sulfhemoglobin, have been reported in the clinical literature. The 4-phenyl form of acetanilide has been included in the list of suspected occupational carcinogens to be reviewed by OSHA.

acetone. C_3H_6O, a volatile ketone used as a solvent and in the synthesis of other organic compounds. It occurs in small amounts in the urine of normal humans and in large amounts in the urine of diabetic patients. Industrial production of acetone averages over 2000 million pounds per year in the United States, with much of the output employed in the manufacture of celluloid, gunpowder, varnishes and chloroform. Acetone has been found to have a relatively low toxic effect through dermal exposure, although skin irritation is a common result because of the defatting action of the ketone which can damage or destroy subcutaneous tissues. Considerable discomfort can also result from exposure through oral or respiratory routes, with nonfatal, but possibly irreversible, changes to tissue surfaces that come in contact with the substance. The lowest reported toxic concentration for humans is 500 ppm, with conjunctival effects. LD_{50}'s for laboratory animals range from approximately 1300 mg/kg for a mouse via intraperitoneal exposure to 20,000 mg/kg for a rabbit administered acetone dermally. Threshold limit values established by humans for exposure to acetone are 1000 ppm for a time-weighted average concentration and 1250 ppm for short-term exposure.

achromatic. A term applied to lenses signifying their more or less complete correction for chromatic aberration.

acid. For general purposes, a hydrogen-containing substance which dissociates in water solution to produce one or more hydrogen ions. More generally, however, acids are defined according to other concepts. The Bronsted concept states that an acid is any compound which can furnish a proton. Thus NH_4^+ is an acid, since it can give up a proton: $NH_4^+ \rightleftharpoons NH_3 + H^+$. NH_3 is a base, since it accepts a proton. A still more general concept is that of G. N. Lewis, who defines an acid as anything which can attach itself to something with an unshared pair of electrons. Thus in the reaction

$$H^+ + :NH_3 \rightleftharpoons NH_4^+$$

the NH_3 is a base because it possesses an unshared pair of electrons. This latter concept explains many phenomena, such as the effect of certain substances other than hydrogen ions in the changing of the color of indicators. It also explains acids and bases in nonaqueous systems such as liquid NH_3 and SO_2.

acid dew point. The dew point of flue gases containing little or no SO_3 is known as the water dew point and is usually in the region of 120°F (49°C); if SO_3 is present in any significant quantity, the dew point is raised considerably, to about 300°F (149°C). This is known as the acid dew point. Acid condensation begins at this temperature, heavy condensation occurring when the surface temperatures fall below 250°F (121°C).

acid number. The number of milligrams of potassium hydroxide required to neutralize the total acidity in one gram of fat, oil, wax, free fatty acids, etc.

acid precipitation (acid rain). A term applied to an increased acidity of wet or dry precipitation, generated by the release of sulfates and nitrates in the atmosphere. With switches from coal to oil and natural gas, and the reduction of particulates that neutralize the sulfates and nitrates released by combustion, there has been an increase in acid rain throughout the world. Not all acid rain is man-made. About half is from natural sources, such as volcanoes and plants (photosynthesis products). There is some belief that acid rain may be responsible for substantial adverse effects on public welfare. These effects may include acidification of lakes, rivers, and groundwaters, with resultant damage to fish and other components of the aquatic ecosystem. According to *Science News,* February 2, 1979, Adirondack lakes were becoming fishless because of acid rain and a 1978–1979 survey of 85 lakes in the Boundary Waters Canoe Area along the Minnesota–Ontario border showed that two-thirds of them were near the brink of acidity where fish-life could not be supported. It was also reported that the nearby Great Lakes region was receiving precipitation that was 5–40 times more acidic than that of normal rain. Acid rain may cause acidification and demineralization of the soil, reduce forest productivity, damage crops, and deteriorate man-made materials. These effects could result from years of exposure or from short heat-acidity episodes.

acid-washed activated carbon. Carbon which has been in contact with an acid solution, with the purpose of dissolving ash in the activated carbon.

acidity. The capacity of wastewater to neutralize a base. It is normally associated with the pressure of carbon dioxide, mineral and organic acids, and salts of strong acids or weak bases.

acoustic. Containing, producing, arising from, actuated by, related to, or associated with sound. Acoustic is used when the term being qualified designates something that has the properties, dimensions, or physical characteristics associated with sound waves; acoustical is used when the term being qualified does not designate explicitly something that has properties, dimensions, or physical characteristics associated with sound waves.

acre foot. (1) The quantity of water required to cover one acre to a depth of one foot, or 43,560 ft^3. (2) A term used in sewage treatment in measuring the volume of material in a trickling filter.

acrylonitrile. $CH_2=CHCN$, an explosive, flammable liquid produced by the reaction of propylene with ammonia and oxygen in the presence of a catalyst. About 1,500,000 lbs of acrylonitrile are manufactured each year in the U.S. for use in acrylic and modacrylic fibers employed in the production of clothing, carpeting, blankets, draperies, and upholstery. Other major uses include the manufacture of styrene-type resins, other plastic products, and latices; it is also used as a fumigant. The Food and Drug Administration has banned the application of acrylonitrile materials in the manufacture of beverage containers. NIOSH has estimated that at least 125,000 persons are employed in jobs that may involve contact with acrylonitrile. The chemical structure of acrylonitrile is similar to that of vinyl chloride, a substance that has been identified as a cause of human cancer; animal studies with acrylonitrile indicate that it may be a tumor-inducing agent, including carcinomas. A series of preliminary epidemiological studies by E. I. du Pont de Nemours and Co. indicated an excess risk of lung and colon cancer among workers with potential exposure to acrylonitrile and a cancer mortality rate that was double the expected rate for a population group of similar size. OSHA has recommended a standard for occupational exposure to acrylonitrile of 20 ppm for an eight-hour time-weighted period. However, NIOSH has advised that it "would be prudent to handle acrylonitrile in the workplace as if it were a human carcinogen."

acrylonitrile butadiene styrene (ABS). A black plastic material used to make pipes suitable for carrying sun-heated water in solar space heating and cooling, hot-water, and swimming pool installations.

actinide series. Elements of atomic numbers 89 through 103 analogous to the lanthanide series of the so-called rare earths.

activated carbon. Any form of carbon characterized by high adsorptive capacity for gases, vapors, and colloidal solids. Carbon must usually be activated to develop adsorptive power, achieved by heating to 800–900°C with steam or CO_2, which produces a porous particle structure. This material can be used for clarifying liquids and the purification of solutions (electroplating). The activity of (activated) carbon is the maximum amount of vapor which can be absorbed by a given weight of carbon under specified conditions of temperature, concentration of water vapor, and concentration of other vapors.