# 2011 Version 6: Wildfire Glossary of Environmental, Insurance and Restoration Terms

**By Patrick J. Moffett, REA, CHMM**

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## Introduction

Over the past 20 years as an environmental professional and master restorer; teacher and lecturer on managing fire and wildfire damaged properties, the past 4 years have been the most challenging. The challenge comes in educating insurance adjusters, building owners, restoration contractors, attorneys and arbitrators about what it takes to assess a typical wildfire smoke and soot contaminated building to removing chemical residues.

In comparison to 10 years ago, today's science that identifies the presence of soot and char in buildings has changed but there still are difficulties to overcome. One difficulty is the fact there are no standards for soot and char collection and how many samples represent statistically quantitative data. Another challenge is directing the lab to provide us with a better level of scientific examination beyond minimally accepted TEM and PLM analysis. Today TEM and PLM can be coupled with EDS/EDX, GC/MS/FID and FTIR analysis. We now have the ability to provide customers with better interpretation of data that helps environmental hygienists determine whether the building is or is not affected by smoke and char; whether it should or should not be cleaned based on circumstances.

Another challenge for the restoration industry: Workers are not sufficiently trained and certified in smoke, soot, ash, char, corrosion and chemical residue cleanup. Untrained workers can increase property damage including damage to contents, furniture, antiques, appliances, computers and works of art.

Because industry is lacking in accepted methods of environmental investigation and testing, and some restorers are relying on untrained workers, insurance adjusters and building owners are frustrated because of a lack of consistency to bring smoke and char contaminated buildings back to a clean and deodorized state. Finally, the restorer who can make a difference in cleaning and deodorizing buildings and contents often don't get the job because price rules which often results in quality to be sacrificed.

In 2009, I completed a non-scientific survey of environmental professionals, restorers and adjusters who attend my classes. I found all three groups are using different interpretations to describe fire damaged and wildfire smoke and char contaminated buildings. Because of this issue I spent the spring and summer of 2010 compiling information from government and fire agencies, the restoration and insurance industry, environmental professionals and laboratories. After considerable research and a 2011 update, I believe this glossary is the most extensive glossary produced to date. If you want to know more about me refer to the last page of the document.

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**Abrasion mode –** A size range of particles, typically larger than about 3 micrometers in diameter, primarily generated by abrasion of solids.

**Abrasive blasting –** The use of compressed air with an abrasive medium (e.g., dry ice, baking soda) to remove surface discoloration, accretions, char and fire residue.

**Absorption –** (1) A class of processes by which one material is taken up by another. (2) The taking-in of chemicals and byproducts through the skin or by ingestion and inhalation.

**Absorption v. adsorption –** A sponge absorbs moisture in high humid air and gives it back as the air dries; the activated carbon filter in a gas mask adsorbs gaseous odors allowing the wearer to breathe fresh air. The activated carbon filter won't give back the odor.

**Accelerant –** Any substance, nearly always a liquid that was placed at a fire scene to facilitate the spread of a fierce and fast blaze. The most common accelerants found are petrol, kerosene, mineral turpentine and diesel – all mixtures of hydrocarbons derived from petroleum. Other accelerants found include ethanol or methylated spirits (combination of methyl and ethyl alcohol), and acetone.

**Accumulation mode –** A size range of airborne particles, from about 0.1 to 3 micrometers, formed largely by accumulation of gases and particles upon smaller particles. They are very effective in scattering light.

**ACGIH –** The American Conference of Governmental Industrial Hygienists, Inc. ACGIH is an organization open to all practitioners in industrial hygiene, occupational health, environmental health, or safety. Industrial hygiene deals with the protection of the health of those involved in industry. This classifies it as a form of preventative medicine.

Education Note: ACGIH publishes over 400 titles in occupational and environmental health and safety and publishes Threshold Limit Values (TLVs) for over 700 chemical substances and physical agents as well as 50 Biological Exposure Indices for select chemicals. "See TLV." For more information about ACGIH go to: http://www.acgih.org

**Acid cleaner** - A chemical compound capable of breaking down smoke and char residue followed by rinsing and drying. On some tile surfaces having grout or aluminum window frames, phosphoric acid cleaners may be the appropriate chemical to bring back the finish to a clean condition.

**Acid deposition (acid deposits) –** (1) Acids commonly found in smoke film, soot and ash that settle on surfaces. Acids can be responsible for corrosion of the underlying substrate. Organic acids include hydrocarbons VOCs and PAHs, and organic acids including sulfur and nitrous oxides, benzene, 2-

 

furaldehyde, and ketones and aldehydes can be responsible for property damage. (2) Wet and/or dry deposition of acidic materials to water or land surfaces. Some chemicals found in acidic deposition include nitrate, sulfate, and ammonium.

**Acid precipitation –** It is usually rain with high concentrations of acids produced by the interaction of water with oxygenated compounds of sulfur and nitrogen which are the by-products of wildfire combustion.

**Acid rain –** The deposition of acid chemicals in the atmosphere that becomes a mixture of rain, snow, fog, or precipitation mist falling on land surfaces. The pH of rain is considered acid when it is below 5.6.

**Acid smoke –** Fire residues that have low to high levels of acidity.

**Acid smoke residue cause -** Smoke and soot residue components that are affected by moisture and humidity.

**Acrid smoke smell –** When breathing smoke an acrid smoke smell is a sharp, harsh, unpleasant smell similar to the smell of wet cigarette or cigar ashes. Smoke smells consist of VOCs.

**Activated carbon –** A carbonaceous material capable of capturing airborne odor molecules. Activated carbon is found in special HVAC filters that trap fire and nuisance odors from entering the building or air scrubbers that trap malodors from entraining into indoor air. "See Potassium permanganate."

**ACV –** Actual cash value. Based on computation, the method of knowing what an insurer will pay an insured, after a loss, for a specific insured item. ACV is calculated by subtracting depreciation from replacement cost and is part of the claims recovery process.

**Adjuster –** (1) An insurance person that understands policy interpretations and coverage and serves as a coordinating link between the insured and insurance company, and often contractors involved in cleanup, deodorizing and restoration services. (2) A person or organization licensed to evaluate the amount of damage to property and negotiates insurance losses.

**Adjuster, public –** A person licensed by the state who, for compensation, is contracted and then acts on behalf the insured, negotiating for or effecting the settlement of a claim involving loss or damage.

**Adjuster, company –** An employee of an insurance company who negotiates and settles claims against the insured.

 

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**Adjuster, independent –** A licensed independent adjuster that works on a contract basis and charges a fee to adjust the insurance company's claim.

**Adsorbed smoke –** Fine and coarse particles, vapors and gases that are influenced by vapor pressure that become forced into the pores and cracks of a material such as plaster and drywall.

**Adsorbed smoke from a protein fire –** Smoke in a building from a cooking process or from burnt food.

Education Note: While smoke and soot cleaning will help remove surface contamination, surface cleaning will not remove smoke and odor molecules adsorbed into a material. The heat transference process that caused adsorbed smoke to bond with a material in the first place should be reversed-engineered by thermally desorbing compounds out of a material with a dry fog or thermal fog. In completing this process successfully for a kitchen and pantry, turn-off all gas supplies that can back flash from gas appliances; all contents and appliances must be removed; old vinyl wall paper should be removed; ceiling fixtures and wall outlet plates removed; ventilation registers cleaned and then sealed; cabinets may need to be detached; ceiling walls and flooring cleaned (degreased) and deodorized; dry fogging or thermal fogging the room is next; keep the room closed (sealed) with the fog encased; then, a reevaluation of any remaining lingering odor is completed later in the day or next morning to identify its source. "See Dry fogging; Thermal fogging."

**Adverse health effect –** Changes in body function or cell structure that might lead to disease or health problems.

**Aerodynamic diameter –** The behavior of airborne particles based on their spherical or irregular shape. Aerodynamic diameter is also known as particle size.

**Aerodynamic(s) –** The study of how air and other gases flow, including the thermal dynamic forces created by heat and pressure that act on an object as it moves in air.

**Aerosol –** Suspended fine solid particles and/or liquid droplets that can be found in smoke, air pollution, and smog. Aerosols are defined as a suspension of particles and droplets having a size range between 0.001 to 100 microns in a surrounding gas phase.

**Aerosol classes and subgroups –** The type and group aerosols are classified. Fumes – consist of solid particles ranging in size from 0.001 to 1.0 micron in size. Some typical fumes are those produced by the dispersion of carbon black, rosin, petroleum solids and tobacco smoke solids in air. In wildfires the most familiar form of fume is smoke. Smoke is formed from the incomplete combustion of fuels. Its particles are generally smaller than 10 microns in size; Dusts – Airborne solid particles that are larger than those in a fume. They range between 1 to 100 microns (and even larger) in size. Dust is formed by the release

 

of a material such as soil and sand, fertilizers, coal and cement, pollen and fly ash. Because of their large particle size, dust tends to be unstable in air and they tend to settle out of air more rapidly than fumes, which do not settle out at all but cling with solid particles that fall out of air; Mists – Dispersions in a gas of liquid particles that are generally less than 10 microns in size. The most common type of mist is formed by water droplets suspended in air; Combusted materials – Fossil fuels such as vegetative growth and its byproducts including but not limited to PAHs, CFCs, and VOCs.

**Aerosols from complete combustion –** Airborne aerosols that are formed in a complete combustion environment: a) from mineral matter (ash components) which lead to components such as KCl, $K_2SO_4$, CaO, Al2O3, SiO2; b) a result of contaminants (e.g. Cl and heavy metals present in urban waste wood) which can lead to additional emissions of heavy metals including hydrogen chloride (HC1) and polychlorinated dibenzodioxin and dibenzofuran (PCDD/F).

**Aerosols from incomplete combustion –** A wide-variety of chemicals, vapors and particles from halogenated aromatic hydrocarbons, dioxins, water vapor, CO2, CH4, N2O, and CFCs. Particles from incomplete combustion such as soot and organic particles are present in wildfire smoke and soot. Inorganic particles resulting from ash constituents from native vegetation mainly found as salts like KCl, K2SO4, CaCO3 and CaO. In addition, volatile organic compounds such as polycyclic aromatic hydrocarbons (PAH) can be adsorbed on the surface of soot particle.

**Aerosols from incomplete combustion –** Airborne biomass that results from incomplete combustion such as soot, polycyclic aromatic hydrocarbons (PAH), unburnt carbon, and of unburnt biomass fragments. In simple combustion systems and/or under unfavorable combustion conditions, the mass fraction of unburnt particles can reach more than 90% of the total particle mass.

**Agglomeration –** (1) The process by which collisions from wind turbulence cause moist sticky smoke and soot particles to stick together to form larger particles. (2) Micro-fine (sub-micron) size soot particles that have clustered together to form particles larger than one micron in size.

**AIHA –** The American Industrial Hygiene Association. AIHA organization and membership are dedicated to the anticipation, recognition, evaluation, and control of environmental factors arising in or from the workplace that may result in work-related injury or illness. For more information about AIHA go to: http://www.aiha.org

**Air –** A gaseous mixture of 79.0% nitrogen, 20.9% oxygen and 0.1% of carbon dioxide, argon, ozone, helium, plus other gases from natural and man-made substances.

**Air blasting –** The use of high-pressure air to remove loose soot, ash and char. Air blasting is often combined with an abrasive such as dry ice or baking soda to further remove oily smoke soot and odors.

 

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**Air changes per hour (ACH) –** A term used in abatement and remediation practices that require a specific number of air exchanges per hour at a given rate of speed.

**Air conditioning –** The building's mechanical system designed to filter and control temperature and humidity.

**Air contamination –** Smoke, soot, ash and char, and other gaseous or toxic materials that are in outdoor and indoor air. Air contamination can affect the health of workers and building occupants.

**Air conveyance –** The process by which the building delivers fresh air to a space.

**Air filter –** A porous device used to capture dust, dirt, soot, char and gaseous particles as air passes through the filter.

**Air filtration device (AFD) –** A machine and filtering system capable of removing particulate matter from air. The filtering device (HEPA filter) is 99.97% efficient down to particle size of 0.3 microns (micrometers) in diameter.

**Air flow –** The flow of air from one space to another. Air flow occurs when a high pressure goes to a low pressure. The bigger the difference between high and low pressure the faster the air speed.

**Air mover –** A machine that moves air from one area or environment to another.

**Air parcel –** A volume of air that tends to be transported as a single entity.

**Air pollutant –** An unwanted chemical or other material found in air.

**Air pollution –** (1) Any irritant or unwanted substances in air. (2) Degradation of air quality resulting from unwanted chemicals or other materials occurring in the air.

**Air pollution hot spot –** A location where the emissions expose individuals or populations to elevated risks of adverse health effects.

**Air sampling –** The collection of air for biological, particulate, toxin and gas analysis.

**Air scrubber –** A filtering machine that is capable of removing micro-fine particulates and trapping vapors and gasses.

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**Air scrubber efficiency –** As related to air filtration of particulate matter, a machine with HEPA filtration capable of removing 99.97% of particles that are greater than 0.3 microns in diameter that are in contact with the machine's capture zone.

**Air scrubbing –** A process by which indoor air is scrubbed (cleaned of particulates and/or smoke odor) by mechanical equipment.

**Air quality –** Acceptable air quality is the absence of allergenic, toxic and harmful pollutants. Good air quality allows people to breathe and function normally without experiencing any harmful effects from the air they breathe.

**Air Quality Related Values (AQRVs) –** The values of air quality that including visibility, flora, fauna, cultural and historical resources, related values of odor, soil, water, and virtually all resources that are dependent upon and affected by air quality. "These values include visibility and those scenic, cultural, biological, and recreation resources of an area that are affected by air quality" (43 Fed. Reg.15016).

**Airborne coarse particles –** The relatively large particles suspended in air produced by the mechanical breakup of even larger solid particles.

**Airborne matter –** Any substance consisting of organic or inorganic matter that is suspended in air.

**Airborne particle –** Any particle of any substance that is suspended in air.

**Airborne particles –** Any group of particles of one or multiple substances that are suspended in air.

**Airborne particulate matter (PM) –** In wildfire contaminated air, the sum of solids and liquid particles being coarse, fine and ultra-fine that are suspended in air which some may be hazardous. This complex mixture contains for instance smoke, soot, ash, and char, dust and pollen, other vegetative organic matter, and chemical agents that are part of incomplete combustion. Airborne particulate matter is emitted into air from combustion or because of wildfire storm turbulence.

**Allergen –** A substance that brings on an allergic reaction in humans such as dust, soot, ash, char, pollens and mold spores.

**Allergic reaction** – An abnormal physiological response to a chemical or physical stimulus on the part of a sensitive person.

**Alligator effect –** The splitting or cracking of paint film that resembles the lines, cracks and rectangles found on alligator skin. Alligator effect is often due to a dramatic heat increase resulting in film expansion and sudden shrinkage as heat dissipates or caused by oxidation.

**Ambient –** The surrounding environment. In the case of a building, ambient refers to the outside air as compared to the inside air. In the case of a content sitting in the building, ambient is the inside air surrounding the item.

**Ambient air –** (1) Air that is accessible to the public. (2) The air that is surrounding an object that is generally referred to as the air within a structure or space.

**Ambient measurement –** Test and sample measurements taken from air, water or soil that identify outdoor concentrations of chemicals or pollutants such as a gas, particle or organism. Ambient measurements are sometimes collected to create a baseline value against other measurements such as building air quality.

**Analysis, accelerant testing –** "See accelerant." Accelerant testing analysis can be performed by Fourier Transform Infrared Spectrometry (FTIR), Gas Chromatography/Mass Spectrometry (GC/MS) and High Performance Liquid Chromatography (HPLC).

**Analysis, black carbon soot/char (not carbon black) –** Black carbon soot and char analysis is best analyzed through transmission electron microscope (TEM), scanning electron microscope (SEM) and for particle morphology coupled with energy (electron) dispersive X-ray for elemental composition. Black carbon soot is sub-micron particles formed through uncontrolled combustion of fossil fuels, biofuel and biomass. "See TEM analysis"

**Analysis, carbon black –** Furnace, lamp, acetylene black are manufactured spherical carbon materials with particle sizes below one micron. A typical use for carbon black includes paint pigmentation, copier toner and automobile tires. Analysis for carbon black requires the use of TEM with EDXA.

**Analysis decisions, laboratory –** Considering the use of one lab over another. It is important to differentiate between laboratories completing analysis because not all laboratories are the same providing the same types of analysis. When the analysis is for carbon black and soot, the analysis of nano-particles with PLM analysis alone is often inconclusive and typically found to be legally indefensible. Inexpensive testing by PLM is limited at best and should not be the only instrument utilized for the analysis of wildfire residue but rather as the beginning phase of an extensive process.

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**Analysis, carbonized material –** Carbonized materials are characterized as char, ash, graphite, coke and coal. This analysis is performed using polarized light microscopy (PLM) or epi-reflected microscopy (RLM). Additional analysis is necessary when attempting to determine the "source" or "point of origin" of carbonized material.

**ANSI –** American National Standards Institute, ANSI, is a private, non-profit membership organization representing over 1,000 public and private organizations, businesses and government agencies. They seek to develop technical, political and policy consensus among various groups.

Education Note: ANSI does not develop American National Standards (ANS's), but they accredit qualified groups to do so in their area(s) of technical expertise such as IICRC. ("See IICRC")

There are over 14,000 ANSI-approved standards in use today. ANSI-approved standards are voluntary; however it is possible that some of the content of these standards could be made into law by a governmental body. ANSI is the official U.S. representative to the International Organization for Standardization (ISO). For more information about ANSI go to: http://www.ansi.org

**Antagonistic effect –** A biological response to exposure to multiple substances that is less than would be expected if the known effects of their individual substances were added together (ATSDR).

**Appraisal –** An evaluation of a home, tenant or commercial insurance property claim by an authorized person to determine property value or damaged property value. Many insurance policies provide for an "appraisal" process to be completed to resolve disputed claims.

**Appraiser, insurance –** A person that is qualified by training and experience to provide an estimate on the costs or value involving a disputed claim.

**ASHRAE –** The American Society of Heating, Refrigerating, and Air-Conditioning Engineers. For more information about ASHRAE go to: http://www.ashrae.org

Education Note: Baxter, D., Mackelprang, C. Andrew, M., Knowles, J., Clutter, J. "*Wildfire Particulate in Proximally Located, Unburnt Buildings*." ASHRAE Spring 2011 Technical Conference.

**ASTM –** The American Society for Testing and Materials, ASTM, is a not-for-profit organization that develops and provides voluntary consensus standards, related technical information, and services having internationally recognized quality and applicability that promote public health and safety, and the overall quality of life and contribute to the reliability of materials, products, systems and services. For more information about ASTM go to: http://www.astm.org

**Antique –** An object that has attained a certain age.

**Architectural details –** Small details in buildings like moldings and carved woodwork that may require special cleaning during the cleaning and deodorizing of soot contaminated or fire damaged buildings.

**Artifact –** A manmade object shaped by human hands.

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**Asbestos –** A naturally occurring mineral fiber that is highly flame resistant but can cause cancer in some persons. Asbestos material in fire damaged buildings requires occupants, inspectors and workers to have a heightened sense of awareness and they must wear appropriate PPE while visiting, working or inspecting the building.

**Asbestos, friable –** Materials that are easily crumbled or pulverized during a fire, causing asbestos fibers to easily become airborne.

**Ash –** The residue that is left after complete combustion.

**Ash, vegetative –** The light grey/white powder left over after vegetation is burned. By PLM ash is not opaque, rather it is light colored with birefringence due to the presence of calcium crystals. The original plant structure is often still present although faint and wispy. The EDS spectrum of ash shows calcium with moderate carbon concentrations (*Wildfire Particulate in Proximally Located, Unburnt Buildings.* ACGIH: Spring 2011 Technical Conference).

**Ash, caustic –** Caustic alkali is part of ash which may include arsenic, copper, zinc and lead (U.S. Geological Survey 12-04-2007).

**Assessment –** An inspection process where the building or area of damage and/or contamination is evaluated.

**Atmospheric clarit**y – An optical property related to the visual quality of the landscape viewed from a distance.

**Atomic oxygen cleaning –** See Cleaning, atomic oxygen."

**Attics and heat stress/heat exhaustion –** The mandatory government requirements to employers to provide employees with a work environment that is safe and where temperatures do not raise the body's core temperature greater than 100.4 degrees F. Employees working in PPE in an attic that is 90F can expect to have core body temperatures exceeding 100F.

Education Note: Attic temperature above 100F can easily cause the core body temperature to rise above the permissible exposure limit level. In California for example, attic temperature can easily reach 90F to 120F. Any attic cleaning or restoration work requires employers to follow OSHA/CDC/NIOSH guidelines for heat stress and heat exhaustion.

**Attic smoke and soot restoration –** The process of removing smoke and soot from attics.

Education Note: Attics are non-living spaces where its wood framing consists of raw lumber that is very porous. Smoke and soot will absorb onto surfaces and can adsorb into porous materials, making cleaning (washing) smoke and soot off of raw lumber almost an impossible task. Fire damaged buildings that experienced direct contact with heat and smoke and soot from combusted materials require a full attic restoration process to be completed. Generally this includes removing all attic insulation and HEPA

 

vacuuming all surfaces. In heat damaged attics, restoration may include dry ice blasting of smoke soot and char. In non-heat damaged attics that experience wet smoke where oily smoke is present, dry ice basting and/or a clear encapsulating sealant will need to be applied.

**Attic soot particulate restoration –** The process of removing soot particles from attic surfaces.

Education Note: Attic restoration is one of the least understood and underappreciated cleanup processes. A light scattering of dry soot particles (without smoke odor residue) requires very little attention other than a light HEPA vacuuming of visible soot settled throughout the attic. However, given this same situation where a dispute results in arbitration or litigation that requires the removal of all soot (e.g., wildfire soot and ash), the environmental professional and restorer are expected to remove insulation followed by cleaning the attic, ducting and the attic HVAC systems. Another complicating factor unique to managing wildfire soot is the entrainment and reintroduction issue. Once soot is removed, any wind from outside can recontaminate the attic with new soot particles. Therefore, to avoid complications, the restorer should get "independent confirmation" from a professional, including pictures, reporting their work was completed satisfactory on a particular date.

**Attainment area –** A geographic area in which levels of a criteria air pollutant meet the health-based National Ambient Air Quality Standard for that specific pollutant.

**Audit –** An investigation of the ability of a system of procedures and activities to produce data of a specified quality.

**Back draft –** A condition that building appliances create when: (1) the furnace is turned off for some time and reigniting it produces a small or large plume of oily smoke sending it throughout a room or building; (2) a fireplace or wood burning stove with its flue closed causing soot to migrate throughout a room or building.

Education Note: Back drafts from an oiled-fired furnace produces thick black clouds of oily soot and smoke film while fireplace or wood burning stove back drafts' generally produce more of a grey-colored smoke and soot residue that is considerably less oily.

**Back trajectory –** A trace backwards in time showing where an air mass has been.

**Background concentration –** A term, used to describe the level and concentration of air, organisms, and chemicals that are part of natural processes. Background concentrations are gathered outside and are usually the starting point for determining acceptable levels of outside gases, particles and microorganism compared to inside gases, particles and microorganism levels.

**Background measurements –** Basic test readings of a given atmosphere used as comparative measurements - measuring against questionable atmospheres. Background measurements will include temperature, humidity and moisture readings.

 

**Background testing –** Baseline testing of conditions in background of another environment.

**BACT –** Best Available Control Technology (BACT). During the management of fire damaged and/or soot contaminated buildings and contents, BACT refers to the best means for controlling damage based on science and technology.

**Baking soda –** Sodium bicarbonate. A powder cleaner and deodorizer. Baking soda is safe for cleaning almost all surfaces including clothing. In removing smoke and soot, baking soda can be mixed in with a cleaner or degreaser to provide better abrasive qualities. It can be used at the completion of the cleanup job to shine crystal chandeliers and silverware. It is also a deodorizer that can be applied directly to dry upholstery and carpets; allowing it to set for 15 minutes and vacuumed. "See Soda blasting."

**BEST –** An insurance estimating software program that calculates labor and material costs, demolition and cleanup, repair and restoration costs. For more information go to: http://www.bluebook.net/products/best-7_5

**Bias –** (1) An unfair influence, inclination, or partiality of opinion. (2) Deviation of results or inferences from the truth, or processes leading to such systematic deviation. Any trend in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that are systematically different from the truth (CDC).

**Biomass –** The total mass of living and dead material in an area.

**Black carbon (carbon black) and soot** – There is no clear definition that differentiates between black carbon and soot.

Education Note: It's believed the indoor air quality industry uses black carbon and soot terms interchangeably. However, there are some important differences between carbon black and black carbon/soot: Microscopically, using TEM analysis, carbon black is more uniform in size than black carbon/soot and the particle and aggregate size vary depending on the grade. The size of primary particles range between 10-100nm up to 200-500 nm.

The size of black carbon/soot particles is mostly in the upper range and the morphology of the aggregates differ. Also, the "neck" connecting the particles is small when compared to the primary particle diameter in carbon black, whereas it can be as large as the actual particle in black carbon/soot. Other important differences are: the amount of aciniform particles (>97% in carbon black and variable starting from 60% in black carbon/soot), the concentration of sulfur (<2% in carbon black and variable in black carbon/soot, but usually higher than in carbon black), and the amount of residual hydrocarbons (low in carbon black, varying up to 20% in black carbon/soot) (EMSL).

 

**Blister (blistering) –** A condition sometimes caused by heat, causing bubbles to form and break because of changes in surface temperature and the humidity underneath the bubble. After the release of surface tension causing paint film to lift, the bubble bursts and blistering results.

**Blow back –** A change in wind direction causing wildfire smoke to come back to an area.

**Boundary layer –** The layered air mass separating the surface of a material from ambient air.

**Building envelope –** All structural parts and components that enclose the interior air space.

**CAA –** The Clean Air Act including all of its amendments in 1999.

**Camera documentation –** Any optical capturing device (e.g., 35mm, digital or video camera) that records and documents events and conditions at fire damage or soot contaminated properties.

**Carbon black –** The manufactured material produced from controlled combustion or thermal decomposition of hydrocarbons. Carbon black is also called acetylene black, channel black, furnace black, lampblack or thermal black. A type of carbon black is toner printer ink. "See analysis, carbon black."

**Carbon black in air samples** – A NIOSH 5000 method that addresses the analysis for carbon black in air samples. This method is gravimetric (it measures the total dust that was collected during a certain period of time), non-specific, and therefore, prone to interferences with any other components of the dust present in the air at the time of collection.

Education Note: This method can be used as initial screening or for OSHA compliancy. Unless additional methods employing electron microscopy are used to characterize the particles in terms of morphology and assess if they really are consistent with carbon black, this method does not give any additional information than the regular methods used to measure the exposure to total nuisance dust (such as NIOSH 0500/0600).

**Carbon dioxide –** ($CO_2$) A colorless, odorless, non-flammable but potentially hazardous gas which results from human and animal activity.

**Carbon monoxide –** (CO) One of the six criteria pollutants. A colorless, odorless and poisonous gas produced by incomplete burning of carbon in fuels. (The EPA ambient air quality TLV for carbon monoxide is 35ppm for a 1-hour work period and 9ppm for an 8-hour work period.) "As a wildfire burns, it emits visible pollution in the form of smoke, soot, and ash.

Education Note: All smoke contains carbon monoxide, carbon dioxide and particulate matter (PM or soot). Smoke can contain many different chemicals, including aldehydes, acid gases, sulfur dioxide, nitrogen oxides, polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, styrene, metals and dioxins. The type and amount of particles and chemicals in smoke varies depending on what burns,

 

how much oxygen is available, and the burn temperature" (DOH-NY State). Fires affect air quality by emitting CO—carbon monoxide—and hydrocarbons, plus nitrogen oxides, all of which, along with sunlight, are needed to make ozone.

Unlike ozone in the stratosphere, which protects us from ultraviolet radiation, high levels of ozone in the troposphere, closer to ground level, can injure or destroy plant life (vegetation), human living tissue, and cause corrosion to metals and finishes.

**Carbonized (carbonaceous) material –** The generic term of carbonized material applies to char, ash, and coke/coal. Carbonization, as a chemical term, is defined as a chemical process of transformation of an organic substance by means of pyrolysis in a residue with carbon as the main elemental component.

Education Note: The carbonized material from a wildfire is not significantly different than the components of a residential fire where wood was the primary component that was combusted. However, residential fire debris usually contains a higher concentration of black carbon/soot and also charring from plastics and fabrics.

**Carcinogens –** Agents that cause or contribute to cancer (Wildfire Smoke: A Guide for Public Health Officials, revised July 2008). For example, formaldehyde is a known cancer causing agent sometimes found in smoke.

**Cascade impactor –** An instrument that samples particles by impacting on solid surfaces via jets of air. After passing the first surface, the air is accelerated toward the next surface by a higher speed jet, in order to capture smaller particles than could be captured by the previous one.

**Cause and origin –** The precise location and mechanism by which a fire originated.

**Cavitation –** Vacuum bubbles created by negative pressure in ultrasonic and megasonic cleaning processes.

**Ceiling plenum –** In commercial buildings, the ceiling plenum represents the space below the floor and above a suspended ceiling. The ceiling plenum accommodates the mechanical and electrical equipment for the HVAC system; electrical, gas and plumbing lines. The ceiling plenum space is kept under negative air pressure.
Education Note: When fire affects building designs of this type, smoke, residue and soot are drawn to this area where the ceiling plenum must be cleaned and deodorized along with interior spaces.

**Certificate of completion –** A completion form. This form confirms all remediation and restoration work outlined in the contract including change orders are completed to the satisfaction of all parties.

**Certificate of satisfaction –** A document the contractor provides to the building owner to sign. The building owner reviews the work completed and upon satisfaction, signs the document. Sometimes the insurance adjuster holds back on making the final payment to the contractor because the certificate of satisfaction is not signed.

 

**Change order –** A written order to a contractor signed by the owner or authorized agent as an addendum to a contract which authorizes a change (deletion or addition) in the current work schedule or work to be completed.

**Char** – Matter that is composed of particles that are larger than 1μm and may preserve the original cellular morphology of the material that was burnt. These particles can range up to millimeter in size.

Education Note: Char is mostly elemental carbon, but it may also contain trace concentrations of mineral components and ash. The main difference between ash and char is that ash may not preserve any of the original morphology of the precursor and it may have a higher concentration of inorganic components due to the complete consumption of some of the organic matrix (ASTM D 6602).

**Char, vegetative –** Wildfire char that is composed of vegetative material which is partially carbonized by incomplete combustion. By PLM these opaque particles maintain the majority of the original plant's morphology, often elongated with holes from xylem structures. The EDS spectrum of char shows high concentrations of carbon, lower concentrations of oxygen and trace amounts of other elements (*Wildfire Particulate in Proximally Located, Unburnt Buildings.* ACGIH: Spring 2011 Technical Conference).

**Charred wood –** Lumber and finishing materials including hardwood that have been converted to charcoal by the application of heat. Charred wood may include wood that has been burnt slightly or partially and wood that has been scorched deeply.

**Chemical sponge –** "See dry sponge."

**Chemicals in soot –** The burning of carbon materials that produce black solid or tarry (oily) substance that form hydrocarbon combustion. Combustion releases small molecular-weight polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) such as C8 to C20 compounds, and various chemicals such as benzene and aldehydes. The composition of soot varies depending on the hydrocarbons being burnt.

**Clarity –** Relative distinctness or sharpness of perceived scene elements.

**Cleaner, aqueous –** A blend of water soluble chemicals designed to remove smoke and soot from surfaces.

**Cleaner, foam and liquid –** Foaming and liquid cleaners capable of removing soot and ash without damaging hard surfaces and most textiles (see labeling instructions for application on textiles). Examples include but are not limited to: Lysol disinfectant foam, Tuff Stuff, Blue Magic, Woolite Carpet Cleaning Foam, OxiClean Miracle Foam, Orange Cleaning Foam, Stainless Steel Magic.

**Cleaner, foam and liquid abrasive –** Aggressive abrasive cleaners capable of removing smoke and soot and imbedded grime without damaging most hard surfaces. (Some products should not be applied on brushed stainless steel and other sensitive finishes.) Examples include but are not limited to: Melamine Foam Cleaner, CRC HydroForce, Seige Porcelain and Enamel Cleaner, Soft Scrub.

**Cleaning –** The act of making something clean. Clean is the absence of dirt and other impurities.

**Cleaning, acid –** A cleaning solution that has a pH significantly below 7, typically a pH below 5.5 Acid cleaners contain acids and other cleaning ingredients including surfactants. Education Note: Acid cleaners clean using the cleaning mechanism of acid solubalization where acid reacts with soils, soot and smoke film to create a water soluble molecule. Through hydrolysis this process is able to break molecules into smaller water soluble substances.

**Cleaning, air –** An indoor air quality control strategy to remove various airborne particulates and/or gases from the air. The three types of air cleaning most commonly used are particulate filtration, electrostatic precipitation, and gas sorption (CDC).

**Cleaning, alkaline –** A water based cleaner that contains alkaline ingredients that cause the cleaner to have a significantly high pH. A cleaner having a pH of 8.5 is considered mild; a cleaner with a pH of 11-12.5 a medium quality cleaner; high pH cleaners are those that are above 12.5 and are considered corrosive. Alkaline cleaners promote saponifying, solubilizing and hydrolysis.

**Cleaning, atomic oxygen –** An atomic cleaning process for removing soot from paintings and other works of art. Atmospheric pressure generates a beam of monatomic oxygen that reacts with carbonaceous deposits that converts the carbon to CO and $CO_2$ thus, converting any hydrogen content of the deposit to $H_2O$ (water vapor). Education Note: Until recently, conventional techniques for cleaning paintings involve the use of solvents, which are not effective in some cases. In contrast, the use of monatomic oxygen causes the removal or carbon deposits followed by cleaning at a controlled rate. (John H. Glenn Research Center, Cleveland, Ohio).

**Cleaning attic insulation –** The removal of visible soot and char off the surface of insulating materials sufficient enough to achieve an appearance acceptance.

Education Note: One of the most difficult jobs is working in attics and attempting to remove settled loose soot and char particles off of insulation. At best, the cleaning process is only an attempt to bring back the remaining insulation to an acceptable condition; not 100% free of soot and char particles.

When attic insulation (especially blown-in insulation) is present and it must be soot cleaned, it's generally more cost effective to remove and replace insulation with new materials rather than attempt cleaning it. It is not unheard of to hear about a cleaning technician mixing (turning) blown-in insulation over so that is has a general soot-free appearance. At that point finding soot particles is like looking for a needle in the haystack.

 

**Cleaning, clothes –** The process of fabric cleaning that removes smoke, soot and chemical byproducts, resulting in returning clothing back to an odor free (odor neutral), smoke stain free and sanitary state.
**Cleaning, dry ice –** "See Dry ice blasting."

**Cleaning, dry sponge –** The removal of smoke and soot-based residues by applying a rubber or synthetic cellular sponge across a sooty surface. "See Dry sponge; Wet sponge"

**Cleaning, emulsion –** A cleaning technique that emulsifies surface contaminants. Emulsion cleaning solvents often include a combination of and synergy with cleaners and surfactants.

**Cleaning ducts –** The removal of fire residues and debris from the interior of air ducts.

**Cleaning, exterior building** – The removal of damaging smoke and soot particles and residues from the outside surface of buildings and surrounding land. Exterior building and the surrounding land cleaning usually requires a detergent chemical pressure washing. Side-by-side tests show chemical pressure washing works best when water temperature at the nozzle is extremely hot (above 200F).

**Cleaning, exterior contents** – The removal of damaging particles and residues from the outside surface of contents, appliances furniture, and fixtures.

**Cleaning, extensive –** The widespread cleaning of dirty, sooty or contaminated items or surfaces.

**Cleaning, fabric –** The inspection and determination how fabric (e.g., draperies, linens and clothing) should be cleaned and what process should be used to remove dirt, residue, smoke, soot, stains and odors. "See Cleaning, clothes."

**Cleaning, final –** The last of several cleaning process that achieves the desired level of cleaning.

**Cleaning, foam –** Spray foam cleaner. The uses of spray cleaning foams are intended to suspend loose and sometimes imbedded smoke and soot without damaging the substrate.

Education Note: Products like Lysol Pro Disinfectant (for general surfaces); Screen Guard (for non-scratch surfaces including computer monitors); Woolite foam carpet cleaner (for most rugs and fabrics); Meguiar's Leather Foam cleaners and conditioners (car and house leather), and Leather Master Foam Cleaner (for suede and alcantara); Sea Foam Spray (for metal surfaces where soot and grease is present); and Orange Clean Foam (for general hard surface cleaning).

Another product for sensitive surfaces is men's and women's shaving cream. As it relates to soot contaminated sensitive materials and surfaces, and depending on the material and its porosity, consider doing a test area first (always read and follow foaming instructions): (a) HEPA vacuum loose soot particles; apply spray foam and let it set from 15 seconds to one minute; carefully HEPA vacuum off foam (with a soft bristle attachment) without touching the surface and determine if the soot residue is gone or the surface responded positively to the treatment. (b) Another test is to HEPA vacuum loose

 

soot particles; apply spray foam and let it set from 15 seconds to one minute; with a cotton ball wipe-test, wipe the test area and see what the underlying surface looks like.

**Cleaning for clean –** The ability to restore and item, content, upholstery or building back to a state of cleanliness without supplemental procedures such as base sealers, paint and finishes.

**Cleaning for paint –** The removal of smoke, soot and ash residues to a degree that is sufficient enough for the proper application of paint.

**Cleaning, gross** – The removal of massive unsanitary waste or contamination.

**Cleaning, heavy –** The removal of massive or large amounts of waste or debris.

**Cleaning HVAC system –** The removal of fire residue and particulates from the exterior and interior housing and all parts making up the air distribution system.

**Cleaning, in plant –** The process of cleaning, sanitizing and deodorizing fabrics, contents, furniture and works of art back to their pre-loss condition in the contractor's place of business.

**Cleaning, interior –** To dismantle as necessary and clean interior components. In a fire or wildfire soot odor cleaning situation, taking out furniture drawers to clean the drawers on all sides and the cabinet may be necessary.

**Cleaning, laser –** The removal of carbon-based smoke and soot with lasers. Laser cleaning is a state-of-the-art cleaning process for removing smoke and soot from paintings and murals in historical buildings and the building. Depending on the setup, laser cleaning can be completed onsite, in a cleaning plant or laboratory. The most accepted laser cleaning method is the Nd:YAG.

**Cleaning, light –** The removal of loose soot and debris by general housekeeping practices including vacuuming and washing.

**Cleaning, mechanical –** The removal of solid particles and smoke film through scrubbing.

**Cleaning, medium –** A middle position in the cleaning process by which the cleaning of surfaces is not light or heavy.

**Cleaning, non-porous materials –** The surface cleaning and removal of contaminants from non-porous materials and finishes such as glass, most plastics, dishware, ceramics, finished wood, vinyl flooring, and sealed marble, granite and terrazzo.

**Cleaning, on-location contents –** The cleaning of contents on-location (on-site) with cleaning solvents and equipment that are commonly found in a cleaning plant.

 

**Cleaning, polyurethane flooring –** The soot cleaning process for hardwood floors having a polyurethane finish.

Education Note: (a) Check with the flooring manufacturer to ensure your recommendations and supplies are the same as theirs. If they recommend a particular cleaning supply or top coat finish, follow their recommendations, otherwise: (b) Remove contents and rugs off the floor. (c) Make sure the ceiling, walls, windows and doors are in a clean state and the floor has already been HEPA vacuumed before final floor cleaning begins. (d) Detergent wash floor with a grease-cutting dish soap such as Dawn and clean warm water. (e) While it's important to not over saturate the floor (no standing water), the floor and sponge cleaning process must wet the floor sufficiently enough to remove smoke film, soot and grime. (f) A second person is to follow the first cleaning person with fresh water rinsing. (g) When either the detergent washing or rinse water becomes cloudy or grey in color, it's time to change out the detergent and the warm rinse water and use a clean sponge mops. (h) This process is to be completed until the washing and rinse water is clear of color. (i) Per manufacturer instructions, apply appropriate topcoat finishes.

**Cleaning, Polyurethane flooring alternative –** Cleaning methods that are different from traditional hardwood floor cleaning processes.

Education Note: (a) When the restorer has a truck-mount cleaning system, steam clean smoke and soot residue off the hardwood floor at 200F or greater along with low pressure misting using a special wand that will not scratch hardwood floors and the system is capable of extracting any remaining surface water at the same time. A white glove test about 10 minutes after cleaning and surface drying should not be able to identify discoloration on the glove, cloth or cotton wipe. (b) Steam clean hardwood floors after HEPA vacuuming of loose smoke and soot residue with vapor-mist steam cleaning systems. The ease of use benefits become obvious within minutes, however, so do the drawbacks when steam vapor towels become overloaded with smoke and soot and must be replaced often in some soot cleanup situations. The two alternative methods described above work in conjunction with each other when smoke and soot is more than light fallout of soot particles.

**Cleaning, vinyl flooring –** "See Cleaning, polyurethane flooring; Cleaning, polyurethane flooring alternative."

**Cleaning, porous materials –** The cleaning of materials and contents that are porous and absorbent.

**Cleaning response –** The ability of a chemical or process to clean smoke and soot off of a surface.

**Cleaning, restorative –** The application of procedures designed to remove damaging smoke and soot residues and odor, and returning the surface or material back to its pre-loss condition.

**Cleaning, secondary –** The second cleaning step in a cleaning process.

 

**Cleaning, spray –** A water spray device or rig that washes off smoke, soot and other debris.

**Cleaning, soaking –** A process of immersion where items are submerged or encased in water bath for a period of time.

**Cleaning, soda blasting –** "See Soda blasting."

**Cleaning, solvent –** The use organics to dissolve and disperse other compounds.

**Cleaning, soot and smoke removal process -** Initially on building material surfaces, soot vacuuming and/or air washing followed by a mild alkaline detergent washing to neutralize, retard or stop pitting and corrosion or discoloration of finishes.

**Cleaning, sponge blasting –** "See Sponge blasting."

**Cleaning, staging of –** Supplies delivered to a loss and staged for the purpose of cleaning.

**Cleaning, steam –** "See Steam cleaning."

**Cleaning, surface preparation before –** The process by which a surface is prepared for cleaning.

Education Note: In smoke and soot removal from sensitive materials, surface preparation generally requires a visual inspection but may require other forms of macro and microscopic of the surface for determining existing damage or potential problems that may occur during accepted cleaning practices. Some problems may include heat damage, high moisture content, bubbling and flaking, swelling, and the presence of heavy soot across a surface. Surface preparation requires addressing each of these issues along with soot removal. Once gross soot is removed the surface should be sufficiently prepared allowing more extensive cleaning to be completed.

**Cleaning, test area –** A process by which a small area of a surface or material can be test cleaned without causing any appreciable damage to that area.

Education Note: On sensitive materials and items, test area cleaning begins with the removal of loose soot and ash, followed by Q-Tip and cotton ball or cotton pad testing. In order, this small but ideal control test method provides valuable information how the surface responds first to water (preferably distilled or deionized water when testing contents and sensitive materials and surfaces); non-aggressive cleaning methods using foam cleaners and liquid detergents; more aggressive cleaning by either increasing the concentration of the liquid cleaning or increased agitation.

Unless the surface is non-permeable and is scratch resistant, the use of scouring and abrasive cleaners is discouraged. However, when the surface is a painted wall or molding, a follow up scouring cleaning process may provide the best results for removing surface stains and chemical residues before repainting. Finally, test area cleaning may require the use of various kinds of cleaning agents including

 

ammoniated and non-ammoniated cleaners; cleaners with low and high surfactantcy; cleaners that are less abrasive and more abrasive.

**Cleaning, upholstery light –** The inspection and determination how upholstery (e.g., fabric and leather chairs, ottomans, couches) should be cleaned and what process should be used to remove surface dirt, oily residue, smoke, soot, stains and odors; smoke and odors trapped in foam and batting. (a) When light or nuisance soot deposits are present, HEPA vacuuming may be all that is necessary to clean upholstery. (b) However, even when light or nuisance soot consists of wet soot or oily soot, professional cleaning us generally recommended. (c) Adding to the complication is smoke odor. When smoke odor is present this is an indication an oily smoke film is present or has absorbed in fabrics, foam cushion and batting.

**Cleaning, upholstery inspection before –** The inspection and determination how upholstery (e.g., fabric and leather chairs, ottomans, couches) must be cleaned.

Education Note Cleaning begins with an inspection process outdoors in sunny - clean air or upholstered furniture that is moved to a professional cleaning plant where they inspect upholstery under bright 100 -500 watt lamps. Also, identification of particulates or damage can be done in a controlled dark environment having a strong UV light, it may be possible to see surface contaminates including soot and char residue. (All of the just mentioned inspection processes may be necessary.)

**Cleaning, upholstery moderate or extensive –** The cleaning process once a thorough inspection of the condition of each piece of upholstery is complete including testing to determine best use of cleaning chemicals.

Education Note: Oily soot is capable of permanently staining upholstery. However, light and medium oily stains may not be visually apparent at first but discoloration may appear weeks later as aging, dullness, loss of luster, color distortion or shading. Cleaning involves following manufacturer instructions. If allowed by the manufacturer, detergents having a pH of 9-12.5 should be applied and then thoroughly rinsed and dried. The rate of drying (i.e., fast or slow) may depend on the type of material and condition. Acid-based cleaners should be used only when the manufacturers recommend their use or color bleeding may be an issue. This recommended cleaning technique should only be attempted by certified upholstery & fabric cleaning technicians (UFT).

**Cleaning, upholstery smoke odor –** (1) A process that removes trapped smoke odor in upholstery framing, foam, batting and surface textiles. (2) A process that incorporates different cleaning and deodorizing methods to clean upholstery.

**Cleaning, ultrasonic –** "See Ultrasonic cleaning."

**Cleaning, wet sponge –** The application of a wet sponge to clean off dust, dirt, soot and oils. Unlike chemical sponges that have small pores and are intended to be used dry, wet sponges have large pores and work best when they are damp or wet.

 

Education Note: In soot cleanup situations, damp cleaning a test area is preferred over an aggressive wet cleaning process. Damp cleaning will control surface moisture and wetness, and any water runoff that may occur which can harm a surface if they are not stopped. In most all situations, lightly HEPA vacuum loose soot first then begin cleaning the surface using a test area as an example of what you will expect to achieve if you cleaned the entire wall, floor, ceiling, or a cabinet surface. "See Cleaning, test area."

**Cleaning with air –** A cleaning process by which air movement aids in the removal of pollutants from indoor air. The University of Florida and the University of Wisconsin's Disaster Handbook provides valuable information involving the management of fire damaged buildings.

Education Note: One recommendation is to ventilate structures with outdoor fresh air, thus, cleaning the interior by removing airborne pollutants. While this is an accepted practice, it doesn't always work when the surrounding community continues to be affected by wildfire smoke and soot fallout. When this purging process is used in wildfire smoke and soot contaminated buildings, the building's incoming air must be filtered at the air intake (ventilation system intake or door and window intake). Makeup outside air should be filtered with no less than pleated filters that stop larger particles greater than 1 micro in size from entering the building.

**Cleaning with forced air pressure –** A cleaning process that uses dry compressed air to force settled and airborne matter off of a material and out of the airstream. This process is also called air sparging.

**Clearance, baseline data –** Data that is collected outside a cleaned or decontaminated area.

**Clearance, building –** The return of normal building conditions determined by inspection and testing.

**Clearance, environmental –** In smoke, soot and ash environmental contaminant conditions, environmental clearance is an adherence to government regulations when regulated waste is present.

**CO –** Carbon monoxide. An odorless, colorless, and highly poisonous gas. "See Carbon monoxide."

**$CO_2$ –** Carbon dioxide. "See Carbon dioxide."

**Coagulation –** The process by which small smoke particles collide with and adhere to one another to form larger particles.

**Coarse mass –** Mass of particulate matter having an aerodynamic diameter greater than 2.5 microns but less than 10 microns.

**Coarse mode –** A size range of particles between 2.5 microns and 10 microns. Coarse particles are mostly composed of soils. The sum of the masses of coarse and fine particles (all particles smaller than 10 microns) is called PM10.

**Cold fire –** A fire that has heavy oily residue from smoldering or incomplete combustion.

 

**Cold fogging –** A type of fog produced by the fine spray of water-based chemicals and deodorizers with an ultra-low volume (ULV) fogging machine. The ULV fogger relies on their ability to atomize fine droplets in air usually by a venture effect. Fine droplets (5-15 microns in size) are more likely to enter small pours, cracks and crevasses where smoke and soot remains.

**Collectible –** An object or category of objects that is collected by enthusiasts. Virtually any object may be considered collectible if the market exists which establishes their value.

**Color –** A qualitative sensation by humans that describes hue, brightness and saturation. Color plays a role in fire damage remediation since colors can change or be distorted by acid residue.

**Color contrast or difference –** Contrast between two adjacent scene element colors. Color contract difference is any difference in color hue, saturation, or brightness, between two perceived objects.

**Colorimetric analysis –** Chemical analysis based on the colors of dyes formed by the reaction of the analysis with reagents.

**Combustible liquid –** Any liquid having a flashpoint at or above 100F (37.8C) but below 200F (93.3C) except any mixture having components with flashpoints of 200F or higher, the total volume of which make up 99% or more of the total volume of the mixture.

**Combustion –** The rapid process of oxidation that occur when organic matter ignites and burns, producing light and heat.

**Combustion byproducts –** The spent fuel after a fire. Combustion byproducts are produced whenever carbon-based fuels such as gas, oil, kerosene, wood, or charcoal are burned and are also produced by tobacco smoking. The major pollutants released during combustion are carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulates and water vapor that can form into sulfuric acid. Nitrogen dioxide is one substance responsible for yellowing and aging materials after a fire.

**Combustion, incomplete –** The response by heat to be inefficient and produces byproducts. Complete combustion uses up all the fuel in a reaction and produces a limited number of byproducts. Incomplete combustion occurs when there is not enough of an oxidant to burn up all the fuel in an efficient manner.

**Commissioning –** The start-up of a building after construction where testing and adjusting HVAC, electrical, plumbing and other systems have been accomplished to assure the proper functioning and adherence to design criteria.

**Complexities –** Any condition at the jobsite that causes the job to become more difficult or detailed.

 

**Complications –** The act of becoming complex, intricate, or perplexing. A complication is generally any work condition that arises after the start of work that causes or necessitates a change in the scope of work activities.

**Combustion -** In fire damaged buildings and in wildfires, combustion is the incomplete burning of materials (byproduct residue). Often combustion residue is smoke and char that range from 0.1 to 4 microns in size. Soot particles can be much larger depending on the type of fire, temperature, humidity, wind and the type of material being consumed. (See soot)

**Computer Estimating Programs –** Loss estimating programs for the demolition, cleanup, deodorization, repair and restoration of buildings and contents. "See BEST; PowerClaim; Simsol; Xactimate"

**Concentration –** The relative amount of a material in a combination with another material such as 5 parts (of acetone) per million (of air).

**Condensation –** (1) A deposit of moisture droplets from humid air on surfaces that is cooler than the air. (2) A process by which molecules in the atmosphere collide and adhere to small particles.

**Condensation counter-nuclei –** An instrument that counts nucleation mode particles by causing them to grow in a humid atmosphere, and observing light reflections from the individual enlarged particles.

**Condensation nuclei –** The small nuclei or particles with which gaseous constituents in the atmosphere (e.g., water vapor) collide and adhere.

**Conditioned air –** Indoor air that is heated, humidified, dehumidified or cooled to maintain an interior space within the "comfort zone."

**Conditioned air space –** The part of the building that is designed to be thermally conditioned or controlled for the comfort of its occupants or contents.

**Conduction –** The transfer of heat between two objects that are in direct physical contact. Conduction allows the heat to be transferred inside and throughout the fuel, rather than only heating the surface. Because wood is a poor conductor of heat it will combust rather than transfer heat to another material.

**Conflagration –** An uncontrolled burning that threatens property and life.

**Conservation and Restoration –** The efforts to rehabilitate, structurally and cosmetically, historically significant buildings and contents that have been soot contaminated or fire damaged.

**Conservation, contents –** Equipment and methods used to conserve artifacts, manuscript, works of art and historically significant items.

**Containment –** (1) A precautionary measure used to contain and control contamination or material damage. (2) A temporary structure or material that is designed to restrict access and becomes a confined work space.

**Contaminant –** A substance or material capable of causing adverse health responses in humans or causing damage to the environment, including buildings and contents.

**Continuous sampling device –** An air analyzer that measures air quality components continuously.

**Contractor –** (1) A person or company qualified and licensed in the field of construction and installing its components. (2) A tradesperson, specialist or competent person qualified to complete specific services and work tasks.

**Contents –** Personal property items contained within a structure that are not construction fixtures or built-in cabinets. Contents usually include window coverings, area rugs, furniture, appliances and electronics; works of art, utensils and dishware.

**Contents manipulation –** The required handling and positioning of furniture and other personal property at the time of loss to manage an emergency disaster or cleanup situation during the course of building repairs.

**Contents processing –** A systematic process for identifying, categorizing, removing, cleaning and restoring contents.

Education Note: Before handling contents, there must be a documentation process for fire damaged or soot contaminated contents followed by inventory and segregating them into process management categories such as: (1) cleanable; repairable, non-salvageable, not cost-effective to save; (2) irreplaceable (meaning, make every attempt to save and salvage the item), works of art and historically significant items (often requiring a conservator to evaluate their condition and how they must be handled), electronics and appliances (items that will continue to experience corrosion damage until they are cleaned and stabilized), antiques and collectibles (requiring special handling and cleaning).

**Contrast –** Relative difference between fire and soot damaged materials and non-affected materials of like-kind and quality.

**Convection –** (1) Air currents induced by the different densities of warm and cool air. (2) The transfer of heat through the movement of a liquid or gas. (3) The mechanical transfer of heated molecules of a gas or liquid from a source to another area.

**Convection current –** The upward movement of air caused by thermal expansion.

**COPD –** Chronic obstructive pulmonary disease, or COPD, refers to a group of diseases that cause airflow blockage and breathing-related problems. COPD includes emphysema, chronic bronchitis, and in

 

some cases asthma. COPD is a leading cause of death, illness, and disability in the United States. Persons with COPD must be removed from wildfire situations until their indoor air is safe to breathe.

**Corrosion –** Action or the effect of eating away gradually. Corrosion results through oxidation caused by acids or alkali (acid induced corrosion by smoke, soot and ash).

**Corrosive –** Residues of smoke soot and ash that cause or contribute to corrosion. Corrosive smoke contains chlorides and sulfates; when combined with water or surface moisture they form hydrochloric or sulfuric acids.

**Criteria pollutant –** EPA uses six "criteria pollutants" as indicators of air quality, and established for each of them a maximum concentration above which adverse effects on human health may occur.

Education Note Threshold concentrations are called National Ambient Air Quality Standards (NAAQS). The criteria pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter and lead.

**Cross contamination –** The spread of contaminates from an affected area to a clean or non-affected area.

**Crown fire –** A fire that has ascended from the ground into the tops of trees and can advance more or less independently of the ground fire.

**Cryogenic blasting –** Super frozen gases of carbon dioxide that are propelled through a high pressure nozzle to remove surface contaminants such as soot and ash; rust, corrosion and oxidation. "See Dry-ice blasting."

**Current conditions –** Refers to ambient, building and content conditions at this time.

**Cupping –** A condition that occurs in wood in fire damaged buildings because firemen used water to put out the fire; humidity is dramatically altered because of the fire; the building is now exposed to outside weather conditions. Water/moisture becomes trapped in wood resulting in swelling and expansion.

**Damage –** Loss of a material or surface by contamination, oxidation, abrasion, moisture or heat.

**Damage appraisal –** An evaluation or estimate of the damaged caused by a fire or damage caused by wildfire fallout.

**Damage assessment –** The process of assessing property damage that are directly or indirectly (e.g., environmental) relate to the claim.

**Damage, collateral –** Unintended damage sustained by non-affected building materials or contents during the course of cleanup, decontamination and remediation.

 

**Damage, consequential –** (1) Loss of value that does not arise as a direct result of an event, but which is incidental to it. (2) Damage incurred as an indirect cause of the loss.

**Damage, direct –** (1) Physical damage to real or personal property. (2) The area most affected by damage.

**Damage, ensuing** – Damage that occurs from an earlier damage or loss.

**Damage, extensive smoke and soot –** Damage that consumes most if not all the building or item; or it has compromised the material's structural integrity or its environmental state.

Education Note: Extensive smoke and soot damage is a general term describing not just the amount of damage but also the severity. In a wildfire, extensive damage includes but is not limited to wide-spread and far-reaching smoke and soot damage in walls, ceiling and flooring, even though the building may not have sustained light to extensive structural damage. Extensive damage to contents describes a situation where a vast amount of contents or works of art are affected by heat, or significant smoke and soot; a single item that experienced major damage.

**Damage, incidental –** Damage that occurs coincidentally with another loss or disaster. An example is water damage caused by firefighters during the attempt to stop a wildfire or a building fire.

**Damage, indirect –** Losses resulting from direct damage to a property, such as income and expense loss that results from the inability to use damaged property.

**Damage, latent –** Building damage that is present but it is not visible; secondary damage that later becomes noticeable but it is found to be related to the initial cause of damage.

**Damage, extensive –** Widespread material damage. Extensive means the building or item has widespread damage to more than one area or part, requiring it to be replaced or restored at a cost that may be close to or greater than the estimated replacement cost value.

**Damage, heavy smoke and soot –** Damage that consumes a large portion of a building or item; compromised the material's structural integrity or its environmental state.

Education Note: Heavy damage is a general term describing not just the amount of damage but also the severity. In a wildfire, heavy damage includes but is not limited to significant heat damage or serious smoke and soot damage, even though the building may not have sustained structural damage. Heavy damage to contents describes a situation where a vast amount of contents or works of art are affected by heat, or significant smoke and soot; a single item that experienced major damage. "See Heavy damage."

**Damage, light smoke and soot –** Minor isolated damage to a material or item. In restoration terms, light damage is damage that is easily repairable or restorable.

 

Education Note: In wildfires, light damage may be heat discoloration or blistering to one side of a building siding or finish; soot in the attic as compared to soot in the building; the settling of specks of soot-like particles on horizontal surface such as flooring and contents. "See Light damage."

**Damage, moderate smoke and soot –** Damage to a surface area or material that is damage somewhere between light and heavy.

Education Note: Moderate damage in a wildfire may be described as soot contamination in an attic causing insulation to be removed and replaced; removal of soot by HEPA vacuuming followed by cleaning of contents and flooring; cleaning of ventilation systems because of the presence of soot; cleaning of contents, walls, floors and draperies because the windows were open at the time of loss. (See Moderate damage."

**Damage, prior –** Damage or distress to a property or item that exists before a loss.

**Damage, secondary –** (1) Building damage that arises out of primary damage, such as wildfire soot fallout that occurs continuously over the next few days or a gust of hillside wind occurring weeks later. (2) Damage to materials or contents sustained from indirect or prolonged exposure to disaster contaminates such as heat, moisture, humidity, smoke and soot.

**Datalogger –** An electronic device for measuring analog or digital signals and recording the results on a storage media. Some dataloggers can record a number of locations reporting them as separate channels.

**Debris –** The building material waste after demolition and unwanted waste after a fire.

**Debris removal –** The removal and disposal of unusable items and materials that don't have any redeeming salvage value.

**Decomposition –** The breakdown of organic materials through decay, heat or flame.

**Decontamination –** (1) The systematic removal of toxic, allergenic or dangerous substances from a building or its contents. (2) Disinfecting or sanitizing a surface or item exposed to pathogens.

**Degreaser –** A cleaner that is designed to remove oils and greases including heavily impacted smoke film.

**Dehumidification –** The process of removing moisture from air.

**Dehumidifiers in fire/soot damaged buildings –** A humidity control process that removes high or excess moisture content from air and soot contaminated or fire damaged surfaces.

Education Note: The dehumidification effect reduces moisture content at the surface of soot contaminated materials allowing these materials to become stable (less damaged or contaminated by soot and ash. One or more dehumidifiers are used to control the relative humidity to around 40% while indoor cleaning and deodorizing occurs.

 

**Dehumidifiers in water damaged buildings –** A humidity control process that is designed to remove moisture from humid indoor air and wet building materials.

Education Note: Fire damaged buildings that are flooded with water from putting out the fire offers unique challenges to restorers. Besides removing fire damage and char, restorers must simultaneously dry wet building materials using dehumidifiers.

**Delamination –** The separation or detaching a layer from the previously adhered composite. In fire damages, delamination is caused by heat or moisture (absence of) that separates finishing materials from the base material.

**Deliquescence –** The process that occurs when the vapor pressure of the saturated aqueous solution of a substance is less than the vapor pressure of the water in the ambient air.

Education Note: Water vapor is collected until the substance is dissolved and in equilibrium with its environment. Example includes the process by which solids absorb enough moisture from the air to dissolve themselves. Another example is calcium chloride that dissolves in the presence of moisture because of its moisture holding capacity.

**Demolition –** The systematic removal of damaged building components in order to allow repair and restoration.

**Deodorant –** A chemical or gas that covers, masks, modifies or destroys odor causing agents.

**Deodorization –** The process of odor removal by removing physical materials containing odors or by adding chemicals.

**Deodorization, hydroxyl –** A chemical compound in the form of a gas produced by a machine to provide odor control and deodorization of organics such as volatile organic compounds. VOC's include smoke odor that can be controlled or abated by hydroxyl deodorization.

**Deodorize –** Any process that eliminates offensive odors.

**Deodorizing (deodorization) –** (1) The act of depriving molecules to carry odors. (2) Elimination of odors. (3) To mask or eliminate an odor.

**Depressurization –** A condition that occurs when air pressure inside is lower than air pressure outside.

**Destructive inspection/testing –** The application of inspection and test procedures that damage or destroy building materials.

**Dew point –** The temperature at which humidity in the air reaches saturation and will condense upon a solid surface.

 

**Diffusion –** In a wildfire that affects a building with heat and combusted materials, diffusion refers to the spreading out of gases, vapors and particulates from a concentrated source resulting in an increase in the entropy (degree of disorder) of the substances that affect the building. Diffusion also occurs because of the random movement of molecules of the substance which allows them to separate from one another.

Education Note: The greater the space between molecules the greater ability they have to spread out from one another. The more packed the molecules are in the substance the less space to maneuver, and therefore, the more difficult for diffusion to occur. Gaseous substances in a wildfire are in a league all to themselves. The molecular particles of gas are much more distant from one another than either liquid or solid particles are to each other. Gaseous substances can penetrate deeper into building materials than particles.

**Disaster –** A sudden, unplanned event causing unacceptable damage or loss.

**Discoloration –** Any change in the apparent color of an image. Often refers to the loss of blue sky color due to air pollution.

**Disinfect –** To free materials from biological contamination.

**D'limone –** A solvent from the citrus family. D'limone combined with other chemicals is a cleaner and degreaser of smoke film. Plastics and ceramics respond positively to D'limone-based cleaning products.

**Dose-response –** The relationship between the dose of a pollutant and its effect on a biological system.

**Dry cleaning –** Any process that cleans clothing and textiles using a chemical solvent rather than water.

**Dry ice blasting –** The surface treatment equipment and process for removing soot and char with pellets of dry ice.

Education Note: Dry ice blasting uses soft dry ice, accelerated at supersonic speeds, and creates mini-explosions on the surface to lift the carbon particles off an underlying substrate. The combined impact energy dissipation and extremely rapid heat transfer between the pellet and the surface cause instantaneous sublimation (vaporization) of the solid CO2 into a gas. The gas expands to nearly 800 times the volume of the pellet in a few milliseconds in what is effectively a "micro-explosion" at the point of impact. At the point of pellet contact surface temperatures can be -109F for a fraction of a second, and within a matter of seconds, warm back to ambient temperatures.

**Dry fog –** Molecules that land on a surface but they do not moisten the surface.

Education Note: Molecules produced by a dry fogger or ultra-low volume fogging machine are less than 20 microns in size. Dry fogging machines are capable of producing larger and smaller molecules (e.g., 5-50 microns). Setting the dry fogging machine to less than 20 microns will produce a dry fog.

 

**Dry smoke –** Fire residues characterized by loose, non-smeary particles which tend to remain on a surface. Dry smoke reflects a freely burning fire with cellulosic materials as a primary fuel source.

**Dry sponge (chemical sponge) –** A surface cleaning process for the removal of dry dirt, dust, hair, smoke, soot and residue. Dry sponges are made from natural rubber, a blend of natural and synthetic rubber and sometimes cellulose materials that absorb dry particles through physical action. Even though the fire restoration industry refers to the sponge as a chemical sponge, the sponge does not contain chemicals.

**Dry sponge cleaning –** "See Cleaning, dry sponge."

**Drying chamber –** (1) A designated room at the loss that is not affected by water or smoke where wet contents are taken to dry. (2) A specially constructed room at a cleaning or storage plant where wet contents are dried. (3) When the type of damage to the structure prevents drying contents in the area of the moisture intrusion, or if contents require special handling, specialized drying chambers can be created to process contents outside the affected area (ANSI/IICRC S500 Standard, 2006).

**Duration –** (1) The length of time it took for smoke, soot and ash fallout to contaminate a building. (2) The length of time smoke, soot and ash remains on a surface to cause discoloration, oxidation and material damage.

**Dust –** (1) A general name given to tiny solid particles having a diameter of less than 20 microns. (2) Finely divided solids that become airborne from their original state without any chemical or physical change other than fracture (MSHA).

Education Note: Particles in air come from sources of dust lifted by wind currents. General indoor dust contains skin cell parts, hair, pollen, spores, textile and paper fibers, cotton lint, minerals from outdoors and many other airborne products coming from combustion.

**Ecosystem –** An area where energy, nutrients, water, and other biological and geological influences, including all living organisms, work together and influence one another.

**Eddy effect –** A circulation of air that develops during wildfire combustion of vegetation resulting in temperature and humidity changes. A turbulent wind eddy can change the wildfire's direction.

**EDS –** Energy dispersive spectroscopy. An analytical method that analyzes metallic species in diesel soot as compared to analyzing other types of soot. TEM/EDS are often used together to analysis carbon content. SEM/EDX analyzes elemental content and morphological parameters of diesel soot aggregates.

**EDX –** Energy Dispersive X-ray. In soot and char testing, usually EDX analysis follows TEM analysis. From a laboratory use prospective, the EDX instrument could be an attachment to the TEM instrument.

**Effective temperature –** The temperature where the effects of humidity and air movement produce secondary damage by saturated air or surface wetness.

**Electrical fire –** A fire originating in an electrical device or wiring. An electrical fire may become noticeable by its distinct pungent odor.

**EMC –** Equilibrium moisture content. The moisture in surrounding materials that will challenge damaged materials to again reach a state of equilibrium over time.

**Emergency repairs –** The process of providing immediate service to eliminate further damage. Emergency repairs include but are not limited to board-up, plumbing and electrical, water extraction, pack-out of key valuable or irreplaceable items in unsafe buildings, corrosion control, and removal of hazardous situations in occupied buildings.

**Emergency services –** The rapid response by specialized contractors and service personnel. A lack in immediate response (hours or a day) reduces the chance of survival, salvage and restoration of a fire or smoke damaged building and contents because of conditions continuing to cause damage.

**Emergency treatment –** Remedial action by trained fire damage restoration technicians to reduce property loss immediately after the damage.

**Enthalpy –** Heat content; a thermodynamic property of a system.

**Environmental agents –** Conditions other than indoor air contaminants that cause stress, comfort, and/or health problems (e.g., outside smoke entering the building from a fire, high temperatures and humidity, drafts, lack of air circulation).

**Environmental toxicity –** The hazardous effect that a given compound or chemical has on the environment, no matter if the environment is land, sea or air--or a building and its environment.

**EPA –** The US Environmental Protection Agency. For more information go to: http://www.epa.gov

**Equilibrium –** The balance between opposing sides.

**ERH –** Equilibrium relative humidity. The equilibrium relative humidity balance is achieved when vapor pressures within the material and the environment are equalized.

**Etching –** A pitting on the surface of some finishes, glass, metal and stone caused by chemical reaction from acid-based smoke and ash.

**Etiology –** A branch of medical science dealing with the study of all causes of disease or abnormal conditions.

**Evaporation –** The conversion of a liquid substance into a gaseous vapor state.

 

**Exhaust fan –** A fan that exhausts smoke and soot out of a building.

**Extensive damage –** "See Damage, extensive."

**Extraction, vacuum –** The partial removal of surface debris using a vacuum.

**Fading –** The natural occurrence or gradual loss of color intensity of material or finish usually due to light. Fading can occur when materials are exposed to heat, soot and acid-based residues.

**FEMA Cleanup Guidelines –** The Federal Emergency Management Agency (FEMA) provides wildfire smoke remediation guidelines in a pamphlet titled "Tips From State And FEMA On Smoke Removal And Fire Cleanup" (available on-line http://www.fema.gov/news/newsrelease.fema?id=4046). The FEMA document outlines cleaning and remediation actions homeowners should undertake following a wildfire to reduce smoke and ash contamination of their properties. The course of actions specified by FEMA includes:

- Pressure washing the exterior of the home, walks and automobiles
- Washing all interior walls and hard surfaces with mild soap or other appropriate cleaning solutions or products and rinse thoroughly; including inside cabinets, drawers and closets.
- Launder or dry clean all clothing.
- Cleaning all household items.
- Cleaning all carpets, window coverings, upholstered furniture and mattresses with steam or other appropriate equipment to clean, disinfect and deodorize.

A precaution not provided in the FEMA pamphlet is that cleaning actions should be performed in a way to minimize the re-entrainment of particles. Cleaning methods that should be avoided include vacuuming, dry dusting, sweeping, and vigorous wiping that will aerosolize smoke particulates from surfaces. In addition, cleaning of the interior of electronic components, such as computers, stereos and televisions; as well as refrigerator condenser coils and fan or other appliances that would attract particulates should also be performed (Kristen Shaw, CSC).

**Fine particles –** Particulate matter with an aerodynamic diameter of 2.5 microns or less (PM2.5). Fine particles are smaller than coarse particles and they are responsible for most atmospheric particle-induced extinction. Ambient fine particulate matter consists basically of five species: sulfates, ammonium nitrate, organics, elemental carbon, and soil dust. "See Coarse Particles; Ultra-fine Particles; PM2.5; PM10."

**Fine particulate matter –** Particulate matter with an aerodynamic diameter less than 2.5 microns (PM2.5). Since fine particles smaller than 10μm are only partly precipitated in the nose, they can be inhaled and transported to the human lungs. Hence the particle fraction PM 10 (particulate matter < 10μm) is commonly used nowadays for the definition of emission limits. "See PM2.5."

 

**Fine soil –** Particulate matter composed of pollutants from the Earth's soil, with an aerodynamic diameter less than 2.5 microns. The soil mass is calculated from chemical mass measurements of fine aluminum, fine silicon, fine calcium, fine iron, and fine titanium as well as their associated oxides.

**Fire –** the rapid oxidation of materials causing them to combust. Fire is the most common form of conflagration that causes burning.

**Fire damage cleanup** – (1) The process of removing physical material damage. (2) The process of cleaning surfaces back to a clean deodorized state.

**Fire damage demolition –** The process of removing fire damaged materials for disposal.

**Fire damage restoration –** The process of rebuilding and restoring a building and/or its contents back to a pre-loss condition.

**Fire debris –** The byproducts of burnt combusted materials.

**Fire ecology –** The study of wildland fires and their relationship to the living and nonliving environment.

**Fire point –** The lowest temperature at which a material can evolve vapors fast enough to support continuous combustion.

**Fire regime –** The role fire plays in an ecosystem. It is a function of the frequency of fire occurrence, fire intensity and the amount of fuel consumed.

**Fire residue –** Solid or viscous combustion products transported as a component of smoke which falls out or are adhered to surfaces in its path. Fire residue usually contains black carbon/soot, char and ash, other organics and chemical properties.

**Fire triangle –** An image of the three components--heat, fuel, and oxygen--that are necessary for a fire to ignite and continue burning.

**Flammable limits –** Flammables have a minimum concentration below which propagation of flame does not occur on contact with a source of ignition.

Education Note: This is known as the lower flammable explosive limit (LEL). There is also a maximum concentration of vapor or gas in air above which propagation of flame does not occur. This is known as the upper flammable explosive limit (UEL). These units are expressed in percent of gas or vapor in air by volume. For the novice, different materials have different flammable limits.

**Flammable liquid –** Any liquid having a flash point below 37.8°C (100°F), except any mixture having components with flashpoints of 100°F or higher, the total of which make up 99 percent or more of the total volume of the mixture.

**Flammable range –** The difference between the lower and upper flammable limits, expressed in terms of percentage of vapor or gas in air by volume, and is also often referred to as the "explosive range."

**Flammability –** The relative ease with which a fuel ignites and burns regardless of the quantity of the fuel.

**Flash point –** The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. Two tests are used - open cup and closed cup.

**Fly ash –** Fine solid particles of soot, ash and dust carried into the air when fuel is burnt.

**Fogging –** A restoration process involving smoke and soot odor control. In wet fogging practices the fogger broadcasts finely divided particles as a mist. In thermal fogging the fogger's solvent carrying agent is delivered as a fine mist of smoke.

**Forensic science –** The application of accepted investigation, science and engineering practices. The investigation of a fire or crime scene for determining cause and origin.

**Freeze drying –** A process that takes moist or wet contents (usually books, manuscripts and files) and places them in a freeze drying unit coupled with vacuum pressure. This process removes the moisture and by freeze drying, all or some of the smoke odor is dissipated.

**FTIR –** Fourier Transform Infrared Spectroscopy (FTIR). An analysis technique that measures absorbed light as a specific wavelength. Identifying the origin of black carbon/soot formation can help to eliminate the potential sources.

Education Note: Source identification relies upon the analysis of the chemical fingerprint of the residual hydrocarbons that are still present in the residue. These methods analyze for the presence of selected functional groups that distinguish sources such as paraffin residue from candles or fuel oil from oil heaters. For example, in the case of combustion of liquid fuels and diesel, the residue usually contains a large variety of residual hydrocarbons and inorganic components (such as iron, chromium, and nickel-containing dust) besides black carbon/soot. Combustion of candles leaves residues that contain alkanes, alkenes, wax esters, and polycyclic aromatic hydrocarbons (PAH). Therefore, the combined analysis by FTIR, GC, and the elemental composition derived by EDX mentioned above offer

 

a comprehensive picture that enables source identification. A2 Technologies just came out with the first handheld FTIR called Exoscan. (See Analysis, black carbon soot.)

**Fuel –** All burnable materials.

**Fuel load –** The amount of potentially combustible material found in an area. It is usually expressed as tons per acre.

**Fume –** Airborne particulate formed by the evaporation of solid materials, e.g. metal fume emitted during welding. Usually less than one micron in diameter.

**Gas –** A state of matter in which the material has very low density and viscosity; can expand and contract greatly in response to changes in temperature and pressure; easily diffuses into other gases; readily and uniformly distributes itself throughout any container.

Education Note: A gas can be changed to the liquid or solid state only by the combined effect of increased pressure and decreased temperature. Examples include sulfur dioxide, ozone, and carbon monoxide.

**Ghosting –** A condition usually caused by soot that represents residual pyrolyzed fuel particles.

Education Note: Ghosting can be charged soot particles that tend to cling to everything. While ghosting can be caused by wildfires, further investigation may identify underlying carbonized soot conditions from candles, lack of ventilation of wood burning fireplace, furnaces, water heaters, cigarette smoking, cooking and automobile exhaust. Hydrocarbons will seek equilibrium with their environment (Frick's Law).

**Grease fire –** Petroleum products or animal fats that combust to produce a very hot fire that creates extremely oily smoke.

**HAP –** Hazardous air pollutants (HAP).

**Hazardous waste –** Related to fire damaged buildings, the byproduct waste of combusted hazardous materials.

Education Note: The State of California Department of Toxic Substances Control determined buildings constructed before 1978 that burned in wildfires are likely to release hazardous lead-base paint; buildings constructed before 1980 that burned in wildfires are likely to release hazardous asbestos materials.

**Haze –** An atmospheric aerosol of sufficient concentration to be visible. The particles are so small that they cannot be seen individually, but are still effective in scene distortion and visual range restriction.

 

**Heat –** The release of energy from atoms through a solid or liquid by conduction and through an empty space by radiation.

**Heat damage –** Expansion and deformation caused by high heat (radiated temperatures).

**Heat line –** A distinct discoloration or a smoke line along a wall or ceiling that represent areas affected by heat. The heat line is the visible division between areas affected by heat and those that are not.

**Heat transference –** The transfer of heat that flows toward a substance of lower temperature until the temperatures of the two substances equalize, and travels by; conduction, convection or radiation.

**Heavy damage -** A term in the restoration industry that describes the amount of carbon combustion and smoke residue along with extensive physical material damage (charring or heat damage) to building materials and/or finishes.

Education Note: Heavy damage removal includes removing char, soot and smoke film on vertical walls, horizontal ceilings and floors followed by restoration and repair including a final cleaning and deodorizing process.

**Heavy damage to contents –** A term in the restoration industry that describes the amount of carbon combustion and smoke residue along with extensive physical material damage (charring or heat damage) on contents or their finish.

Education Note: Heavy damage includes heat damage and soot and smoke film on multiple sides of the content that must be individually inspected, controlled cleaned and deodorized and reevaluated for salvage or repair.

**HEPA filter –** High Efficiency Particulate Air Filter. A disposable, extended medium, dry type filter with a particle removal efficiency of no less than 99.97 percent for 0.3 micron size particles.

**HEPA vacuum –** A vacuum incorporating a HEPA filter. A HEPA vacuum is different than a regular household vacuum in that it contains a special rated filter capable of trapping very fine dust particles that are too small to see. This type of filter is called a High Efficiency Particulate Air (HEPA) filter.

Education Note: There are differences between the quality and efficiency of household HEPA shop vacuums that are less than $200.00 and commercial HEPA vacuums starting at $600.00 and going up to $4,000.00. When a homeowner completes their own vacuuming of loose soot and char particles involving a nuisance or light particle fallout situation, a household HEPA shop vacuum should be sufficient to complete particle removal. However, in more complicated cleanup situations, a commercial HEPA vacuum is required. Several abatement distributors include Aramsco, Abatix and Jon-Don.

**HEPA vacuum brush –** A horse-hair brush and supporting fabricated plastic nozzle that attaches to a HEPA vacuum hose.

 

**HEPA vacuum brush cleaning of flat building surfaces –** Fine horse-hair attachment that's capable of removing loose dust and soot particles.

Education Note: This process usually works well in removing dry non-oily soot particles in a nuisance or light soot fallout loss. In this situation the fine horse-hair attachment has physical contact with ceilings, walls and floor surfaces and soot from exposed building framing in attics.

**HEPA vacuum brush cleaning of upholstery –** The use of a long (1-2 inch) horse-hair brush attached to a HEPA vacuum that removes loose soot particles.

Education Note: In this instance the HEPA vacuum brush cleaning process is poorly named. Meaning, the goal in HEPA vacuuming sensitive materials (upholstery and other fine finishes) is to use high vacuum pressure to remove loose soot particles. In this situation the brush is just a protector for the surface. When surface contact is unavoidable the soft horse-hair brush reduces the chance scratching and damaging materials will occur or smearing soot causing it to imbed deeper into the fabric.

**HEPA vacuum cleaning process –** The systematic cleaning of soot particle fallout in a building. Each soot particle cleanup loss will be different. In other words, there are no two soot and char particle cleanup losses that will be exactly the same.

Education Note: With some deviation, the recommended guidelines for cleaning soot particles through HEPA vacuuming tend to fall into a pattern: (a) Assess the extent of soot fallout in buildings; (b) seal-off all openings; (c) change building filters with pleated filters when the HVAC system must remain operational; (d) HEPA vacuum soot off of floors were foot traffic can grind in soot and contribute to cross-contamination; (e) in nuisance and light soot fallout situations, HEPA vacuum loose soot off of all horizontal surfaces; (f) in medium, heavy and extensive soot fallout situations, the first cleaning involves HEPA vacuuming loose soot off of all surfaces beginning with the ceiling, then walls and windows, and then flooring.

**Heightened awareness –** After a fire, a tendency by some persons to perceive one's surroundings with greater scrutiny, often mistaking long-standing conditions for new damage; perceiving smoke odor is still present after cleaning when it may not actually be there.

**Hidden damage –** Damage that is not readily noticeable to the naked eye. Examples include heat damage or smoke and soot damage that is not noticeable until exploratory investigation discloses the damage.

**High volume sampler –** A particle collection device placed in ambient air to collect outdoor air samples and indoor air to show particulate differences or variance in types of particle size and distribution, and genus and species when biological substances are collected in a media.

**Historic dust –** Indoor dust that settles over time to represent common dust deposits in a building.

 

Education Note: Why historic dust is important in wildfire soot contamination situations, is when some persons claim their building experienced extensive soot fallout in almost all rooms. When an environmental professional is hired to identify soot in a building that is constantly cleaned, sampling historical dust (above ledges, cabinets, behind furniture) may provide valuable information that confirms or denies the merits of the claim.

**Hot fire –** A term in the fire damage restoration industry that describes extremely hot heat (usually above 1,500F) that leaves very little non-combusted materials behind. In other words, hot fires consume materials rapidly leaving behind ash as the remnant of its complete combustion.

**Hot oily residue -** Chemicals in smoke and soot that rapidly cool on the surface creating an almost baked-on like finish.

**Hot fogging –** A process of using thermal fogging and heated solvents to produce a hot fog.

**Hot water extraction –** A surface cleaning process in which heated detergent solutions are sprayed directly on a contaminated material followed by the simultaneous extraction that carries off dissolved particles and residues.

**Household dust –** Indoor contaminates including dead skin from humans and pets, finely ground plant and insect parts, minute particles of sand and soil, cotton and synthetic fabric fibers from clothes, carpets, and upholstery.

Education Note: Dust typically accumulates in carpets, on horizontal surfaces, computer and TV screens, and sometimes clumps into dirt-balls of fabric fibers, also known as "dust bunnies." Daily activities can stir up dust into the air. Like other allergens, dust can trigger allergic reactions to people who are sensitive where this condition can lead to sneezing, runny nose, and itchy-watering eyes.

**Humidity –** The moisture (water vapor) content of the air. An increase in air moisture is referred to as an increase in humidity.

**Humidity monitoring –** The organized observation and recording of ambient temperature and humidity during the cleanup and removal of soot and ash.

Education Note: Keeping indoor humidity below 40% provides a better environment that can be cleaned easier because loose soot and ash particles remain dry reducing the opportunity for them to smear or agglomerate.

**Hydrocarbons –** Compounds containing only hydrogen and carbon gaseous byproducts. Examples include methane, benzene, decane, etc.

**Hydrolyze –** To break a molecule apart using acids and hydroxyl ions from water.

 

**Hydrophobic –** Lacking affinity for water, or failing to adsorb or absorb water.

**Hydroxyl deodorization –** A chemical compound in the form of a gas produced by a machine to provide odor control and deodorization of organics such as volatile organic compounds. VOC's include smoke odor that can be controlled or abated by hydroxyl deodorization.

**Hygroscopic –** Readily absorbing moisture such as from the atmosphere.

**IAQ –** Indoor air quality. The condition of the ambient air within a building. In maintaining good IAQ the indoor air is to remain free of harmful pollutants that can cause irritation or illness.

**IAQA –** The American Indoor Air Quality Association (IAQA). A nationally recognized organization that tests and certifies technicians and indoor environmental professionals. For more information go to: www.IAQA.org

**Ignition –** The initiation of combustion.

**IICRC –** The Institute of Inspection, Cleaning and Restoration Certification (IICRC). The IICRC trains and certifies technicians in water damage restoration, microbial remediation, fire damage remediation and many other specialized areas. For more information go to: www.IICRC.org

**Impingement –** The ability of smoke odors and vapors in a gaseous state to embed them self into porous materials through the force of high vapor pressure transfer and mass heat. Impinging airborne smoke odors and impinged drywall occurs with heat transference that can lock-in odors once surfaces cool.

Education Note: What sometimes occurs, high velocity heated airflow that is directed towards or perpendicular to the material surface, causes heated air and smoke molecules to "impinge." Impingement may cause a surface to harden or crust as pores and cells fill with smoke and soot or close up because of heat and the removal of moisture. It is not unusual for a finish to blister or break apart.

**Incomplete combustion –** A combustion process that does not convert all of the fuel's carbon components and hydrogen into carbon dioxide and water. Smoke is formed during incomplete combustion (EPA). Incomplete combustion involves the generation of carbon monoxide and other chemicals including PAHs.

**Indoor environmental professional (IEP) –** A person by education, field training and certification that is qualified and competent to conduct environmental investigations in damaged and contaminated buildings. When state or federal regulations apply the IEP may need to be state licensed in the assessment and testing of asbestos and lead-base paint.

**Industrial hygienist (IH) –** A person qualified by education and field training and has the experience to anticipate, recognize, evaluate, and develop controls for occupational settings.

**Industrial hygienist, certified (CIH) –** A person qualified by degree and field training and experience to anticipate, recognize, evaluate, and develop controls for occupational settings.

**Infiltration –** A term used in restoration when outside air leaks into a home or building through the cracks, fissures and holes in windows and walls. The differential between the indoor conditions against the outside pressure conditions causes these seepages to occur.

**Ignition source –** Anything that provides heat, spark or flame sufficient to cause combustion/explosion.

**Ignition temperature –** The minimum temperature to initiate or cause self-sustained combustion in the absence of any source of ignition.

**Incompatible –** Materials which could cause dangerous reactions from direct contact with one another.

**Inhalable particulate matter –** Particles smaller than about 12 micrometers in diameter, capable of being drawn into the human bronchial system. Larger particles tend to be filtered out in the upper respiratory tract.

**Integrated sampling –** An air sampling device that allows estimation of air quality components device over a period of time (e.g., 24 hours to two weeks) through laboratory analysis of the sampler's medium.

**In-plant cleaning –** "See Cleaning, in-plant."

**Inventory –** An item by item listing of a group of articles or contents.

**Inventory assessment –** The planning and development stage for the inventory of items and materials.

**Irritant –** A substance known to cause discomfort or an unhealthy physical response.

**JHA –** Job hazard analysis. An OSHA requirement to be completed any time a hazard or hazardous situation is likely or imminent.

**Kalamein door –** A fire door sheeted with metal plate.

**Laboratory (Soot, Ash, Char and Smoke) Analysis –** The analysis it takes to prove a hypothesis involving particulate matter and smoke affecting buildings, contents and the indoor environment.

 

Education Note: There are no standards for analysis so that different qualified labs may have various methodologies for analysis, resulting in different findings for the same samples. Soot, or carbon black particle assessment is based on a visual assessment of morphology.

Carbon black particles resulting from combustion are irregularly shaped. [Laboratory] identification of combustion by-product soot particles in a field of hundreds or thousands of irregularly shaped particles requires extensive experience in particle identification. Unburned wood or biomass particulates distributed in smoke have none of the characteristics of carbon black and are not identified in TEM analysis.

Particles of metal oxides may appear the same as carbon black. Particles considered to be carbon black can be additionally assessed by energy-dispersive x-ray spectrometry (EDX). However, confirmation by EDX requires nearly pure carbon residue, so that fragments of hydrocarbons and unburned portions of biomass that retain hydrogen and oxygen atoms may not be confirmed as carbon black or by-products of combustion.

Other types of laboratory analysis for combustion by-products are available, such as Gas Chromatography Flame Ionization Detector (GC FID), for identification of fuel products, specifically diesel fuels. Data to identify combustion by-products in settled wildfire smoke particulates is not available in commercial analytical laboratories.

Research laboratories that study wildfire smoke have the technology and the methodology for quantifying samples that are properly collected. However, most research laboratories study airborne smoke, not settled smoke particles. The cost for the analysis is usually prohibitively expensive. So, as indoor air quality professionals, what can we recommend to homeowners, property managers and school administrators in communities impacted by wildfire smoke? (Kristen Shaw, CSC).

**Lead-based paint –** Films and coatings (paint) that contain lead. Lead-based paint levels are those that have 1.0 milligrams per square centimeter (mg/cm2) which is the same as 0.5 percent by weight, 600ppm in household paint, 5000*u*g/g, 5000 mg/kg (EPA).

**Light damage –** A term in the restoration industry that describes the amount of carbon combustion and smoke residue. Light damage of soot and smoke film usually responds to HEPA vacuuming and general cleaning.

**Light damage to contents –** A term in the restoration industry that describes the amount of carbon combustion and smoke residue on contents. Light damage of soot and smoke film is usually found on horizontal surfaces only; they usually respond to HEPA vacuuming and general cleaning.

**Loss assessment –** The visual assessment and testing process that identifies the extent of building damage and contamination including the presence of regulated waste such as asbestos and lead-based paint.

 

**Loss inspection –** The visual inspection process that identifies and estimates the amount of building damage and the recommended procedures for removing it.

**Loss mitigation –** (1) The processes required to stop further damage from occurring. (2) The removal of damaged materials including regulated waste.

**Loss of use –** A provision in a homeowner and tenant (renters) policy that reimburses them for the additional living expenses (ALE) such as housing and food, because they had to live elsewhere while the property is being restored following a disaster.

**Masking –** The temporary obstruction of an odor. Masking with chemical sprays and sealers cover up odors where they can reappear later.

**Medium damage –** "See Moderate damage."

**Medium Contamination –** The term used to categorize what industry says is an average amount of smoke and soot deposits as compared to light and heavy smoke and soot deposits.

**Megasonic cleaning –** A cleaning technique utilizing sound waves at frequencies higher than those for ultrasonic cleaning systems, from 500 kHz to 2 MHz.

**Micron –** A unit of length equal to one millionth of a meter; the unit of measure for wavelength.

**Mists –** Suspended liquid droplets generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state, such as by splashing, foaming, or atomizing. Mist is formed when a finely divided liquid is suspended in air.

**Mobilization costs –** The hard costs a contractor has to spend before they begin work.

Education Note: In large-loss fires and wildfire damage situations, mobilization costs often include setting up a command post (motorhome) at the jobsite so that the building owner, tenants, adjusters, police, fire marshal, project supervisors and technicians have a safe place to meet, rest, eat and receive first aid. Mobilization costs also include bringing in generators and gas to run generators because building or community power is out, dumpsters for debris removal for burnt trees and brush and the building's charred wood, moving trucks to move contents out of the building.

**Moderate damage –** A term in the restoration industry that describes the amount of carbon combustion and smoke residue along with some physical material damage (charring or heat damage) to building materials and/or finishes. Moderate damage includes soot and smoke film on vertical walls, horizontal ceilings and floors that must be cleaned and deodorized.

 

**Moderate damage to contents –** A term in the restoration industry that describes the amount of carbon combustion and smoke residue along with some physical material damage (charring or heat damage) on contents or their finish. Moderate damage includes soot and smoke film on more than one side of the content that must be individually inspected, cleaned and deodorized.

**Morphology –** The form, shape, or structure of a surface, object or organism.

**Natural conditions –** Atmospheric conditions that is acceptable to the majority of persons.

**Negative air pressure –** Air pressure in a building or space that moves from high to low. In a heated building air pressures are high, pushing out to ceilings, walls and floors that have cooler lower air pressure spaces that also attract smoke and soot.

**Negative air machine (NAM) –** A machine that produces negative air pressure between one space and another.

**Neutralization –** In fire damage restoration neutralization is the removal of smoke odors.

**NIOSH –** The National Institute for Occupational Safety and Health. NIOSH is part of CDC through the Department of Health and Human Services. NIOSH is responsible for conducting research and making recommendations for the prevention of work-related illness and injuries. For more information go to: http://www.cdc.gov/niosh

**$NO_x$ – Nitrogen oxides.** The generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts [such as nitric oxide (NO) and nitrogen dioxide ($NO_2$)].

Education Note: Many of the nitrogen oxides are colorless and odorless. However, one common pollutant, nitrogen dioxide ($NO_2$) along with particles in the air can often be seen as a reddish-brown layer over many urban areas. Nitrogen oxides form when fuel is burned in a wildfire. However, the daily primary sources of $NO_x$ are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels (USEPA). The term nitrogen oxides and oxides of nitrogen may be used interchangeably.

**Non-combustible –** (1) Materials made of cement, steel and fire retardant substances that will not ignite when subject to fire. (2) Materials that meet statutory requirements for ignition and flame spread.

**Nucleation –** In the context of air pollution caused by wildfires, nucleation is the first step of the process by which gases are converted to small liquid droplets (ultrafine particles). This occurs either when certain gases condensate or when different gases react with each other. The ultrafine particles formed are called "nuclei" and can grow in size when more gases condensate on them or when several droplets merge.

 

**Nuisance dust –** Dust that has a long history of little adverse effect on the lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control.

**Nuisance soot and ash –** Soot and ash that has no known adverse effect on the lungs and does not produce significant organic disease or toxic effect when exposures are kept under reasonable control.

**Odor –** (1) A description of the sense of smell of a substance. (2) A scent that affects the olfactory system (sense of smell). Odors can be pleasant, offensive, and/or disagreeable.

**Odor counteractant –** Any substance that mitigates odors.

**Odor pockets –** Cavities, cracks, air spaces and voids in or behind a material that allows a fire odor to remain.

**Oily fire –** A term in the restoration industry describing a furnace oil fire; a fire having a lot of combusted plastics, urethanes, resins and polymers including carpets, finished hardwood floors, vinyl flooring, vinyl wallpaper, oil-based paint.

**Oily smoke film –** A film on a surface consisting of an oily carbon-based residue. Besides having a yellow, brown or black carbon film color, oily films can vary somewhat based on its physical properties including viscosity and thickness. Traction and friction are the other physical measurements for determining oily film. In environmental science, scraping oily film can be collected and sent to a lab for GC/MS analysis to identify VOCs and PAHs.

**On-location –** The process of cleaning and deodorizing contents at the space they were found.

**Open item –** A service or item listed in the estimate for which the cleanup or restoration procedure or cost cannot be determined without further inspection, exploratory inspection and testing, or investigation through sample cleaning and testing. Open items do not include hidden damage or contamination that could not have been anticipated.

**Organic carbon –** Aerosols composed of organic compounds, which may result from emissions from incomplete combustion processes, solvent evaporation followed by atmospheric condensation, or the oxidation of vegetation that cause emissions of smoke, soot and ash and chemical byproducts.

**Organic compounds –** Chemicals that contain the element carbon.

**Organic matter –** Carbon-containing plant and animal residues that can burn in a fire.

 

**Organic vapors –** Organic compounds that become aerosolized as a gas with changes of vapor pressure and heat. Organic vapors include new car smells to vapors that are not easily detected by smell such as formaldehyde. In wildfires organic vapors can consist of a wide variety of volatile organic compounds (VOCs) that are attached to incomplete combusted particles and smoke film.

**Oxidation –** The process of removing hydrogen atoms or electrons from a compound or the addition of oxygen atoms to create oxides. This process applies to metals (ex: iron converts to rust or iron oxide), nonmetals (ex: sulfur is converted to sulfur oxide), and organic matter (ex: carbon is converted carbon oxide; hydrogen is converted to hydrogen oxide).

**Ozone –** ($O_3$) a photochemical oxidant and a major component of smog. Ozone is a form of oxygen having three molecules, an oxidizing agent with a weak chlorine odor, produced naturally through sun light and lightning or by a machine.

**Ozone generator –** In fire damage remediation and smoke odor control, a type of mechanically generated ozone used to destroy fire-caused odors.

**Pack-in (pack-back) –** The return of contents after processing or on completion of building restoration.

**Pack-out –** (1) The documentation of damaged or contaminated items and contents followed by inventory, wrapping, boxing and removal. (2) The packing and transportation of contents to a cleaning and restoration plant for processing (cleaning and deodorization; damage assessment and repair).

**PAH –** Polycyclic aromatic hydrocarbon. A group of over 100 different organic compounds composed of several benzene rings. Some PAHs are persistent and carcinogenic.

Education Note: PAHs are commonly formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are commonly found in wildfire smoke.

**PAH in soot –** PAHs in soot are known as mutagens and a probable human carcinogen. They are classified as "known human carcinogen" by the International Agency for Research on Cancer (IARC).

**Paring –** The use of one substance to neutralize another. Paring agents are chemicals that bind with and remove (neutralize) aerosolized VOCs (chemicals that make up a smoke odor); odors at their source.

**Particles, partially decomposed organic –** Brown/amber remains from partially decomposed vegetation which has not been combusted. By PLM most particles appear brown/amber, thicker particles can be dark brown to opaque (*Wildfire Particulate in Proximally Located, Unburnt Buildings.* ACGIH: Spring 2011 Technical Conference).

**Particulate matter –** A suspension of fine solid or liquid particles in air, such as dust, fog, fume, mist, smoke or sprays.

Education Note: Particulate matter suspended in air is commonly known as an aerosol. Particulate matter or an agglomeration of matter in a wildfire cleanup situation has an observable length and width of 40 microns or above.

**Particulate matter –** Another component of smoke, categorized as particulate matter, can be composed of any of the combustion by-products, including PAHs, organic debris and inorganic residues. Numerous air pollution studies have shown that small increases in the concentrations of particulate matter are associated with notable increases in respiratory and cardiovascular disease mortality. The association between increased respirable particulate matter and childhood asthma and other respiratory diseases is also well established.

Education Note: Particulate matter small enough to be inhaled is segregated by size: particles up to 10 micrometers (µm) in diameter ($PM_{10}$), which the EPA considers "inhalable coarse particles"; and particles smaller than 2.5 µm in diameter ($PM_{2.5}$), called "fine particulates." If inhaled, the larger $PM_{10}$ deposit in the upper respiratory tract, while smaller $PM_{2.5}$ travel deeper into the lungs and generally are retained within the lungs.

The EPA National Ambient Air Quality Standards (NAAQS) for particulate matter was first issued in 1971, and then revised in 1987 and 1997. In September 2006, the EPA again tightened the PM standards. The revised 2006 standards tighten the 24-hour fine particle standard from 65 micrograms per cubic meter ($\mu g/m^3$) to 35 $\mu g/m^3$, and retained the current annual fine particle standard at 15 $\mu g/m^3$.

Particulate matter is also categorized as "ultra fine particles." Fine particles are less than 2.5 µm in diameter, while ultra fine particles are only 0.15 to 0.4 µm in diameter. (By comparison the period at the end of this sentence is about 500 µm in diameter.) Most ultra fine particles are too small to be removed by HEPA filters, which can remove 99 percent of filtered particles that are larger than 0.3 µm in diameter. The majority of particulate matter produced in a wildfire is in the ultra fine particle size range.

The majority of wildfire smoke particulates are in the fine particulate category. These wildfire smoke respirable particulates can contain organic materials that may have significant long-term health effects, such as PAHs, aldehydes, VOCs and organic acids. The toxicity of particulates retained in the lungs varies with chemical composition. Chemical changes of smoke particulates may occur in the form of chemical reactions with other aerosols. Particles may stick together or break apart, changing the size distribution over time.

Research has confirmed that fine particles outdoors will infiltrate indoors, even with all of the windows and doors closed. Some studies have found that as much as 70 to 100 percent of the fine particles outdoors will infiltrate indoors. Many commercial buildings and schools mechanically draw outdoor air into the buildings. Usually, the outdoor air is filtered before it is supplied to the occupants. However, standard HVAC air filters will not remove most of the ultra fine wildfire smoke particles. Also, many schools that rely on portable buildings for classrooms bring in outdoor air by installing

 

continuous exhaust fans. Unfiltered outdoor air is brought indoors by keeping the classrooms under negative pressure.

When heavy concentrations of tiny wildfire smoke particles enter a home, school or other building, the particles can eventually settle out of the air to deposit on horizontal surfaces, or plate out on vertical surfaces, penetrate upholstery, drapes, and insulation; or electrostatically adhere to electronic components or other charged surfaces, as well as impact on surfaces in the path of air currents. Settled respirable particulate matter can be re-entrained into the air by even small disturbances.

Research shows that large wildfires produce in excess of 36 tons of particulate matter per minute, which is 2,160 tons of particulate matter per hour. Under some conditions, wildfires can produce 30 times that amount of particulate matter (Kirsten Shaw, CSC).

**Peeling –** The release of paint and varnish from surfaces before wood becomes scorched. Finishes release (unbind) from their surface or substrate when heated. This condition can be a result of radiant heat drying moisture out of a substrate.

**PEL –** Permissible exposure limit. The maximum amount or concentration of a chemical that a worker may be exposed to under OSHA regulations.

**Perceptible –** Capable of being seen.

**Peril –** A specific risk or cause of loss covered by an insurance policy such as a fire or windstorm.

**Period of restoration –** The period of time in which insurance coverage is in effect beginning when the damage occurs and ending when operation or property damages are fully restored and recovered.

**Personal property –** Things that are moveable and not attached to the land. Damage to personal property may be covered under the owner's building insurance, a separate policy or rider.

**Personal protective equipment (PPE) –** Devices worn by the worker to protect against hazards in the environment. Respirators, gloves, coveralls, boots and hearing protectors are examples.

**pH –** The measure of acidity or alkalinity of a substance. This is measured against a scale of 0 to 14 where 7 is the neutral point.

Education Note: Acids have a pH less than 7 while alkaline have pH greater than 7. pH measures the concentration of hydrogen ions in a solution. Acids have high hydrogen ion contents while a solution with low concentrations are called alkaline or base.

**Phosphoric acid –** An acid commonly used to remove smoke film and soot from hard surfaces. Phosphoric acid cleaners can be applied on fiberglass tub and shower enclosures, light fixtures and crystal (with immediate rinsing), ceramic tile, grout, aluminum windows and door frames; clay and concrete blocks, brick, stone and mortar.

 

**Photosynthesis –** The process by which green plants convert solar energy into chemical energy in the form of organic (carbon-containing) molecules, releasing oxygen as a by-product; 6 $CO_2$ + 6 $H_2O$ + sunlight ------> $C_6H_{12}O_6$ + 6 $O_2$.

**PIC –** Particles of incomplete combustion. The generated waste produced during a fire from ignited materials.

**Plastic fire –** A type of fire caused by combustion of plastic products that produces hydrogen chloride gases which are highly corrosive.

**PM 1 –** Measure of particulate matter (pollutants from combustion and natural sources); denotes particles smaller than 1 micrometer in diameter and particles that are submicron.

Education Note: As shown in some investigations, the main fraction of the particulate matter in burnt combusted materials can be smaller than 1µm. As a consequence, most PM 2.5 investigations also focus on PM 1 and submicron particles.

**PM 2.5 –** Measure of particulate matter (pollutants from combustion and natural sources); denotes particles smaller than 2.5 micrometers in diameter. "See Fine particles; Fine particulate matter."

**PM 10 –** Measure of particulate matter (pollutants from combustion and natural sources); denotes particles with a nominal size less than 10 micrometers in diameter.

Education Note: The number indicates the aerodynamic particle diameter in micrometers (µm) according to a separation efficiency of 50 % in the sampling system. Further PM 2.5 and PM 1 are also used. Beside this, the *total suspended particulate matter (TSP)* was used earlier. This particle fraction is defined as fine particulate matter with a setting velocity of less than 10cm/s (Dockery, D.W. & Pope, C.A. *Acute Respiratory Effects of Particulate Air Pollution*.)

**Porosity –** The state of being porous. A measure of how porous a material is - is based on the ratio of the volume of pores to the total volume of the material.

**Post conditions –** After cleaning, deodorization and restoration, the absence of smoke, soot and gasses.

**Potash –** The potassium carbonate derived from wood ash.

**Potassium permanganate –** A chemical ($KMnO_4$) capable of capturing odor molecules in air or combined as a poultice to remove adsorbed odor molecules in a material.

Education Note: Potassium permanganate is highly reactive under high moisture content conditions. It will oxidize a wide variety of inorganic and organic substances. Potassium permanganate (Mn 7+) is reduced to manganese dioxide ($MnO_2$) (Mn 4+) which precipitates out of solution. All reactions are exothermic. Potassium permanganate is only supplied in dry form.

**PowerClaim –** An insurance estimating software program that calculates labor and material costs, demolition and cleanup, repair and restoration costs. For more information go to: http://www.powerclaim.com

**ppb –** Parts per billion (1 in 10^9).

**ppm –** Parts per million (1 in 10^6).

**ppm –** Parts per trillion (1 in 10^12).

**Precursor –** A substance or condition whose presence generally precedes the formation of another, more notable, condition or substance.

**Pre-loss condition –** The appearance and state of repair which existed prior to the loss.

**Pressuring washing –** The use of water under pressure along with detergents to remove surface contamination such as smoke, soot and ash and oily residues. In wildfire smoke cleanup situations hot water pressure washing (200F to 300F) works best.

**Pressure washing, high –** Pressure washing systems using high pressure water at 500 psi or greater.

**Pressure washing, low –** Pressure washing systems using low pressure water between 40-100 psi.

**Pressure washing, medium –** Pressure washing systems using medium pressure water between 100 to 500 psi.

**Pressurized smoke –** (1) Combustion products propelled by high heat, temperature differential, or vapor pressure which causes them to penetrate normally enclosed spaces. (2) Smoke and gases that increased in size due to heat which cause moving particles to penetrate porous materials and small spaces.

**Prevention of Significant Deterioration (PSD) –** A program developed onsite to reduce fire, smoke, acid corrosion and other forms of control that limits further damage to property.

**Primary & Secondary particles –** "Primary particles" are directly released into the atmosphere by the wildfire combustion processes and turbulent wind. "Secondary particles" are those that form in the atmosphere from other gaseous pollutants from incomplete combustion; particularly sulfur dioxide, nitrogen oxides, ammonia, and volatile organic compounds.

**Primary damage –** (1) Damage to a building and contents as a result of direct contact with the cause such as a wildfire or building fire. (2) Damage caused by the immediate, direct impact of a peril, as opposed to secondary damage which occurs over time.

 

**Primary particles –** Primary particles are suspended in the atmosphere as particles from the time of emission, e. g., dust and soot.

**Protein fire –** The slow combustion or carbonization of animal fat (e.g., beef, poultry, fish) during a fire. Combustion decomposition produces a clear fine mist that is often invisible, but having an obnoxious and persistent odor.

Education Note: Protein odor is capable of penetrating the smallest of pores and spaces. Protein fires can be an isolated fire such as an over where a turkey is charred. In this instance there is no other visible damage besides a strong smell. Protein fires can produce a clear color residue having a baked-on finish. This strong finish requires a lot of scrubbing and degreasing to clean walls, cabinets and floors. Even when surfaces are at their cleanest, some odors will not have gone away because they penetrated cracks and pores of surrounding materials.

**Pyrolysis –** The second stage of ignition during which energy causes gas molecules given off by a heated solid fuel to vibrate and break into pieces. Education Note: Pyrolysis is the chemical decomposition of a condensed substance by heating. It does not involve reactions with oxygen or any other reagents but can take place in their presence. Pyrolysis is a special case of thermolysis, and is most commonly used for organic materials; extreme pyrolysis, which leaves only carbon as the residue, is called carbonization and is related to the chemical process of charring.

**Pyrophoric –** A chemical that will spontaneously ignite in air at a temperature of 130F (54.5C).

**Pyrophytes –** Species of fire-loving plants that must be subjected to fire to complete a part of their life cycle.

**Pyrolyzed –** A chemical process in which a compound is converted to one or more products by heat.

**Puff-back –** An uncontrolled discharge of soot from a clogged or malfunctioning heating system. A puff-back results in fine particles of soot that will deposit throughout a building.

**Radiant (radiant heat) –** The transfer of heat energy by rays such as the sun or a heat source. Heat is not considered present until the energy strikes and is absorbed by an object.

**Radiant heat transfer –** Heat that occurs when there is a large difference between the temperatures of two surfaces that are exposed to each other, but are not touching.

**Re-entrainment –** Situations that occur when the air being exhausted from a building is allowed to be brought back into the building through air intakes, windows and other openings.

**Re-entrainment of smoke and soot –** Situations where the building was just or recently cleaned, and smoke and soot outside is allowed to reenter the cleaned space.

**Relative humidity –** (1) The relationship between air volume and the amount of moisture it holds at a specific temperature expressed as a percentage of that air's total moisture holding capacity. (2) The ratio of the actual vapor density (which indicates the amount of water vapor present in the air) to the theoretical maximum (saturation) vapor density at the same temperature, expressed as a percentage. This may be expressed as: $U = 100\ e/e´w$ where *e* is actual vapor pressure and e´w saturation vapor pressure with respect to water at the same temperature.

**Remediation –** To correct or counteract; to remedy.

**Remove and reset –** (1) The manipulation by means of picking up an item and moving it to another space. (2) The detaching of an item such as a toilet and reinstalling it at a later time.

**Repair –** The fixing or restoration of an item or material.

**Replacement cost –** Based on calculation, the method of computing the fair value of an item insured at today's cost. (1) Replacement cost is not market value, but is instead the cost to replace an item or structure at its pre-loss condition. (2) The cost of replacing property without a reduction for depreciation. By this method of determining value, damages for a claim would be the amount needed to replace the property using new materials.

**Residue –** (1) The remnants of smoke, soot, gases after combustion. (2) The remnant of smoke, soot and ash left on a surface after cleaning.

**Respirable particles –** Airborne particles of combustion products, dust and pollen.

Education Note: Health effects from exposure to respirable-size particles in the air depend on the types and concentrations of particles present, the frequency and duration of exposure, and individual sensitivity. Health effects can range from irritation of the eyes and/or respiratory tissues to more serious effects, such as cancer and decreased lung function. Biological particles such as animal and insect allergens, viruses, bacteria, and molds, can cause allergic reactions or infectious diseases (Public Health, North Carolina)

**Respirable particles PM10 –** Airborne particles having an aerodynamic diameter <= 10 microns. Particles < 5 microns in size can penetrate into the lower respiratory tract.

**Respirable particles PM2.5 –** Airborne particles that penetrate deep into lungs. Particles having an aerodynamic diameter <=2.5 microns. PM2.5 particles settle slowly out of air because they are so light and any form of air movement keeps them airborne (e.g., several hours to several days). Wildfire soot particles can cover hundreds of miles such as from Los Angeles to Las Vegas.

**Respirable size particulates –** Particulates in the size range that permits them to penetrate deep into the lungs upon inhalation.

 

**Respirator, approved –** A device which has met the requirements of 30 CFR Part 11 and is designed to protect the wearer from inhalation of harmful atmospheres and has been approved by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA).

**Respiratory protection –** The means by which humans are protected from inhaling harmful particles, vapors and gases. Devices worn that are expected to protect persons from exposure or overexposure to harmful airborne pollutants and gases.

**Respiratory protection factor –** The assigned protection factor given to types of respirators. For more information go to http://www.osha.gov/Publications/3352-APF-respirators.pdf and http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-appa.html

**Respiratory protection program –** The standard set by government that protects workers in the workplace from harmful airborne substances. In the US, contractors must provide workers with a respiratory protection program based on federal codes of regulations (CFRs) mainly CFR 1910.134.

**Restoration (restore) –** The process of bringing a damaged or contaminated building and/or contents back to their pre-loss condition and appearance.

**Restoration techniques –** Methods used in rebuilding buildings and structures with historically accurate materials to achieve historical authenticity in keeping with a particular time period or event. The term should be distinguished from preservation techniques on the basis of the difference in meaning between restoration and preservation, which is a matter of degree. While both seek to achieve historical accuracy, preservation does not imply rebuilding.

Education Note: Restoration Techniques should also be distinguished from conservation technology, a distinction having to do with the range of reference present in each term. While restoration can include buildings, in U.S. usage the term conservation cannot.

**Restorative cleaning –** The application of procedures for removing smoke, soot and ash on contents and building materials.

**Restorative drying –** The process of removing moisture from wet building materials and bringing them back to their dry equilibrium moisture content.

**Retardant –** Any substance that slows or blocks a fire or an odor.

**RIA –** The Restoration Industry Association. RIA maintains programs to train and certify fire damage restoration firms and technicians. One program is called the Certified Restorer (CR) that focuses on damage repair. For more information on RIA go to: http://www.ascr.org

 

**Rust –** (1) The reaction of iron and oxygen in the presence of water or moisture. (2) The reaction between iron and harmful chemicals.

**Rust control inhibitor –** A product like LPS-3 that forms a transparent film on a surface to inhibit corrosion. Other products of consideration include Rust-Oleum and CRC inhibitor sprays.

**Rusting –** The common generic term for corrosion caused by the oxidation of metals and alloys.

**Salvage –** The recovery of damaged building components and contents.

**Sanding –** The debriding of a surface by abrasion. "See dry ice blasting; soda blasting"

**Santa Ana wind phenomenon –** The type of wind near a large body of water and desert that is close to mountains. The Santa Ana wind phenomenon is a type of drainage wind coming off a mountain or hillside where cooler offshore winds build up under the hotter air mass increasing air pressure.

Education Note: As air becomes compressed it causes the air mass to warm and dry. High winds and low humidity help dry out vegetation that makes the wildfire more flammable.

**Scope of work –** The written document that outlines the steps of cleanup, remediation and restoration.

**Sealants –** Viscous materials that change from their liquid state to become a solid as it dries. Sealants are used to seal soot in a ventilation system or lock-down soot on building framing. "See soot set."

**Secondary aerosols –** Aerosol formed by the interaction of two or more gas molecules and/or primary aerosols.

**Secondary particles –** Particles form in the atmosphere by a gas-to-particle conversion process.

**Sensitizer –** A substance that may cause no type of health reaction in a person during the initial exposure, but afterwards, further exposures will cause an allergenic response to the substance.

**Settling rate –** The rate in time that smoke, soot and ash settles out of air onto a surface. When wind throughout the community is still, large char particles of incomplete combustion settle out of air first followed by ash, then finer soot particles in the PM10 range and harmful micro-fine respirable particles below the PM 2.5 range.

Education Note: When gusts of wind or wildfire wind are present the settling rate formula outline above is no longer accurate or reliable. The presence of wind causes soot and ash to be continuous where the settling velocity has too many variables.

**Shading –** In fire damage restoration, shading is the presence of an oily film (usually from a fire damage or smoke contamination) that causes a gradual color change across a surface over time.

**Simsol –** An insurance estimating software program that calculates labor and material costs, demolition and cleanup, repair and restoration costs. For more information go to: http://www.simsol.com

**Smoke –** The incomplete combustion of carbonaceous materials in a wildfire including trees and chaparral vegetation. (1) Smoke consists of very small organic particles of carbon, oily tar-like substances, liquid droplets, and gases such as CO, $CO_2$, VOCs and PAHs, such as benzene, aldehydes (including formaldehyde) and acrolein. (2) The individual compounds present in smoke number in the thousands. Smoke composition depends on multiple factors, including the fuel type and moisture content, the fire temperature, wind conditions and other weather-related influences, whether the smoke is fresh or "aged," and other variables. (3) Different types of wood and vegetation are composed of varying amounts of cellulose, lignin, tannins and other polyphenols, oils, fats, resins, waxes, and starches, which produce different compounds when burned (Wildfire Smoke: A Guide for Public Health Officials, 2008).

**Smoke –** A complex mixture of particles, liquids and gaseous compounds, including polynuclear aromatic hydrocarbons (PAHs), organic acids, particulate matter (PM), semi-volatile and volatile organic compounds (VOCs) and the inorganic fraction of particles.

Education Note: The types of particles, liquids and gaseous compounds released in smoke depend on the fuel type and the amount of fuel, among other factors. The fuel for a house fire or structure fire includes all of the items burned in the building: carpet, carpet pad, paint, electronics, linens, clothing, synthetics, polymers, etc. The fuel for a wildfire is primarily plant material such as wood from trees and shrubs, as well as grasses (Kirsten Shaw, CSC).

**Smoke, acid –** Fire residues characterized by acidity that is capable of damaging, corroding and discoloring materials and finishes.

**Smoke and airborne particulates –** The compounds present in soot in the form of particulates. Particulate matter is the principal pollutant of concern from wildfire smoke for the relatively short-term exposures (hours to weeks) typically experienced by the public. Particulate matter is a generic term for particles suspended in the air, typically as a mixture of both solid particles and liquid droplets.

**Smoke and fume size –** The size of smoke and fume particles suspended in air. (1) According to journals of science, smoke and fume suspended in air can range from 0.001 to 100 microns. (2) According to IICRC's FSRT technical information, most smoke and fumes produced by building fires are 0.5 microns to 7 microns in size; the particulate size of most combusted smoke particles is in the range or 0.1 to 4 microns in size.

**Smoke, chronic health effects from –** "There is the potential for chronic health effects from exposure to the components of smoke. Long term exposure to ambient air containing fine particles has been associated with increases in cardiovascular disease and mortality in populations living in areas with higher fine particulate air pollution.

 

Education Note: Frequent exposure to smoke for brief periods may also cause long-term health effects. Firefighters, who are exposed frequently to smoke, have been examined for long-term health effects (for example, cancer, lung disease, and cardiovascular disease) of repeated smoke exposures. The findings from these studies are not consistent or conclusive. Some studies show an increased frequency of these diseases among firefighters compared to similar male reference populations (e.g., male policemen, white males in the general population), while others do not" (DOH-NY State).

**Smoke concentration –** The amount of combustion products found in a specified volume of air, commonly expressed as micrograms of emission per cubic meter of air.

**Smoke health effects –** Eye and respiratory irritation and reduced lung function (Seltzer, J. M.D; Miller, M., M.D; Seltzer, D., M.A. "*Health Risks of Wildfires for Children – Acute Phase*" 2007).

**Smoke impaction –** In wildfire terminology, smoke impaction is the transference of smoke, soot and chemical byproducts into a building through convection (heat transfer and mass particulate transfer by wind turbulence).

**Smoke inhalation –** The taking in of air into the lungs containing fine and micro-fine particles, vapors and gases in smoke. "Exposure to high levels of smoke should be avoided.

Education Note: Individuals are advised to limit their physical exertion if exposure to high levels of smoke cannot be avoided. Individuals with cardiovascular or respiratory conditions (e.g., asthma), fetuses, infants, young children, and the elderly may be more vulnerable to the health effects of smoke exposure. Inhaling smoke for a short time can cause immediate (acute) effects.

Smoke is irritating to the eyes, nose, and throat, and its odor may be nauseating. Studies have shown that some people exposed to heavy smoke have temporary changes in lung function, which makes breathing more difficult. Two of the major agents in smoke that can cause health effects are carbon monoxide gas and very small particles (fine particles, or PM2.5). These particles are two and one half (2.5) microns or less in size (25,400 microns equal an inch) and individual particles are too small to be seen with the naked eye. Inhaling carbon monoxide decreases the body's oxygen supply. This can cause headaches, reduce alertness, and aggravate a heart condition known as angina. Fine particles are able to travel deeply into the respiratory tract, reaching the lungs.

Inhaling fine particles can cause a variety of health effects, including respiratory irritation and shortness of breath, and can worsen medical conditions such as asthma and heart disease. During increased physical exertion, cardiovascular effects can be worsened by exposure to carbon monoxide and particulate matter. Once exposure stops, symptoms from inhaling carbon monoxide or fine particles generally diminish, but may last for a couple of days" (DOH-NY State).

**Smoke impact assessment –** An environmental term describing sampling in the field and analysis in a lab that together provides valuable information about a smoke contaminated building.

**Smoke intrusion –** Smoke from prescribed fire entering a designated area at unacceptable levels.

 

**Smoke odor –** The perceived presence of odors by olfactory nerves that detect quantities of aerosolized combusted substances and gases.

**Smoke odor contamination –** (1) The unintended presence or introduction of smoke, soot, ash and chemical byproducts into a building, material or content. (2) The soiling of materials by organic and inorganic substances after combustion. (3) The presence of particles, chemicals and gases and other undesirable substances after a fire.

**Smoke odor contamination, secondary –** In smoke odor assessment and recognition, secondary smoke odor contamination includes underlying contamination by chemical residues and oxidation; cross-contamination by vapors and gases transferred from an affected air stream to non-affected air stream, such as the building's ventilation system.

**Smoke odor counteractant –** A chemical capable of adsorbing, paring, digesting, diffusing, oxidizing or neutralizing smoke odors.

**Smoke pall** – Extensive, thick blanket of smoke spreading more or less horizontally from a fire.

**Smoke particle health characteristics –** The characteristics, sources, and potential health effects of particulate matter to human health. The size of particles inhaled affects their potential to cause health effects in humans.

Education Note: Particles larger than 10 micrometers do not usually reach the lungs, but can irritate the eyes, nose, and throat. For purposes of comparison, a human hair is about 60 micrometers thick. Small particles with diameters less than or equal to 10 micrometers, also known as particle pollution or PM10, can be inhaled deep into the lungs; exposure to the smallest particles can affect the lungs and heart. Particle pollution includes "coarse particles," also known as PM 10 – 2.5, with diameters from 2.5 to 10 micrometers and "fine particles," also known as PM 2.5, with diameters that are 2.5 micrometers and smaller.

**Smoke plume –** The gases, smoke, and debris that rise slowly from a fire while being carried along the ground because the buoyant forces are exceeded by those of the ambient surface wind.

**Smoke residue –** Combustion products that remain after the dissipation of smoke.

**Smoke stain –** A discoloration by the penetration of fire residues into a material or surface.

**Smoke, types of –** There are two types of smoke, corrosive smoke and inert smoke. Corrosive smoke contains chlorides or sulfates which combine with water to form hydrochloric or sulfuric acids. Inert smoke is primarily carbon-based particles.

Education Note: Carbon based smoke is like a fine dust without corrosive properties. In some situations it can be cleaned off of the surface of contents and appliances more easily, without harming or staining the substrate.

 

**Smoke vent height –** The level in the vicinity of the fire at which smoke ceases to rise and then moves horizontally with the wind at that level.

**Smoldering –** A condition where materials burn slowly without a flame. (Fire is allowed to continue or exist in a suppressed state.) Smoldering also creates wet smoke residues whenever oxygen is depleted.

**$SO_2$ –** Sulfur dioxide. A corrosive gas produced by the burning of fuels, such as coal and oil that contain sulfur. It is also produced from sea spray, organic decomposition and volcanic eruptions. When combined with water in the air, it produces corrosive sulfuric acid. "See Sulfur dioxide."

**Soda blasting –** The use of baking soda (e.g., Arm & Hammer) forced under pressure to remove soot, oil, grease and other types of pollutants and harmful substances.

**Solvent –** (1) A liquid, solid or gas that is capable of dissolving another liquid, solid or gas. (2) A liquid substance that is capable of dissolving other substances. The most common solvent is water.

**Soot (sooty) –** A general term referring to impure carbon particles caused by hydrocarbon's incomplete combustion. Soot can be powdery, oily or tar-like depending on the type of combustion fuel.

**Soot –** (1) Fine black particles composed principally of carbon that is produced by incomplete combustion. (2) The unwanted byproduct from incomplete combustion or pyrolysis of carbon containing materials.

**Soot –** Impure carbon particles resulting from the incomplete combustion of the gas- phase combustion process.

Morphology of soot particles are similar to carbon black, fine micron/submicron sized spheroids. The EDS spectrum of soot shows strong carbon concentrations with few or no trace elements present (ASHRAE April 15, 2011, Technical Conference). "*Wildfire Particulate in Proximally Located, Unburnt Buildings*."

**Soot agglomeration** – Particles of carbon that is impregnated with tar forming the incomplete combustion of carbonaceous material (ASTM D1356).

**Soot fallout, extensive –** A person with average eyesight can see soot and ash fallout covering most all horizontal and many vertical indoor surfaces; this typically represents an extensive wildfire soot fallout cleanup situation.

**Soot fallout, heavy –** A person with average eyesight can see soot and ash fallout covering many horizontal and some vertical indoor surfaces; this typically represents a heavy wildfire soot fallout cleanup situation.

**Soot fallout, light –** A person with average eyesight can see minute amounts (specks) of soot and ash fallout on some horizontal indoor surfaces; this typically represents a light wildfire soot fallout cleanup situation.

**Soot fallout, moderate –** A person with average eyesight can see sporadic soot and ash fallout on a number of horizontal indoor surfaces; this typically represents a moderate wildfire soot fallout cleanup situation.

**Soot fallout, nuisance –** A person with average eyesight can see minute amounts (specks) of soot and ash fallout on a few horizontal surfaces; this typically represents a nuisance wildfire soot fallout cleanup situation.

**Soot fallout, positive/negative laboratory findings –** Through sampling and analysis, the laboratory results are either: a) positive for the presence of soot and char fallout; or b) the results are negative for the presence of soot and char fallout.

**Soot morphology –** (1) The analysis of the size, shape, weight and fractional dimension of soot as a particulate or agglomeration. (2) The analysis of the soot's dynamic shape, fractal aggregates, total mass and black carbon content. (3) The analysis of the mass-mobility relationship of weight and mass of soot to remain suspended in air.

**Soot residue –** Particulates (e.g., combusted materials), chemicals (e.g., PAHs) and gases (e.g., VOCs) that remain after a fire and settles on surfaces; absorb into pores or adsorbed into the material's physical structure.

**Soot set (soot sealer) –** A clear adhesive-like liquid that is sprayed into ducting in order to bond and immobilize loose soot or fire residues. Education Note: Soot sealers may not be recommended because over time the bonding agents tend to break down causing soot and fire residue to become part of the ventilation system's air stream.

**Soot tag –** A term described by the fire restoration industry that describes soot webs. "See soot webs."

**Soot web –** An irregular shape spiral design of soot particles agglomerated in corners of sooty or fire damaged buildings. Theories about how soot webs are created include: soot particles that cling to an already existing spider web; a fire that affects indoor spaces where the inside corners of rooms experience eddy effects (turbulence) resulting in chains of soot particles to cling together or with dust to form webs of soot.

Education Note: Soot tags (soot webs) are ionized smoke residues that are often formed by the combustion of synthetic materials (plastics, carpet to urethane floor finishes). They tend to be black in color and they easily smudge when disturbed. Their removal is best done with paper towels that cause the soot tag or soot web to cling to it. The paper towel is then folded into itself and disposed. Spraying

 

soot webs with a cleaner/degreaser causes it to explode (disintegrate) making soot removal a more difficult task.

**SOP –** Standard Operating Procedure. The procedure contractors use to operate their company; health and safety procedures; administrative and field procedures for completing work.

**Spalling –** Chipping or pitting of concrete, masonry and stone surfaces.

**Spalling indicators –** Craters or chips in the surface of concrete and stucco which indicates direction of fire spread.

**Specific heat –** The heat required to raise a unit mass of a substance one degree Kelvin. It is the heat capacity of a system per unit mass; i.e., the ratio of the heat absorbed (or released) to the corresponding temperature rise or fall.

**Spent material or item –** (1) A material or item that experienced fire damage or impurities from smoke and odor and is damaged to a point it must be removed and replaced or taken out of service. (2) Any material or item that has been used as a result of contamination, it can no longer serve for the purpose intended; or is nonfunctional in the sense that it cannot continue to be used for its original purpose (EPA Memorandum 9441.1994(07)).

**Spoilage –** A condition after a fire where heat, moisture, smoke and ash affect food, medical supplies and other sensitive items causing them to be disposed. Spoilage also occurs when electricity in a cooled building or refrigeration appliance is tuned off causing damage to a product or produce.

**Spoliation –** In law, spoliation is the removal or destruction of an item or material from a fire that is relevant to investigating cause and origin.

**Sponge blasting –** A process of removing smoke, soot and other contaminants with forced air and pieces of sponge. In theory, once the sponge media collides with surface contaminants, very small sponges expand where this process creates a vacuum – entrapping smoke and soot while holding contaminants in the sponge. The waste is separated and sponges are recycled for reuse in the system.

**Spontaneous combustion –** (1) Unprompted combustion within a material by localized heat and not by an external ignition source. (2) Combustion of a thermally isolated material initiated by an internal chemical or biological reaction producing enough heat to cause ignition.

**Stable air mass –** An air mass which has little vertical mixing.

**Stack effect –** Pressure-driven airflow produced by convection as heated indoor air rises, creating a positive pressure area at the top of a building and negative pressure area at the bottom of a building. Stack effect can overpower the mechanical system and disrupt ventilation and circulation in the building.

 

**Stain kill –** A sealer designed to block the transmission of stains out of a material.

**Stain sealer –** A sealant such as a shellac-base product that locks stains in place.

**Standard of care –** Practices that are common to reasonably prudent members of the trade who are recognized in the industry as qualified and competent.

**Steam cleaning –** The process where steam combined with detergents followed with vacuuming removes dirt, grime, soot and smoke from carpets and other fabrics; hard surfaces including wood and vinyl floors, marble and granite.

**Structure fire –** Fire originating in and burning any or all parts of a building and other structures.

**Subsidence –** Downward or sinking motion of air in the atmosphere. Subsiding air warms due to compression. Air temperature increases and humidity decreases as air subsides. Subsidence results in a stable atmosphere inhibiting dispersion. Subsidence is generally associated with high atmospheric pressure.

**Subsidence inversion –** An inversion caused by subsiding air, often resulting in decreased atmospheric mixing conditions.

**Sulfate –** Solid or liquid particulate matter composed of sulfuric acid [$H_2SO_4$], ammonium bisulfate [$NH_4HSO_4$], or ammonium sulfate [$(NH_4)_2SO_4$]. Atmospheric sulfate aerosols are often formed from the atmospheric oxidation of sulfur dioxide.

**Sulfur dioxide –** A gas $SO_2$ consisting of one sulfur and two oxygen atoms. $SO_2$ is important to identify because during combustion sulfur dioxide is capable of converting to an aerosol that settles out of air with smoke and soot. On a damp surface, $SO_2$ can convert into acid droplets consisting primarily of sulfuric acid. "See $SO_2$."

**Sulfur dioxide cleaning –** The use of detergent cleaners to remove smoke caused acid-based residues on surfaces.

**Surface area-to-volume ratio –** The ratio between the surface areas of an object, such as a fuel particle, to its volume. The smaller the particle, the more quickly it can become wet, dry out, or become heated to combustion temperature during a fire.

**Surface fire –** Fire that burns loose debris on the surface which includes dead branches, leaves, and low-growth vegetation.

**Surface layer –** A concentration of air pollution that extends from the ground to an elevation where the top edge of a pollution layer is visible.

**Surface wipe –** A streak test collected from a given surface that is intended to identify carbon black, soot and other naturally occurring environmental particulates.

**Surface wind –** A wind measurement taken above the surface, customarily a distance of 20 feet above the average vegetative surface to minimize the distorting effects of local obstacles and terrain.

**Surfactant –** A surface active agent; any wetting agent. A formulation which, when added to water in proper amounts, will materially reduce the surface tension of the water and increase penetration and spreading abilities of the water.

**Tape sampling –** A field sampling method that collects loose surface debris.

**Technically exhaustive inspection –** a technically exhaustive home inspection is a comprehensive and detailed investigation and examination of a home or establishment, which includes or involves dismantling, use of advanced techniques, measurements, special instruments, calculations, testing, research and technical analysis. This also requires specialized knowledge and training.

**Technically exhaustive testing –** A series of tests in combination with other tests having various values in order to prove a hypothesis.

**TEM analysis –** The transmission electron microscopy (TEM) testing and method is an evaluation of the morphology of the particles present in the sample to determine primarily if their morphology is consistent with the unique grape cluster, or acinoform, morphology of carbon black and soot.

Education Note: Using ASTM D6602, it designates TEM analysis as the mandatory evaluation technique for black carbon/soot. Examination of the samples using light microscopy should be used only as a screening/presumptive method. The same ASTM D6602 method mentions using Scanning Electron Microscopy (SEM) as ancillary method for black carbon/soot and carbon black analysis. But similar to polarized light microscopy (PLM), the PLM method should be used only for screening purposes or for supporting the TEM data. SEM is used to further characterize the morphology of particles where its data supports the TEM data.

**Temperature inversion –** A weather condition in which warm air sits atop cooler air, promoting inversion stagnation and increased concentrations of air pollutants. (A condition of a layer of atmosphere in which temperature increases with altitude.) Such a layer is stable where pollutants tend to migrate through it at a slower rate.

**Temporary repairs –** The use of equipment and supplies that secures or mitigates property damage or supports a structure until rebuilding activities begin.

**Tetrahedron** - The elements required to start a fire. Tree elements must be present for the fire to occur: heat, oxygen and fuel, and the chemical chain reaction. Together, this process is referred to as "fire tetrahedron."

 

**Thermal contraction/expansion –** Dimensional changes in building materials caused by dramatic fluctuations in heat.

**Thermal decomposition –** A chemical reaction in which a heated compound breaks up into at least two other compounds.

**Thermal desorption –** The use of heat to increase volatility of a contaminant such as aldehydes (formaldehyde). Thermal desorption is not combustion; it neither produces incineration nor is it designed to destroy organic materials.

**Thermal fogger –** A machine that produces high temperatures to create large quantities of fog without degrading the active ingredient.
Education Note: Thermal foggers create a very large quantity of very small droplets, very quickly. This process makes the machine ideal for fogging large indoor open spaces. Thermal fog is visible, helping the operator to monitor the dispersion of fog and ensure thoroughness of application. "See Ultra-low volume fogger." Thermal foggers include product names Electro-Gen and Thermo-Gen available through distributors like Jon-Don.

**Thermal fogging –** Machines that produced heated air and evaporated oil-based solvents in air. In fire damage restoration, thermal foggers are designed to disperse an odor counteractant by a machine that ignites a combustible solvent where its particles are dispersed as fine molecules of a dry fog.

**TLV –** Threshold limit value. TLV reflects the level of exposure that a typical worker can experience without an unreasonable risk of disease or injury.

**Total loss –** (1) An article or structure damage so severe that it cannot be repaired; are not cost effective to repair; repair will exceed its value. (2) Situations where damaged materials no longer meet code or materials are damaged beyond salvage value.

**Total suspended particulates (TSP) –** (1) Total particulate matter in a sample of ambient air. (2) A regulatory measure of the mass concentration of particulate matter (PM) in community air.

Education Note: The chemical complexity of airborne particles requires that the composition and sources of a large number of primary and secondary components be considered. Major components of suspended fine particles are SO4 = H+, NO3−, NH4+, organic compounds, trace elements (including metals that volatize at combustion temperatures), elemental carbon, and water. In a wildfire, normal airborne components along with burnt combustion and its chemical byproducts and oxides combine and become a dangerous mixture of air to breathe.

**Toxicity –** A relative property of a chemical agent and refers to a harmful effect on some biologic mechanism and the conditions under which this effect occurs.

**Trisodium phosphate (TSP)** – A cleaning agent that removes smoke and soot without harming many finishes.

Education Note: TSP was widely used up to the 1970s and 80s where it was found to be an ecological disposal problem. TSP today is made with TSP substitutes such as sodium carbonate that is friendly to the environment as far as disposal is concerned. TSP is commonly used with mineral spirits to cut smoke film on ceramic tile and other hard surface materials affected by hydrocarbon residues including painted walls, ceilings and trim. During cleaning TSP breaks the gloss of latex and oil-based paint; and scrubbing helps to open the pores of drywall and plaster, providing a method of removing adsorbed smoke odor molecules. TSP should not be used on metal and metal finishes because it can contribute to corrosion. On sensitive finishes consider using baking soda; plastics including fiberglass and white appliances consider using phosphoric acid; a mild alkaline cleaner consider using a product with D'limone; and sensitive-soft finishes consider using foaming cleaners. "See Baking soda; Phosphoric acid; D'limone; Cleaning, foam."

**Turbidity –** A condition that reduces atmospheric transparency to radiation, especially light. The degree of cloudiness, or haziness, caused by the presence of aerosols, gases, and dust.

**Ultra-low volume fogger (ULV fogger)** – A machine manufactured to disperse liquids in extremely fine droplets (5-15 micron particles) so as to produce an almost dry mist. ULV foggers are "cold foggers" as compared to "thermal foggers." The ULF fogger generates fog (fine-mist) droplets by using a high volume of air at a low pressure. The machine is capable of producing droplets of a more precise size because the absence of a large number of very small droplets limits the penetration of the fog into highly obstructed areas or porous materials. "See Thermal fogger." ULV foggers include products such as the Flex-A-Lite available through distributors like Jon-Don.

**Ultra-fine particles –** Particles suspended in air that are smaller than 0.1 micrometers in size (PM 0.1). Ultrafine particles are formed by nucleation, which is the initial stage in which gas becomes a particle. Ultra-fine particles can grow up to a size of 1μm either through condensation, when additional gas condensates on the particles, or through coagulation, when two or more particles combine to form a larger particle.

**Ultrasonic cleaning –** (1) Removal of residues by an immersion process in which electronically induced cavitation enhances the effectiveness of the solvent or detergent. (2) The process of cleaning objects with ultrasound waves of water along with detergents to agitate and remove contamination.

**Ultrasonics –** Solution cleaning machines utilizing sound waves from 20 kHz to over 100 KHz.

**Umpire –** In insurance terms, an umpire is a neutral third-party selected by the two opposing appraisers for a property appraisal who resolves any differences between the two appraisers.

 

**Unsalvageable –** Materials or contents that are beyond the possibility of cost-effective restoration and their current state of condition causes them to have no apparent market value.

**USEPA –** United States Environmental Protection Agency. "See EPA."

**Vacuum freeze drying –** "See Freeze drying."

**Vapor pressure –** Pressure (measured in pounds per square inch absolute - psia) exerted by a vapor. If a vapor is kept in confinement over its liquid so that the vapor can accumulate above the liquid (the temperature being held constant), the vapor pressure approaches a fixed limit called the maximum (or saturated) vapor pressure, dependent only on the temperature and the liquid.

**Vapors –** The gaseous form of substances that are normally in the solid or liquid state (at room temperature and pressure). The vapor can be changed back to the solid or liquid state either by increasing the pressure or decreasing the temperature alone. Vapors also diffuse. Evaporation is the process by which a liquid is changed into the vapor state and mixed with the surrounding air. Solvents with low boiling points will volatilize readily. Examples include benzene, methyl alcohol, mercury, and toluene.

**Ventilation rate –** (1) The amount of air inhaled in a specified time period (e.g., per minute, per hour, per day, etc.); also called breathing rate and inhalation rate. (2) The rate which air is delivered and processed throughout a building.

**Visual air quality –** Air quality evaluated in terms of pollutant particles and gases that affect how well one can see through the atmosphere.

**Visual inspection –** (1) A hands-on inspection process that assesses general conditions as well as damaging conditions affecting a building or material. (2) The inspection of a loss without the aid or benefit of measuring instruments or testing equipment.

**Visual inspection, exploratory –** A hands-on inspection process that assesses the potential or suspected building or material damage through dismantling or damaging materials.

**VOC –** Volatile organic compound. Any organic (carbon-containing) compound that evaporates readily to the atmosphere at room temperature. VOCs are found in wildfire smoke and the settled smoke indoors where it can cause health problems in some persons. VOCs are often described as an odor given off by fire residue.

**Volatility –** The tendency or ability of a substance including liquids to vaporize. Such liquids as alcohol and gasoline, because of their well-known tendency to evaporate rapidly, are called volatile liquids.

**Warping –** The deformation of a surface from its original or intended shape caused by sharp temperature increases and/or changes in moisture content.

 

**Washout –** The process by which particles are flushed from air by air scrubbing; flushing of particles and residues off a material or item by water or cleaning solvent.

**Waste hauler –** A contractor that removes spent or damaged materials for disposal.

**Water damage –** The destructive effects of water or moisture on buildings and personal property.

**Water damage from fires –** Water that enters buildings as a process of putting out a fire. Water damage from fires includes standing water, free-unbound water, trapped-unbound water, saturated water, high indoor rH, and water having contact with smoke that contributes to oxidation.

**Wet cleaning –** A process of cleaning on the wet side. Wet cleaning can be aggressive where abrasive cleaners are used to fine cleaning with non-abrasive cleaners.

**Wet fog –** Aerosolized droplets of water or solvents as a mist or fog.

Education Note: Wet fogging is an odor control and odor paring process by which a chemical fog is broadcast throughout the building or area. A wet fog mist consists of large molecules is usually 30-60 microns in size; a wet fog is usually 20-30 microns in size; a dry fog is usually 10-15 microns in size. There is a super-fine category called ultrasonic fog that is atomized at 2-10 microns. (See wet fogging)

**Wet fog stability –** The ability of a fog or mist to remain airborne. The stability of a fog can vary widely depending on the liquid (composition, vapor pressure, surface tension and density), particle size distribution, droplet density, air currents, sunlight, and air temperature and condensation surfaces.

**Wet fogging –** A process of fogging water and oil-based chemicals in air. High pressure sprays deliver a wide range of particle sizes, depending on liquid pressure and nozzle opening. For fog output, typical liquid pressures are 500 - 1,500 psi, and orifices are 0.005 of an inch or smaller. Spray nozzles that fog fine droplets require high grade filtration to protect against nozzle plugging.

**Wet smoke –** Airborne combustion byproducts containing high liquid components that are in the form of aerosols. Wet smoke conditions can be generated by smoldering oxygen starved fires, where the fire residues are sticky (tacky), they penetrate deep into pores, and they have a strong lingering odor.

Education Note: The wet misting spray created by firemen to shutdown oxygen in a fire can increase the moisture content in smoke and soot causing it to break apart or agglomerate. However, calling this type of situation wet smoke damage doesn't fit the wet smoke definition.

**Wet sponge –** A synthetically made sponge. We sponges are designed to be soaked in water and cleaning detergents that together, lightly scrub a surface (e.g., dishes, glassware, plastics, silverware, pots and pans, kitchen counters), and not cause harm to the surface. "See Chemical sponge; Cleaning, wet sponge; Dry sponge."

# 2011 Version 6:
# Wildfire Glossary of Environmental, Insurance and Restoration Terms

**Wildfire –** Any wildland fire that requires a suppression response. A controlled burn may be declared a wildfire if part of it escapes from the control line or if weather conditions deteriorate and become unacceptable, as described in the burning plan.

**Wildfire wind shear –** Winds generated by atmosphere, heat and turbulent forces causing a dramatic change in wind speed and direction.

Education Note: Wind shear makes for choppy wind conditions causing erratic gusts (across and up and down and in layers simultaneously) between 5-20 mph, and can increase from 5 to 100 mph for short periods.

The fundamental dynamics through which a forest fire and the atmosphere interact to yield different convective regimes is still not well understood. However, through dimensional modeling (Advanced Regional Prediction System (ARPS)), science is attempting to better understand the impact of the environmental wind profile based on intensity and spatial scale. ARPS modeling is attempting to investigate surface buoyancy parameters and advection parameters. The goal is to model the degree to which the environmental wind advects updrafts away from the fire; upstream surface wind and mixed layer wind speeds that become independent from each other.

**Xactimate –** An insurance estimating software program that calculates labor and material costs, demolition and cleanup, repair and restoration costs. For more information go to: http://www.xactware.com

**XRD –** X-ray Diffraction. An analysis method for assessing diesel fumes obtained from crude oil.

**XRF –** X-ray Florescence. XRF is a field-application scientific X-ray emitting detection instrument that identifies the presence of lead-based paint and lead substances in a material or on its finish. XRF analysis is important in wildfire cleaning and restoration when building materials manufactured or constructed before 1978 must be removed or disturbed. XRF analysis is also important in identifying the fallout of burnt nearby buildings, ensuring their char particles are not a source of lead-based paint particles.

**Yellowing and discoloration –** The development of yellowing can be a result of thermally induced heat caused or from material contact with smoke and soot residue. Yellowing is often caused by nitrogen dioxide ($NO_2$) in smoke and soot.

**Zoning –** (1) The process of separating damaged parts of a building into different work tasks. (2) The process of separating smoke and soot cleanable parts of a building into manageable sections. Zoning in this situation begins at the most affected area or rooms; working towards less contaminated areas or rooms.

# 2011 Version 6:
# Wildfire Glossary of Environmental, Insurance and Restoration Terms

**About Patrick Moffett:**

Patrick is a senior environmental/industrial hygienist, a California registered environmental assessor, a California licensed general contractor and an industry certified master fire/smoke odor restorer. Patrick is employed by Environmental Management & Engineering, Inc. (EME) in Huntington Beach, CA. Patrick has over 20 years of experience assessing fire and wildfire damaged properties:

- Environmental assessment and testing of hazardous chemicals and waste along with interpreting state and federal regulations that apply to mitigate damage;
- Consulting with state and local agencies including EPA, Fish and Game, Air Quality Management District, California Department of Toxic Substance Control, fire marshals, forensic specialists, health departments, abatement and remediation contractors;
- Designing scope of work plans for removing smoke, soot and ash that affects buildings and contents followed by clearing restorers work and the building;
- Writing technical articles and teaching industry professionals and adjusters about methods and procedures required to cleanup fire and wildfire caused damage and contamination.
    - *Soot Particles: A Procedural Guide for Containing and Removing Wildfire-Caused Soot in Buildings, 2008*
    - *Containment and Removal of Fire Retardants Settled on Buildings, Contents and Land, 2008*
    - *Dilemmas Associated with the Clean-up of Wildfire Smoke and Soot in Buildings, 2010*