Fire Hazards For Chemicals Report

Fire and explosion accidents are of major concern to the owners and operators of many industries like refineries and petrochemical, gas processing, offshore facilities, and other chemical industries. Fire in an industrial setting can pose several hazards for the facility, its personnel, and the surrounding communities who could be severely affected. Two of the main inherent hazards associated with fires are thermal radiation and smoke.

Smoke

The smoke released by any type of fire (chemical industry, forest, brush, crop, structure, tires, waste, or wood burning, etc.), is a mixture of particles and chemicals produced by incomplete burning of carbon-containing materials. All smoke contains very dangerous asphyxiant gases (some of them highly toxic), water vapor, carbon monoxide, carbon dioxide and particulate matter (PM or soot).

Smoke can also contain aldehydes, acid gases, sulfur dioxide, nitrogen oxides, VOCs, particularly benzene; aldehydes such as formaldehyde and acrolein; a wide variety of PAHs, including pyrene, phenanthrene, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene resulting from combustion of organic matter; metals, dioxins and particulate matter (PM), principally in the $PM_{2.5}$-size range. These microscopic particles can penetrate deep into your lungs. They can cause a range of health problems, from burning eyes and a runny nose to aggravated chronic heart and lung diseases. Exposure to particle pollution is even linked to premature death.

The type and number of particles and chemicals in smoke varies depending on what is burning, how much oxygen is available, and the burn temperature. Factors such as smoke yield, fire size, particle size, and ambient conditions (wind direction and speed for example), dictate smoke's transport into the environment. Soot particles may obscure visibility, and hazardous chemicals may constitute a health hazard due to inhalation and eye irritation.

Soot particles (PM) in a range of 0.01 to 10 microns of diameter, are respirable and can penetrate the alveolar region of the lungs. The generated soot particles may adsorb toxic gases from the products of combustion, which present public health concerns due to the inhalation of these toxic particles. Therefore, the downwind dispersion and deposition of these particles and their effects on the environment and humans is of major concern. Another danger is that smoke contains flammable compounds. With increased oxygen, these can ignite either through open flames or by their own temperature.

FIRE ADVERSE EFFECTS

Fires or explosion of certain hazardous substances can affect both animals and human populations. Some produce toxic effects in humans or the environment after a single, episodic release. These are referred to as **acute toxicity**. Other produce toxic effects after prolonged exposure which is called **chronic toxicity**.

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Environment: Impacts on the environment can be severe, killing organisms in lakes, rivers, destroying animals and plants in contaminated areas and affecting biodiversity.

Humans: Chemical hazards pose a wide range of health effects (irritation in several systems, sensitization, and carcinogenicity, among others) and physical hazards (flammability, corrosion, and explosibility).

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. Some people exposed to heavy smoke have temporary changes in lung function, which makes breathing more difficult. There is also 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 high air pollution. Frequent exposure to smoke for brief periods may also cause long-term health effects.

Two of the major agents in smoke that can cause health effects are carbon monoxide and fine particles, or $PM_{2.5}$. These can 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. Inhaling carbon monoxide decreases the body's oxygen supply. This can cause headaches, reduce alertness, and aggravate a heart condition known as angina. Individuals with cardiovascular or respiratory conditions (e.g., asthma), fetuses, infants, young children, pregnant women, and the elderly, may be more vulnerable to the health effects of smoke exposure.

PREVENTION OF EXPOSURE: Exposure to high levels of smoke should be avoided. Individuals are advised to limit their physical exertion as cardiovascular effects can be worsened by exposure to carbon monoxide and PM. Once exposure stops, symptoms generally diminish but may last for a couple of days.

ENVIRONMENTAL MONITORING DURING AND AFTER A FIRE

There is always concerns about what chemicals are being released to the air during a fire and what might be in the soot and ash after a fire. These questions often lead to requests for testing (e.g., air, water, soil sampling). In most cases, the chemicals released by any fire are very similar. Usually, any fire will result in the release of large amounts of PM and carbon monoxide, as well as varying amounts of volatile organic chemicals (VOCs) (such as benzene), polycyclic aromatic hydrocarbons, metals, and other chemicals.

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Environmental testing of some chemicals in smoke may give an idea of the potential adverse effects that people are facing. When the testing is possible, first responders, health and environmental agencies, and others, would identify information needed, objectives, and testing methods to provide clear, meaningful results. For example:

- Air sampling with real-time instruments may be performed by fire fighters or health and environmental agencies, to help guide urgent decisions, such as where to establish evacuation boundaries or what personal protective equipment should be worn by fire fighters.
- Air sampling during long-duration fires (e.g., fires lasting days to weeks) may help to understand the significance of health risks from the longer-term exposures people may experience, and where those exposures may be occurring.
- Sampling of air and other media after fires that cause the release of large amounts of specific chemicals, may help to guide any necessary post-fire cleanup decisions.

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