Science-based Steps
Of The Cleaning Process

This is part three in a series on the science-based steps of the cleaning process. Each step contains scientific concepts and principles explaining cleaning’s effectiveness in putting unwanted matter in its proper place.

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Examining Particles, Pollutants And Pesticides

How is our health affected by these particles?

Our respiratory system consists of the nose, throat and lungs.

The nose, or nasopharyngeal area, includes the nasal cavity, pharynx and larynx. This region is primarily where allergic reactions are triggered.

The throat, or tracheobronchial area, consists of the trachea and bronchial tree down to the lungs. Most allergic reactions are caused by particles >10 μm.

These large-size particles irritate mucous membranes in the cranial cavity.

Unfortunately, not all airborne contaminants are visible. Therefore, a quality cleaning strategy is needed.
The pulmonary system’s natural defense mechanism usually clears them from the lungs.

The lungs’ first line of defense is the epiglottis, a flap of tissue covering the trachea.

It opens to allow breathing and closes to block organisms and matter in the mouth and throat from entering the respiratory tract.

Lungs are adversely affected in several ways.

Air passages can be irritated, airways obstructed and cell lining damaged.

Cell damage eventually can lead to tumors, increased fluids (swelling or edema) and decreased respiratory capacity.

Many irritating volatile organic compounds (VOCs) in a high enough concentration produce these effects.

A healthy body is fairly efficient at expelling particles in the 2.5-10 μm range.

Organisms and particles that get past the epiglottis can become trapped in the mucous coating the lungs’ trachea and bronchial tubes.

Cilia — small, hair-like cells — move the material trapped by the mucus back to the mouth.

The body triggers the diaphragm muscle to contract.

The resulting cough expels pollutants in the mucus to the mouth.

Smaller particles (<2.5 μm) move deeper into the lungs.

If not cleared naturally, the lungs can be scarred or the particles remain trapped, creating conditions for diseases like cancer.

Scarred lung tissue cannot exchange gases.

Lung function also is weakened.

This weakness is serious in infants.

Their lungs are not fully developed and once damaged they stop developing.

It also can be serious for the elderly, whose lung function has decreased naturally.

If small particles or biological agents reach the alveoli deep in the lungs, there is one final chance for removal.

Macrophages — the immune system’s scavenger cells — surround them.

The lymphatic system then flushes them from the lungs.

If the pollutant is not cleared it stays in the lungs or passes into the blood stream as a gas and is delivered to the organs.

Particles in the <2.5 μm range are regulated by ambient air standards.

This reduces their transportation and industrial sources’ emissions so a higher level of outdoor air quality is achieved.

Generally, these small particles are PICs and not related to indoor allergic reactions.

When controlled outdoors the indoor air quality is not adversely impacted.

Very small particles, especially in the <1 μm range, are a large component of atmospheric dust.

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If particles settle or become trapped (e.g., on carpet), they are difficult to remove and re-entrain.

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What Are Asbestos Fibers?

Airborne asbestos fibers are found in small amounts in offices and homes. Average asbestos concentrations in urban ambient air typically are <1 ng/ m³ and rarely exceed 5 ng/ m³.

One nanogram (ng) is one-billionth of a gram.

Enough is found, however, to pose a modest risk in unusual circumstances, especially where building and insulating materials containing asbestos are abused or poorly maintained.

Asbestos, a naturally occurring mineral fiber found in rocks, is not used as much in building materials.

While its heat resistance and durability offer many uses, recent information details the increased health risk from asbestos exposure.

Individuals exposed to high levels of airborne asbestos fibers for an extended time in uncontrolled amounts often contract asbestosis.

This lung disease causes scar tissue to grow over lung tissue thereby reducing gas exchange.

In the past, several forms of asbestos were used in assorted commercial products when their fire, heat and chemical resistance was needed.

These products included actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite.

Asbestos’ resistance, low cost and physical strength also made it a popular choice in textile, friction, cement, plastic, paper and insulation, many of which were used in buildings.

Recently asbestos was linked to cancers of the lungs, esophagus, stomach and colon, including mesothelioma, a rare cancer of the chest and abdominal lining.

These cancers may appear years after the initial exposure.

There does not appear to be a “safe” level of asbestos exposure that would eliminate cancer risk.

Cigarette smoking, when combined with asbestos exposure, greatly increases the risk of lung cancer.

Buildings where asbestos-containing materials are intact seldom show increased concentrations of airborne asbestos over ambient levels.

Effective cleaning removes trace amounts of fibers that otherwise might end up in indoor air.

What Are Organic Pollutants?

Organic pollutants are carbon-containing compounds.

Commonly referred to as VOCs when existing as a gas, they come from indoor sources, including furnishings, building materials, tobacco smoke, fires, fuels, solvents, pesticides and cleaning products.

A by-product of many cleaning processes, managing VOCs is required for effective cleaning.

VOCs compromise a large class of compounds with varying chemical and physical properties.

Over 900 compounds have been identified in indoor environments while many more remain unknown.

The health effects of some compounds also have been acknowledged.

Many gas-phase organic compounds have greater indoor concentrations than outside.

Sensory irritation is a mild effect of VOCs.

More serious effects include behavior and brain function changes, blood disorders and cancer.

The concentrations needed for human response are known for some compounds.

Cancer risk numbers have been calculated for others.

VOC mixtures commonly found in offices have been tested to determine the concentrations needed for human response.

A VOC concentration of 5 to 25 mg/m³ causes behavioral changes in sensitive adults.

Other VOC effects include an annoying odor, skin irritation and neurotoxic symptoms, such as headache, fatigue or diminished concentration.

There still is little data regarding man’s response to VOCs.

It is known that individuals complain and are more dissatisfied when there is inadequate ventilation for these compounds.

This dissatisfaction translates into reduced productivity for those occupying the indoor environments.

What Are Pesticides?

Pesticides are organic chemicals in a liquid and vapor phase that are applied in and around buildings to control insects.

They are, by definition, poisonous substances affecting the nervous or reproductive systems and the liver and sometimes cause allergic reactions.

Thanks to industrial and animal studies human responses to doses are known for some pesticides.

Pesticides can be directly introduced inside or enter through foundation cracks and openings.

The atmosphere in the average U.S. residence contains various pesticides with concentrations 10 to 100 times greater than ambient outdoor concentrations.

Chlorpyrifos, diazinon, chlordane, propoxur and heptachlor are the most common pesticides found indoors.

Exercise extreme caution when using pesticides inside.

Cleaning interior surfaces removes and controls pesticide residues left behind when applied indoors or infiltrated from outside.

This causes them to adhere to surfaces, especially carpet.