Indoor Air Quality
And Particle Detection Methods

by Jason Kelly
IAQ and Particle Detection Methods

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What is Indoor Air Quality?

Indoor air quality is the air quality within and around buildings and structures. IAQ is known to affect the health, comfort and well-being of building occupants. Poor indoor air quality has been linked to sick building syndrome, reduced productivity and impaired learning in schools.

In the last several years, a growing body of scientific evidence has indicated that the air within homes and other buildings can be more seriously polluted than the outdoor air in even the largest and most industrialized cities. Other research indicates that people spend approximately 90 percent of their time indoors. Thus, for many people, the risks to health may be greater due to exposure to air pollution indoors than outdoors.

Pollutant Sources

There are many sources of indoor air pollution in any home. These include combustion sources such as oil, gas, kerosene, coal, wood, and tobacco products; building materials and furnishings as diverse as deteriorated, asbestos-containing insulation, wet or damp carpet, and cabinetry or furniture made of certain pressed wood products; products for household cleaning and maintenance, personal care, or hobbies; central heating and cooling systems and humidification devices; and outdoor sources such as radon, pesticides, and outdoor air pollution. The relative importance of any single source depends on how much of a given pollutant it emits and how hazardous those emissions are. In some cases, factors such as how old the source is and whether it is properly maintained are significant. For example, an improperly adjusted gas stove can emit significantly more carbon monoxide than one that is properly adjusted.

Some sources, such as building materials, furnishings, and household products like air fresheners, release pollutants more or less continuously. Other sources, related to activities carried out in the home, release pollutants intermittently. These include smoking, the use of unvented or malfunctioning stoves, furnaces, or space heaters, the use of solvents in cleaning and hobby activities, the use of paint strippers in redecorating activities, and the use of cleaning products and pesticides in housekeeping. High pollutant concentrations can remain in the air for long periods after some of these activities. Below is the current National Ambient Air Quality Standards (NAAQS) table for PM exposure in ambient air.

<table>
<thead>
<tr>
<th>Pollutant (PM)</th>
<th>Primary/Secondary</th>
<th>Averaging Time</th>
<th>Level</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM&lt;sub&gt;2.5&lt;/sub&gt;</td>
<td>primary</td>
<td>1 year</td>
<td>12.0 μg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>annual mean, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>secondary</td>
<td>1 year</td>
<td>15.0 μg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>annual mean, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>primary and secondary</td>
<td>24 hours</td>
<td>35 μg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>98th percentile, averaged over 3 years</td>
</tr>
<tr>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
<td>primary and secondary</td>
<td>24 hours</td>
<td>150 μg/m&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Not to be exceeded more than once per year on average over 3 years</td>
</tr>
</tbody>
</table>
The effects of Particulate Matter

Particulate matter (also referred to as PM or particle pollution) is a complex mixture of solid and/or liquid particles suspended in air. These particles can vary in size, shape and composition.

Exposure to inhalable particles can affect both your lungs and your heart. Many studies directly link the size of particles to their potential for causing health problems. Small particles (less than 10 micrometers in diameter) can get deep into your lungs, and some may even get into your bloodstream. People with heart or lung diseases such as coronary artery disease, congestive heart failure, and asthma or chronic obstructive pulmonary disease (COPD), children and older adults may be at greater risk from PM exposure. Scientific studies have linked PM exposure to a variety of health impacts, including:

- Eye, nose and throat irritation;
- Aggravation of coronary and respiratory disease symptoms; and
- Premature death in people with heart or lung disease

PM stands for particulate matter (also called particle pollution): the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope.

Particle pollution includes:

- PM10: inhalable particles, with diameters that are generally 10 micrometers and smaller; and
- PM2.5: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle.
**Particle Counter and Air Sampler Monitoring**

Handheld IAQ particle counters are used to detect high levels of particle concentrations. Particle Counters convert particle count samples into equivalent PM concentrations for PM 2.5 and PM10’. These PM levels can be observed for each room being sampled and compared to acceptable levels outlined by the National Ambient Air Quality Standards (NAAQS).

Air Samplers are used to sample air environments in indoor spaces. The air sample is impacted onto an agar media and this sample is then incubated. Standards or Threshold Limit Values (TLVs) for airborne concentrations of mold, or mold spores, have not been set. Currently, there are no EPA or OSHA regulations or standards for airborne mold contaminants. EU studies and regulations indicate the following levels:

European Union mold exposure standards: for apartments the E.U. uses these mold level designations:

- Indoor mold spore counts of < 50/m³ very low
- Indoor mold spore counts of < 200/m³ low
- Indoor mold spore counts of < 1000/m³ medium
- Indoor mold spore counts of < 10000/m³ high
- Indoor mold spore counts of > 10000/m³ very high

**Steps to Reduce Exposure to Indoor PM**

- Frequently test indoor environments at least 6 monthly to annual for PM levels and also for mold spore counts using an IAQ particle counter and an active air sampler.
- Vent all fuel-fired combustion appliances to the outdoors (including stoves, heaters and furnaces)
- Install and use exhaust fans vented to the outside when cooking
- Avoid the use of unvented stoves, fireplaces or space heaters indoors. If you must use unvented appliances follow manufacturers’ instructions especially related to ventilation.
- Choose properly sized woodstoves, certified to meet EPA emission standards; make certain that doors on all woodstoves fit tightly.
- Use appropriate wood in stoves and fireplaces. Check EPA’s BurnWise program for Safe Wood-burning Practices
- Have a trained professional inspect, clean and tune-up central heating system (furnace, flues and chimneys) annually. Repair any leaks properly.
- Change filters on central heating and cooling systems and air cleaners according to manufacturer’s directions.