



IAQ Problem Factorsⁱ

Indoor Air Quality (IAQ) is defined by a set of ever-changing factors, including outside air quality, weather, building operation, type of mechanical systems inside the building, contaminants that may be present, and the types of occupants in the building. Building use can also be a factor. Buildings that are designed for one purpose often end up being used for something entirely different. The new use may be incompatible with the original building design, and if the building owners are unaware of the need to adjust building design or operation to account for the new use, IAQ problems can result.

Most experts group all of these interrelated factors into the following four primary factors (Figure 1-2) that are common to every IAQ problem in every climate:

Contaminant(s)

Contaminants that can result in IAQ problems are generally classified into the following categories:

- ❖ Combustion products (smoking and cooking)
- ❖ Volatile organic compounds (VOCs) from solvents and cleaning fluids
- ❖ Respiratory particulates (asbestos and dust)
- ❖ Respiratory by-products (carbon dioxide)

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- ❖ Microbial organisms (fungi and bacteria)
- ❖ Radionuclides (radon)
- ❖ Odors (perfume, smoking, mold and mildew)

These contaminants cause IAQ problems only when a specific set of conditions exists that promotes them or allows them to reach levels that cause reactions in susceptible building occupants. Sometimes, these conditions can be changed easily and the problem quickly remedied. For example, simply increasing the volume or distribution of outside air may reduce elevated levels of VOCs within a building to acceptable levels. At other times, however, such as when microbial problems occur, the conditions can be complex, requiring modification of both the HVAC system and the building envelope along with careful removal of the microbially (mold) contaminated materials. The major types of contaminants in a building can change depending on the building's location and condition, the climate, and the building use. Mold and mildew are the number one problem in hot, humid climates.

HVAC system

The HVAC system is typically designed to control the temperature inside a building and, as a by-product, also controls relative humidity (RH). In so doing, the HVAC system should keep most people comfortable while they are inside. This system also helps control contaminants in a building in three ways: (1) by filtering contaminants out of the air before they reach the building occupants (filtration), (2) by diluting the contaminants in the air by adding fresh air (ventilation), and (3) by maintaining the right pressure balances between building spaces to keep contaminants

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from moving into the wrong place (pressurization). If the HVAC system fails to operate properly, IAQ problems usually occur.

Pathways

Pathways involve both a route for contaminants to travel through a building and a mechanism like air pressure to push the contaminant along that route. Pathways are affected by the building design, the operation of the HVAC system, and the building use.

Building occupants

People who spend an extended period of time (an 8-hour work day, for example) in a building are likely to report symptoms when IAQ problems occur. As such, they are a good barometer of the health of a building.

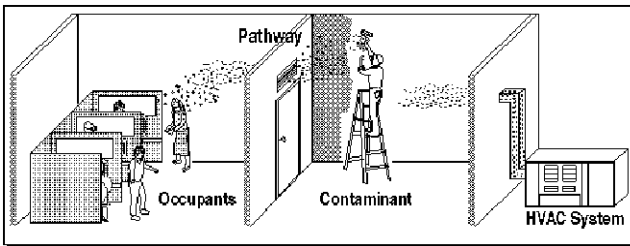


Figure 1-1. Four factors contribute to the development of an IAQ problem: (1) the presence of one or more contaminants, (2) an HVAC system that either fails to sufficiently dilute the contaminants or moves them through the building, (3) a pathway that enables the contaminants to reach the building occupants, and (4) one or more occupants who react to the contaminants.

All four of these factors must be present for an IAQ problem to exist. A change in any one of them can cause a dramatic change in the types of problems and symptoms that occur. If one is removed or eliminated, the IAQ problem will go away, either temporarily or permanently.

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At a large office building in Los Angeles, workers in one section of the building were exposed to chemicals, including paints and adhesives, from another section of the building that was being renovated. The fumes were migrating to the workers' area through the HVAC system that served both areas. The workers sued the building owners and managers, as well as the contractors, product manufacturers, and installers, and won a large financial settlement. If the building owner or manager had been aware of the four IAQ factors and taken proactive measures, the problem could have been easily avoided. For example, the pathway or pressure that enabled the chemicals to reach the occupants could have been removed by setting up a temporary exhaust system in the renovation area and blocking the return vents to the building HVAC system. These simple steps would have prevented the chemical fumes from getting into the common HVAC system where they could travel to the occupied areas of the building.

ⁱ Adapted from Solving Moisture and Mold Problems in Hot, Humid Climates originally authored by George DuBose and J David Odom and published by CH2M Hill for the Disney Development Company.