

ACVA Atlantic Inc.
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WHAT IS INDOOR AIR QUALITY?

Historical Background

In 1968, an explosive epidemic characterized by fever, headaches and muscular pains struck 144 people, including 95 of the 100 employees at a health department building in Pontiac, Michigan. A defective air conditioning system was implicated as the source of this illness, which was labeled "Pontiac Fever," though the particular bacterium was not isolated.

In 1976, a pneumonia-like disease hit 182 people attending an American Legion Convention at a hotel in Philadelphia. Twenty-nine of the victims died. "Legionnaires' Disease" was traced to contamination of the hotel's air conditioning system by a bacterium which was labeled "Legionella pneumophila" -- the same germ that caused the outbreak of Pontiac Fever eight years earlier.

In 1977, four babies died after contracting an infection in a Dutch hospital. The hospital identified the infection, but not the source. An investigation later revealed that two birds had died inside the air conditioning ductwork, and that bacteria from the remains had multiplied rapidly in the dirty ductwork and spread to all parts of the building.

These cases demonstrate dramatically that dirty air conditioning is a health hazard, and can even be fatal.

The founders of ACVA Atlantic Inc. were struck by the great difficulty in finding that cause of such outbreaks -- and the assumption that such extreme cases must be only the tip of the iceberg. Epidemics of colds or flu symptoms, stomach or respiratory disorders, and sore eyes do occur in the workplace, but rarely is the true source discovered. Often that source is the building's air handling system, an extremely effective breeder and carrier of germs.

One difficulty in effectively studying indoor air quality is that several diverse areas of expertise are needed, including chemistry, microbiology, and air conditioning engineering. ACVA integrated these skills in the formation of unique diagnostic teams to study internal air quality.

In 1981, ACVA Atlantic Inc. became the first firm in the United States specializing in indoor air quality. Since then ACVA has undertaken projects or ongoing contracts for a wide range of hospitals, businesses, and government agencies -including exclusive contracts with the Social Security Administration, Longworth Congressional Office Building, the U.S. Supreme Court, the Department of Health and Human Services, the Federal Reserve Bank, and the General Services Administration, which oversees some 7,000 federal government buildings nationwide. Prior to 1981, ACVA's founders had already studied many major buildings in England, Germany, Sweden, Japan, Singapore, and Hong Kong.

In total, by the end of 1986 ACVA Atlantic's technicians have studied over 36 million square feet of space, occupied by more than 200,000 people. Now ACVA's U.S. personnel are currently involved in studying buildings throughout Europe while a new Australian subsidiary, ACVA Pacific Inc. PTY Ltd., was opened in April of 1987 with the intentions of serving Australia and the Pacific region.

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Sick Building Syndrome:

ACVA is often called upon to investigate complaints and symptoms among office workers, including sore eyes, dry throats, nose irritation, fatigue, cough, itching, nausea, headaches, and general respiratory problems. In 80 to 90 percent of these cases, the problems are traced to contaminated air inside a building being circulated through dirty ductwork in the air handling (air conditioning and ventilation) system ... leading to ... "SICK BUILDING SYNDROME."

The National Institute for Occupational Safety and Health (NIOSH) investigated 356 buildings due to staff complaints and found that 50 percent of the problems were directly caused by dirty and inadequate ventilation. ACVA has found over 64 percent of the building studied to have ventilation faults. A reliable nationwide estimate is difficult, but it would not be unreasonable to assume that up to half of all major buildings are "sick" to some degree.

The major causes of Sick Building Syndrome are threefold:

1. **Poor ventilation:** All air handling systems become dirty with time. Dirt and corrosion eventually clog the system and reduce its efficiency. Ventilation may also be hindered by closing the air intake dampers as an energy-saving measure -- thus eliminating all "fresh" outdoor air and forcing occupants to breathe only recycled indoor air;
2. **Inadequate filtration:** Filters catch only larger dirt particles, and often become loose, torn, or clogged, rendering them ineffective; and,
3. **Contamination:** Air conditioning systems -- especially what can be miles of dirty ductwork -- are prime breeding grounds for bacteria, molds and fungi, many of which can cause illness and even death.

Bacterial and Fungal Contamination of Air Conditioning Systems:

Dirty, dusty HVAC systems can act as incubators for bacteria and fungi, especially in areas where free water is available. A small number of microbes finding the right conditions can multiply very quickly and will be carried in the supply air to all parts of the building. Condensate trays, chill coils, humidifier reservoirs and damp internal glass fiber insulation have all been found to be such sources of microbial contamination.

Many of the bacterial species isolated from HVAC systems are harmless dust organisms, such as bacillus, micrococcus, and diphtheroid species. However, the presence of even these harmless species of bacteria may be taken as a sign that the conditions for microbial growth are being supplied and the potential for the growth of more harmful species exists. Species which have been found inside HVAC systems and which are known to cause problems in susceptible people are Pseudomonas sp., especially Pseudomonas aeruginosa, Flavobacterium sp., Staphylococcus sp., Serratia marcescens, thermophilic species of the genera actinomycetes, and microspora and Legionella pneumophila.

Fungi are also ubiquitous in nature and inevitably enter buildings from the outdoors to set up colonies wherever the conditions for growth are favorable. They are very resistant and once they have established themselves in a niche, are very difficult to completely eradicate.

Most species are saprophytic, but many have been found to be the cause of both infections and allergies in office building occupants and have been isolated from various parts of HVAC systems and their associated ducts, chambers, and voids.

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From the results of about 200 surveys of outdoor airborne spores made in various parts of the world the same genera, Cladosporium, Alternaria, Penicillium, and Aspergillus, accounted for the highest mean percentages. A recent survey of eleven Florida homes showed a high incidence of these same genera in their circulating air. From data based on skin reactivity studies, these genera also constituted the most prevalent ones involved in allergic respiratory disease. Approximately 85% of patients found to be allergic to molds will react to one or more of these fungal allergens. Many other fungal species are routinely isolated from the internals of HVAC systems and their relationship to staff allergies is less clear.

Fungal species isolated within buildings which are known to cause infections are Aspergillus species, especially Aspergillus niger and fumigatus, which classically cause serious lung infections.

Normally microbial species do not occur on their own in HVAC systems, they appear to produce microbial communities where some benefit from the presence of others. In most case studies where microbial examinations have been done, stagnant water as might occur in condensate trays, humidifier reservoirs, etc. has been found to resemble a kind of "living organic stew," with representatives of all the different kinds of microorganisms present.

What can be done about Sick Building Syndrome?

The keys are detection, cleaning, and ongoing monitoring, with the focus on preventing future ventilation problems. These are difficult tasks, particularly because major portions of air conditioning systems are largely inaccessible by normal means.

ACVA Atlantic Inc. solves that problem with the Air Conditioning and Ventilation Access System, "ACVA." The system is based on the "ACVA Point," which are access points installed at strategic locations along the ductwork, allowing inspection, monitoring, and if necessary, cleaning and sanitization of the entire air conditioning system. Among the procedures used are:

- * Visual inspection of hidden ductwork with a borescope equipped with a fiber-optic light source to which a camera can be attached.
- * Monitoring of germs, bacteria, and fungi using various sampling procedures.
- * Measurement of carbon dioxide, carbon monoxide, formaldehyde, radon, and other gases.
- * Bulk and airborne samples of asbestos, glass, and other fibers. (This sampling can be expanded into detailed risk assessment studies).
- * Monitoring of airborne dust levels, particle sizes, and particulate amounts.
- * Monitoring and recording of air flow, temperature, and humidity, to help improve the system balance.

In addition, continuous, low-cost monitoring is available using specially designed devices called "ACVA SAMPLAIRES." These monitors are fitted to the ACVA Points and continuously sample the air flowing through the system. Technicians periodically remove and replace the ACVA SAMPLAIRES for analysis, as well as repeating routine visual inspections, checking filters, examining the main air handling units, and collecting microbial samples.

Through these steps air quality can be monitored, trouble spots identified, and problems rectified before contamination becomes widespread.

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