Table 1 — Total Airborne Fungal Isolates from Carpeted and Noncarpeted Areas

		Carpeted Ward[1]		Noncarpeted Ward[1]		Bone Marrow Ward[2]		Reference Ward[3]		Outside	
25°C incubation											
Year	No.	Avg.	S.D.	Avg.	S.D.	Avg.	S.D.	Avg.	S.D.	Avg.	S.D.
1995	13	14	24	14	6	7	6	73	67	1,171	1,148
1996	19	33	38	16	19	11	14	32	45	706	986
1997	13	43	51	18	16	24	22	22	16	408	421
1998	12	46	27	11	8	14	8	30	24	1,131	1,293
35°C incubation											
Year	No.	Avg.	S.D.	Avg.	S.D.	Avg.	S.D.	Avg.	S.D.	Avg.	S.D.
1995	13	5	4	3	3	2	2	10	7	145	222
1996	19	3	4	1	3	1	2	3	3	47	58
1997	13	10	14	4	4	3	3	3	3	82	169
1998	12	6	4	3	4	2	2	7	6	70	81

Source: Streifel et al.

[1]90% dust spot efficient filtration; [2]99.97% efficient filtration; [3]Minimal filtration. S.D. = standard deviation

the patient-care area with minimal filtration, they noted statistically similar results. Table 1 shows the total airborne fungal isolates from the various areas.

The researchers noted that comparing carpet to noncarpet areas in buildings is often complicated by the minimal filtration in most buildings. However, the aggressive filtration in this case allowed a better comparison. The authors also note recent literature describing carpet as a filter that will trap contaminants and keep them from the indoor air. However, the authors note that various factors can result in these trapped contaminants becoming airborne. This is especially problematic in facilities such as hospitals where immune compromised patients may be adversely affected by the airborne pollutants.

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School IAQ Improvements Promise Energy Conservation

A multiyear demonstration project being conducted by the US Environmental Protection Agency (EPA) and the National Association of Energy Services hopes to achieve energy and maintenance savings in a group of schools through improvements that are designed to improve indoor air quality.

Yasmine Redding and Jed Harrison of EPA reported on the initial phase of the project — preintervention baseline studies (Vol. 1, pp. 13-17). This first phase characterized building systems and conditions and projected energy savings and cost payback over the life of the contract with the schools.

The purpose of the program is to demonstrate the "performance contracting" approach, an innovative procurement method offered by energy service companies. In this type of program, payment is linked to performance. Typical contracts include an energy audit, design, financing, installation, training, and maintenance for the life of the contract. The average contract lasts 10 years.

In the demonstration project, the investigators selected five public schools in various US climate zones. The schools chosen are representative of typical public schools, and none was known to have IAQ problems. All were selected from schools that had begun considering energy-related performance contracts with energy service companies.

The researchers selected four sampling locations in each school to monitor IAQ baseline parameters. They also characterized the HVAC systems in the buildings before the energy service companies began upgrading the HVAC system. IAQ and ventilation measurements followed the protocol established by the EPA's Building Assessment Survey and Evaluation program.

Baseline and postintervention monitoring took place, as far as possible, during the same one-week period in two consecutive years. IAQ measurements included temperature, relative humidity, carbon dioxide (CO_2), carbon monoxide, illuminance, and noise. Other measurements included inhalable and respirable particulates. Table 2 shows the school characteristics and baseline IAQ measurements.

Baseline measurements showed that some of the schools exceeded accepted guidelines for such things as CO_2 concentrations, and in some cases failed to provide outdoor air at 8 liters per second per person, as recommended by ASHRAE Standard 62-1989. Following collection of baseline data, the contractors began implementing the upgrades. The upgrades include ventilation improvements and will incorporate such technologies as CO_2 sensors for demand control, minimum outdoor air damper positions, air balancing, and repair of exhaust fans.

Investigators will evaluate and report on the improvements in future papers. However, current estimates place the cost of improvements between $250,000 and $841,000, with annual energy and maintenance savings ranging from $27,400 per year to $246,150 per year. Estimated payback ranges from 3 to 15 years. Table 3 shows the cost of improvements and estimated savings.

Table 2 — Building Characteristics and Baseline IAQ Measurements

School	A	B	C	D	E
Location	Minnesota	New Jersey	Colorado	California	Texas
Grade level	Elementary	High	Middle	Elementary	Elementary
Climate (summer)	Humid	Humid	Dry	Mild	Hot
Climate (winter)	Severe	Moderate	Severe	Mild	Moderate
Floor area (m^2)	7,989	26,987	11,278	3,716	4,116
Classrooms	39	103	56	25	42
Occupancy	910	1,900	900	560	700
Total air handlers	4	93	114	6	38
Average indoor CO_2	680	870	1,020	770	1,480
Maximum indoor CO_2	980	2,350	2,290	1,120	2,870
Average outdoor CO_2	370	480	380	420	390
Outdoor air supply (liters per second per person)	2-32	N/A	2-13	3-11	1-4

Source: Redding and Harrison

Table 3 — Performance Contract Benefits

School	A	B	C	D	E
Value of improvements ($)	412,000	841,000	250,000	435,000	738,000
Projected savings (kWh/year)	247,769	1,289,000	146,863	146,877	205,605
Projected savings ($/year)	27,400	142,500	46,000[1]	29,150	246,150[2]
Length of contract (years)	15	10	10	10	3
Estimated payback (years)	15[3]	6	10	15[3]	3
Maintenance included?	Yes	No	Yes	Yes	Yes

Source: Redding and Harrison

[1]Includes operational savings and capital avoidance. [2]Includes capital cost avoidance.
[3]Project subsidized by measures at other schools in the district under the contract.

The researchers have concluded so far that ventilation improvements can be incorporated into energy-performance contracts.

For more information, contact Yasmine Redding, US EPA National Research Laboratory, P.O. Box 93478, Las Vegas, NV 89193.

Intervention Study Finds Symptom Reduction Following Cleaning

A study among office workers indicated that aggressive cleaning can reduce mucosal membrane irritation, with greater effects among allergic subjects. The results were reported by Knut Skulberg and colleagues from the Oslo, Norway-based National Institute of Occupational Health and Ullevål Hospital (Vol. 1, pp. 92-93).

The study was a double-blind intervention, and the researchers selected office workers with the highest mucous membrane irritation scores, attempting to achieve an equal distribution of gender, mucous membrane symptoms, allergy, and age. The investigators originally selected 118 nonsmoking office workers, but lost 14 due to followup problems.

All subjects received the same information: that their offices were to undergo a light spring cleaning. The offices of 49 persons received an intensive cleaning, while the offices of the control group received only a superficial cleaning. Researchers measured airborne dust concentrations and health indicators before and after treatment. Also 98 persons received allergy tests.

In comparing the results among participants, the investigators found that those in the intervention group had a greater reduction in mucous membrane symptoms after the cleaning than those in the control group. Also, the offices that received the aggressive cleaning had a greater drop in airborne dust concentrations.

While the researchers found symptom reduction among both allergic and nonallergic subjects, the report noted that the degree of reduction was larger for those with allergies.

For more information, contact Knut Skulberg. National Institute of Occupational Health, P.O. Box 8149, N-0033, Oslo, Norway.

Introducing Plants Shows No Effects on Microorganisms

An intervention study to determine the effect of plants on microorganisms in office spaces indicates that introducing as many as six plants has little or no effect on airborne fungal spores. S. Rautiala and researchers from the Regional Institute of Occupational Health (Kuopio, Finland) conducted the study and reported the results (Vol. 2, pp. 704-709).

The researchers selected six offices with no known source of microorganisms and no history of office plants. Gradually, they introduced from one to six plants, measuring the concentrations of airborne microorganisms before introduction as well as seven times after placing the plants in the rooms. They also analyzed the soils from the plants to determine fungal concentrations.

Plants introduced included: diffenbachia maculata, scindapsus aureus, ficus elastica, saintpaulia ionantha, and chlorophytum comosum. All came from florist shops and all were in apparently good condition.

Air samples came from a six-stage cascade impactor at a flow rate of 28.3 liters per minute, and all measurements took place during winter months when concentrations of spores in outdoor air would be extremely low. The researchers also took swab samples of settled dust in the offices in the study.

Results

The researchers reported that before the plants were placed in the rooms, the airborne fungi were less than 10 colony-forming units per cubic meter (cfu/m^3), with no actinomycetes present. Following introduction of the plants, the researchers found airborne fungal concentrations less than 34 cfu/m^3. Only 2 cfu/m^3 of actinomycetes were found in one office.