

The Impacts of Cleaning On Indoor Air Quality

Good housekeeping practices can contribute significantly to improved indoor air quality

BY STEPHEN P. ASHKIN

Building problems relating to indoor environmental quality, such as “Sick Building Syndrome,” “Building-Related Illness,” and Legionnaire’s Disease, are just some of the headline grabbers significantly affected by or, in many cases, directly resulting from poor housekeeping and maintenance. Other problems, including increased absenteeism, low morale, and decreased worker productivity, are now being attributed at least in part to poor or “unhealthy” indoor environments that are due to—or correctable by—appropriate housekeeping and maintenance operations.

Thus, building owners and managers attempting to maintain a healthful indoor environment have begun to recognize that among the greatest impacts on the quality of the indoor environment is housekeeping activities. These activities, both routine and scheduled maintenance as well as emergency corrective actions and other unplanned maintenance requirements, are often the chief culprits causing complaints from building occupants and other building-related problems.

Where it was once thought that most problems could be addressed by simply improving operations of the HVAC system, building managers must now address the total picture. In addition to the correct functioning of the HVAC systems, the actual types of chemicals being used, as well as the cleaning procedures employed throughout the building, are essential ingredients for maintaining the healthful indoor environment. This is perhaps best illustrated by a study conducted at the Frank Porter Graham Child Development Center on the University of North Carolina, Chapel Hill campus (See table below).

The study was a collaborative effort between EPA’s Environmental Criteria and Assessment Office under the direction of Dr. Michael Berry, Research Triangle Institute, the University of North Carolina, a building service contractor, commercial cleaning industries, and

their suppliers.

The deep-cleaning procedure, including new cleaning equipment and cleaning supplies, was found to decrease the levels of airborne dust inside the building by 52 percent.

Total VOC concentrations decreased by 49 percent, total bacteria decreased by 40 percent, and fungi colony forming units decreased by 61 percent.

The researchers offered their conclusions as to the cause of the improvement in the building’s air quality. Generally, the improvements resulted from following sound cleaning practices including the use of the most appropriate chemicals and maintenance procedures.

The study took place over the course of a year. Good indoor air quality was maintained even after the conclusion of the study through continued efforts evolving total quality management (TQM) to train and motivate the workers

What also makes this study so meaningful is that these improvements were achieved not in a building plagued with indoor environmental problems where improvements would be easy, but rather in a well-managed “healthy” building, clearly demonstrating the power of effective housekeeping.

Maintaining A Healthful Indoor Environment

Maintaining a healthful indoor environment requires a special focus on the sources of pollution, such as gases, particles, and biocontaminants and their impacts on the occupants of the building and the workers who maintain the building. Unlike many traditional cleaning programs that focus on a building’s appearance, the removal and control of all soils should be the main objectives. Building owners and managers should follow the axiom: Clean for health first, and appearance second.

Housekeeping and maintenance should focus on the maximum extraction of biocontaminants and particles.

Gases can be controlled by adjusting the HVAC system and through the proper selection of cleaning and other chemicals used and stored in the building.

In all cleaning operations, maintenance personnel should try to schedule the cleaning to be consistent with building activities and in such a manner as to not interrupt the activities of the building. Different areas of the building will require area-specific cleaning.

For example, a day care center in an office building will require different maintenance procedures and chemicals performed at a different frequency than a rarely used conference room in the same building. For major cleaning operations, building occupants should be informed as to the maintenance that is to take place and to any other specifics that may impact their health and welfare. This is applicable to scheduled in-house maintenance activities, unscheduled maintenance, and work done by outside contractors

Schedule maintenance with the operation of the building air handling systems to ensure that work being done in one area does not affect other areas, and that adequate ventilation is available for housekeeping and maintenance workers. When possible, schedule work and air handling systems such that the building can be fully ventilated prior to resuming occupancy.

The selection of products should be the least toxic to perform the specific cleaning task. Chemicals should be treated with respect. Always follow proper dilution, use, safety, and disposal directions. Appropriate safety signs, such as “wet floors” or “construction area,” should be used for proper safeguards. Workers should always wear the appropriate safety protection as required by the manufacturers of the products used.

Safer Chemicals Selection

An overall selection strategy for chemical cleaning products should be based

Assessment of Cleaning Effectiveness

Frank Porter Graham Child Development Center, University of North Carolina at Chapel Hill

Air Pollutant Category Housekeeping	Routine Housekeeping 5 Months	Improved 7 Months	% Change	Most Probable Contribution To Improved Air Quality
Airborne Dust Burdens (micrograms/m ³) –Building means	11.9	5.7	-52	Efficient vacuum cleaners and bags Walk-off mats Damp dust cloths Frequent vacuuming and dusting Deep-cleaning of entire building Dust control on hard surfaces
Total VOC (micrograms/m ³) –Building means	324	166	-49	Cleaning chemicals with less VOC's Extraction from carpets Balanced ventilation system
Biopollutants* –Building CFU/m ³				
<i>Total Bacteria</i>	395	237	-40	Rapid use of disinfectants after accidents Control of food and perishables
–Gram-negative bacteria	17	2	-88	New extraction equipment
–Endotoxin (surface)	352**	100**	-72	Hot water extraction of carpets
–Bacillus	22	18	-18	Moisture Control
–Actinomycetes	36	2	-94	Removal of contaminated sources (wall, rotten tree stump)
<i>Total Fungi</i>	127	50	-61	Walk-off mats
–Penicillium	38	5	-87	
–Aspergillus	4	1	-75	
–Cladosporium	35	27	-23	

* Andersen sampler data only ** Endotoxin per gram of dust

around the 5 R's: Re-evaluate, Reduce, Reuse, Recycle, and Renew. The following hierarchy prioritized waste management practices as follows:

Re-evaluate: Re-evaluate the entire cleaning process to determine if the procedure itself is necessary. Determine if the procedure can be eliminated or replaced with a better or more benign process.

Reduce: Reduce the quality and toxicity of materials being used and packaging. For instance, use products that have a moderate pH (close to 7), low or no VOC's, nonflammable, non-corrosive, or non-reactive.

Reuse: Purchase products that are durable, repairable, reusable, or returnable. For instance, select high quality equipment. Considering that 90 percent to 95 percent of the housekeeping budget is labor, using high quality equipment results in maximum efficiencies and minimizes down time.

Recycle: Purchase for recyclability within your organization's recycling collection system. For instance, some chemical products are packaged in bag-in-the-box containers. However, this is only advantageous from a recycling point of view, if cardboard is recycled

within your building and in your area.

Renew: Select products that are derived from renewable feed stocks, such as detergents and solvents from corn starch, coconut oils, and orange peels. In many instances, products from renewable resources (as opposed to petrochemical derived alternatives) are safer to the user and have reduced negative impacts to the environment.

A Material Safety Data Sheet (MSDS) for each chemical product is required by the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA). Become familiar with the basics of the MSDS and review them periodically to insure the safety of the products used and stored.

MSDS Sheets should be kept on file and available for review by workers. Safety training is required annually for all new chemical products in the workplace. And always follow the manufacturer's recommendations for use, storage, disposal, precautions, and first aid.

The 10 Commandments of Housekeeping

The following is a 10 point list of suggested management principles. These

principles are essential in the maintenance of correct and effective housekeeping practices from the aspect of cleaning and protecting the building, the workers who maintain the building, the building occupants and the environment that will be impacted by the building emissions.

1. *Clean to protect health first, and appearance second.* It is not what is seen that is the real area of concern in the indoor environment. Even clean-appearing buildings can be extremely unhealthful. Thus, focus on cleaning for health and in most cases appearance will be addressed at the same time.

2. *Clean and maintain the building as a whole, not just as separate components.* Cleaning and maintenance in one area of a building can have a major impact on other areas. For example, the fumes from the stripping and recoating of a floor in one area can contaminate adjacent areas or even the entire building via the HVAC system. Appropriate actions must take place to ensure health and safety throughout the entire building.

3. *Schedule routine maintenance.* Scheduled maintenance that is frequent and thorough is the most efficient and

effective method for building maintenance and housekeeping. Concise plans and records are a must.

4. *Scrutinize outside contractors.* Pest control services and roofing contractors may not be as concerned or even aware of the impact of their activities on building occupants. The building owner or manager should pay particular attention to the type of products that “outsiders” are using and recognize that the HVAC system may need to be adjusted to mitigate potential problems.

5. *Minimize human exposure to harmful contaminants and cleaning residues.* Workers should always use the appropriate personal protective equipment, areas where work is taking place should have adequate ventilation, work schedules should be established to minimize exposure to building occupants, and the products used should be the most benign to accomplish the task.

6. *Minimize chemical, particle, and moisture residue when cleaning.* The products that are used for building maintenance due to their ability to quickly and efficiently remove oils, soils, living organisms, etc., can also contribute to a building’s problem if used incorrectly. Use the minimum quantity necessary to perform the task, and to insure that all residues are removed.

7. *Ensure worker and building occupant safety at all times.*

8. *Minimize the amount of pollutants entering the building, while maximizing the amount of pollutants extracted.* It is significantly more effective in terms of both time and money to keep contaminants out of the building than to try to remove them once they have entered. This is true for not just airborne pollutants, such as vehicular exhausts, but for dirt and dust from pedestrian traffic, as well as biopollutants from roof leaks and standing water.

9. *Dispose of cleaning waste in environmentally safe ways.* Cleaning wastes themselves can contribute to indoor environmental problems when stored or disposed of improperly. Reactive products can give off toxic fumes and even water-based wastes can become the ideal breeding grounds for disease-causing organisms.

10. *Focus on people.* A successful housekeeping program requires constant efforts in operations and training. Housekeeping as an industry faces high

personnel turnover rates. Thus, ongoing training is necessary. Furthermore, an IAQ Coordinator should be designated and trained to provide a focal point and to create feedback loops between occupants and building management

Conclusion

The challenge for today’s building owner or manager is to meet the demands of their tenants in a highly competitive marketplace. As tenants become more concerned about the impacts of the indoor environment on both their health and productivity, the need to maintain a healthful environment will increase.

It is now clear that housekeeping plays an essential and critical role in maintaining desired indoor environment performance. Building owners and managers will have to address the needs for appropriate product selection, housekeeping procedures, and their commitment to people in order to meet the required performance levels and tenant expectations for a “healthy” indoor environment.

Stephen P. Ashkin is Vice President of the Rochester Midland Corporation and is active internationally with the development of environmentally preferable products and green technologies. Mr. Ashkin serves as Chair of the ASTM Task Force that is writing the Standard Guide On Stewardship for Cleaning Commercial and Institutional Buildings, and a Task Force Chair of the President’s Green Chemistry Challenge. For more information, he can be reached at 716/336-2308.

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Session I: The Financial Case For Cleaning

Cleanliness may be next to Godliness, but while cleaning is recognized as an important function, we measure cleaning only in the most simplistic of terms. Typically we measure cleaning by the number of complaints about smelly bathrooms, trash cans not being emptied and the little round pieces from a three-hole punch which haven't been vacuumed off the carpets.

Many believe that if it looks clean and building occupants aren't complaining, then it must be adequate. And if this is adequate then we should focus on decreasing cleaning costs. Cleaning costs can be reduced by purchasing cheaper and more aggressive chemicals, less efficient vacuums and other equipment, eliminating chemical dispensing equipment, and reducing the frequencies for cleaning, dusting, vacuuming, and other cleaning operations. However in reducing cleaning costs we may actually be decreasing occupant productivity — a poor business trade-off.

Few building owners or managers equate cleaning to health or productivity. Yet many organizations including the U.S. Environmental Protection Agency (EPA), the World Health Organization (WHO) and the Building Owners and Managers Association (BOMA) have all linked cleanings' impact on indoor air quality problems and the subsequent impacts on health and productivity. These numbers are startling. The WHO states that 30% of buildings worldwide suffer from indoor air quality (IAQ) problems. BOMA quantifies the lost productivity due to IAQ problems at 18% annually. And EPA made the clear connection between IAQ and cleaning and quantified the impacts at \$60 Billion of lost productivity, and in the hundreds of billions of dollars when the associated health care costs are included.

It has now be proven that thorough cleaning can reduce the particles, VOCs and biologicals and have a direct and dramatic impact on health and worker productivity. An informed building owner or manager can use this information to give them a competitive advantage leading to increased success in today's highly competitive business environment.

THE IMPACTS OF CLEANING

A study was conducted at the Frank Porter Graham Child Development Center on the University of North Carolina, Chapel Hill Campus. The study was a

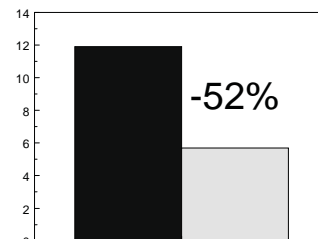
collaborative effort between EPA's Environmental Criteria and Assessment Office under the direction of Dr. Michael Berry, Research Triangle Institute, the University of North Carolina, a building service contractor, commercial cleaning industries, and their suppliers.

The deep-cleaning procedure, including new cleaning equipment and cleaning supplies, was found to decrease the levels of airborne dust inside the building by 52% (Graph 1). Total VOC concentrations decreased by 49% (Graph 2), total bacteria decreased by 40% (Graph 3) and fungi colony forming units decreased by 61% (Graph 4).

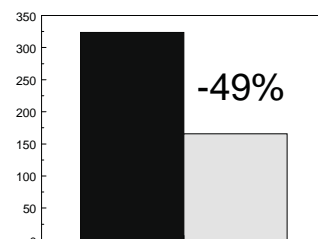
The researchers offered their conclusions as to the cause resulting in the improvement in the building's air quality. Generally, the improvements resulted from following sound cleaning practices including the use of the most appropriate chemicals and maintenance procedures.

Dr. Berry's ground breaking cleaning study quantified the reductions in contaminants. The reductions were dramatic, especially when considering that the study was done in a well maintained building. With these results we can conclude that by decreasing the hazards we would reduce the risks.

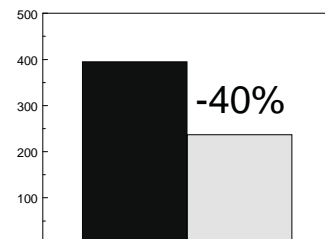
While Dr. Berry's study made the health associations based on reducing hazards, Dr. Leonard Krilov with North Shore University Hospital - Cornell University



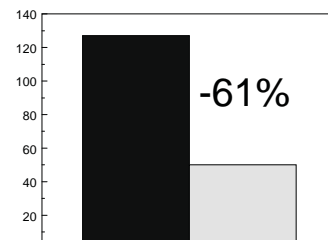
Graph 1: Airborne Dust



Graph 2: Total VOC

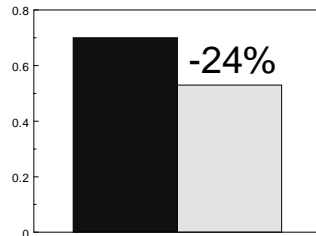


Graph 3: Total Bacteria

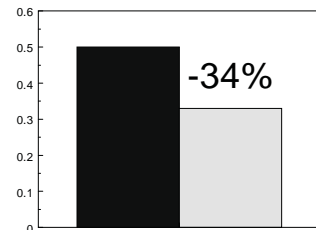


Graph 4: Total Fungi

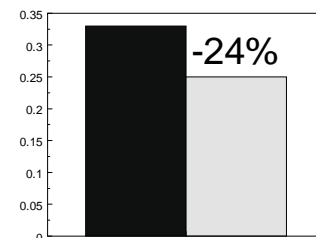
Medical College took the next step. This study conducted at the Association for Children with Downs Syndrome School in Bellmore, New York looked at the health implications associated with improved cleaning. Rather than focusing on the dust, VOCs and biologicals, Dr. Krilov tracked the health and attendance impacts after improved cleaning was implemented. The improved cleaning reduced total illnesses by 24% (Graph 5), doctor visits by 34% (Graph 6), courses of antibiotics by 24% (Graph 7) and days absent from school by 46% (Graph 8).



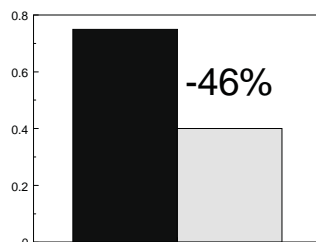
Graph 5: Total Illnesses



Graph 6: Doctor Visits



Graph 7: Courses of Antibiotics



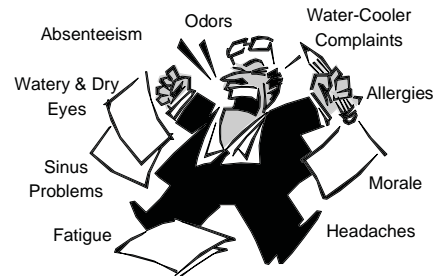
Graph 8: Days Absent from School

In buildings, such as schools and day care centers better cleaning keeps kids in the school which has significant consequences on the children's ability to learn. After all, if Johnny isn't in school, Johnny can't learn. Not only does this directly impact the children, it also affects the families because when Johnny isn't in school, Johnny's parent must stay home from their job to care for him, plus the financial outlays to pay for doctor visits and medications.

But the costs and impacts go beyond just the building occupants and their families. The facility itself may have a direct financial consequence based on increased attendance. In one study done at Syracuse (New York) Public School District by Barry Moore of Opus Consulting reports that attendance increased by 11.7% after improved cleaning was implemented. This generated \$2,513,250 in additional reimbursements to the school for the higher student enrollment.

While we might try to repeat the 11+% increase in attendance that was achieved in Syracuse Schools, this figure would be difficult to attain in the traditional office setting. Parents are willing to keep children home and schools have clear procedures for addressing sick children in the classroom. Office workers on the other hand in the face of down sizing and reorganizing continue to come to work when ill. So while we might not expect double digit improvements in attendance in the office environment, we would anticipate improvements in productivity to easily justify the cost of improved cleaning and in many cases could be used to give the organization a competitive advantage that would directly impact the bottom line.

GENERATING PRODUCTIVITY IMPROVEMENTS

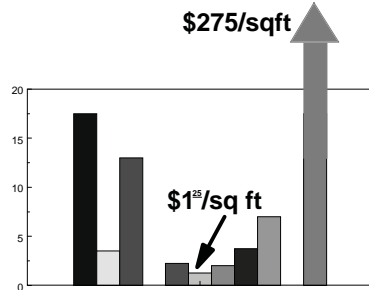


When an employee attends work suffering from health related symptoms such as respiratory illness, allergies and headaches their performance suffers. Symptoms relating directly to cleaning, such as dust from ineffective vacuuming can cause dry and scratchy eyes. VOCs from cleaning products can cause headaches and nausea. Bacterial contamination from molds and fungi can cause allergic reactions and flu symptoms. Even simple odors can cause "water cooler complaints" and low employee morale where workers waste time complaining around the water cooler.

Beyond a justification for additional cleaning, an improved safer, healthier indoor environment can have substantial financial benefits. According to the Building Owners and Managers Association (BOMA) the average costs for a Class A office building is \$275.00 per square foot for the salaries and benefits, while the average cost for cleaning is only \$1.25 per square foot (Graph 9). Thus, each incremental increase of just 0.5% in worker productivity will result in an increase equal to \$1.37 per square foot. These benefits can be

realized by owner occupied buildings to improve productivity, as well as commercial buildings to create added-value or incentives to lease space and retain existing tenants.

In today's highly competitive market-place, improved cleaning can contribute to a more productive workplace. Additional benefits for employers is the contribution that a healthier, more productive workplace can have in recruiting and retaining top



Graph 8: Building Related Costs

talent as part of the quality of life issues. Other benefits could include a reduction in health care and insurance costs. So while cleanliness may be next to godliness, we now know that an investment in cleaning we can improve productivity, attendance and overall success.

Stephen P. Ashkin is vice president of the Rochester Midland Corporation and is active internationally with the development of environmentally preferable products and green technologies. Mr. Ashkin serves as Chair of the ASTM Task Force that is writing the *Standard Guide On Stewardship For Cleaning Commercial And Institutional Buildings*, and a Task Force Chair of the *President's Green Chemistry Challenge*. For more information he can be reached at 716 / 336-2308.