CARPET

Your *Partner* in Managing Allergens & Indoor Air Quality

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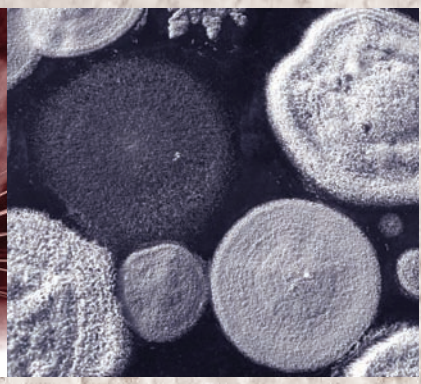

Did you know that carpet can help *improve* Indoor Air Quality?

Carpeting has been an integral part of the indoor environment. But studies now show that in addition to providing warmth and reducing noise, carpet acts as a filter.

Its dense fiber construction has the ability to trap and retain airborne dust, allergens, small particles and fumes, keeping these contaminants and allergens out of the air you breathe.

CARPET IS THE MAJOR AIR FILTER IN THE INDOOR ENVIRONMENT —A FUNCTION THAT IS OFTEN OVER-LOOKED OR UNKNOWN

CARPET ACTS AS A FILTER

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In the last three decades, concern over quality of indoor air has increased. Homes, schools, and offices have been made more airtight in efforts to reduce energy costs. Reduced fresh air exchanges and more time spent indoors have **increased exposure to airborne contaminants**. At the same time, although not necessarily related, there has been an epidemic increase in asthma and allergies. Airborne particles, allergens or chemicals can trigger allergic reactions and asthma attacks.

THE "TRAPPING EFFECT" OF CARPET

Particles, pollen, dander and allergens, which are all light enough to be carried with the wind and too small to be seen, move around indoor and outdoor air. Eventually they settle out on horizontal surfaces. Although dust on bookcases and floors is easily seen, settled dust in carpet is not as visible. According to published research in the *American Industrial Hygiene Journal* by the University of Public Health in St. Louis, Missouri, **carpet is perhaps the most important reservoir of airborne dust, and its contained allergens**.[1] The retention or "trapping effect" of carpet keeps contaminants and allergens out of the air.[2]

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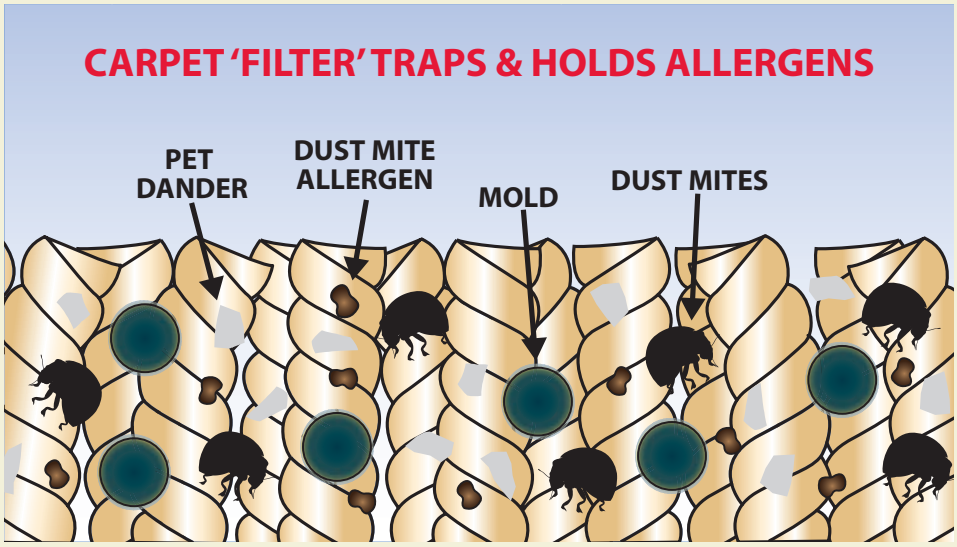
HARD FLOORING VS. CARPET

Reports of biocontaminants found in carpet dust samples have often been taken as evidence that carpet is the source of these contaminants, and will release them into the air. But studies that have taken air and surface samples now show the reverse is true.[3,4] A year-long study in two non-problem schools comparing hard flooring vs. carpet flooring, found significantly higher airborne levels of biocontaminants over the tiled floors than over carpet.[5]

Regular carpet maintenance maximizes the ability to trap particulates as they settle from the air.

Compared to hard floors, studies now show that when carpets are regularly cleaned, their capacity to hold settled dust and allergen out of the breathing zone is most effective. When an air filter is working, it becomes full with use, and this trapped load diminishes its capacity to filter. Although most people routinely replace furnace filters and vacuum cleaner filters, they do not replace carpet very often. Instead, they clean carpet. Research also *shows regular carpet maintenance maximizes the ability to trap particulates as they settle from the air.*[5,6]



*For protocol and results charts visit www.hostdry.com or call HOST at 800-558-9439.

PUBLISHED RESEARCH ON ALLERGENS IN CARPET AND CARPET CLEANING

Much of the published research and publicity on carpet has focused on dust mite allergen in carpet dust. House dust mite allergen exposure is a risk factor for allergic sensitization and asthma development.[7,8] The *Bulletin of the World Health Organization* reports that asthma remains a major clinical problem, and there is evidence that both the prevalence and severity of the disease are increasing: "There is an urgent need for controlled studies, using protocols demonstrated to reduce mite allergen levels by at least tenfold."[9]

Published research on the impact of carpet cleaning on indoor air quality is sparse, and comparisons between studies are difficult. There are variations in protocol, equipment used, carpet characteristics (type, age and wear), and environmental factors (moisture, ventilation, carpet use and season).

A body of published field studies by Racine Industries is an exception. Their field research on HOST® Dry Extraction cleaning in over 180 homes and schools indicates up to 99% extraction of allergens from carpet dust.

This report reviews these published field studies that document the substantial removal of dust mite, cat and mold allergen from both residential and commercial carpet.

CLEANING THE CARPET "AIR FILTER" TO REMOVE ALLERGENS

PROFESSIONAL & DO IT YOURSELF CARPET CLEANING

To measure the effectiveness of carpet cleaning to remove allergens, extensive field studies were conducted by Racine Industries over a period of nine years in 166 homes and 16 schools. The research demonstrated substantial (75% - 99%) removal of dust mite, cat and mold allergen from carpet. The cleaning method used was HOST Dry Extraction with its new, pile-lifting/ vacuuming ExtractorVac® technology.

The series of studies published by Racine Industries* is an exception to the otherwise sparse body of published research on removal of allergen by carpet cleaning.[14,15] Although others have reported allergen removal, their experiments or field studies have not been published in peer-reviewed journals.

VACUUMING ALONE

A search of the published research finds that normal vacuuming removes some, but not all, of mite allergen from carpet, and that the reduction is temporary.[12] Although considerable field research has been conducted into this subject, the ability of vacuuming to remove allergen from carpet is still poorly understood, and the conclusions remain uncertain.[10,11] Each study is specific for one model, or type of vacuum cleaner, and a particular style of carpet. Comparisons between studies cannot be made. The vacuuming field work has employed varying protocols, different makes and models of vacuum cleaners, and a variety of carpet styles in varying stages of wear. This situation is not to be faulted, it is just incomplete. Each experiment is good in and of itself, but not representative of the whole issue. Despite the diversity in methods, vacuum-only experiments consistently report only partial reduction of allergen load in carpets.[12]

These field studies by Racine Industries were presented and published at the 6th and 7th International Conferences on Indoor Air Quality, and published in the Conference Proceedings.[4,16,17] A summary of this research follows.

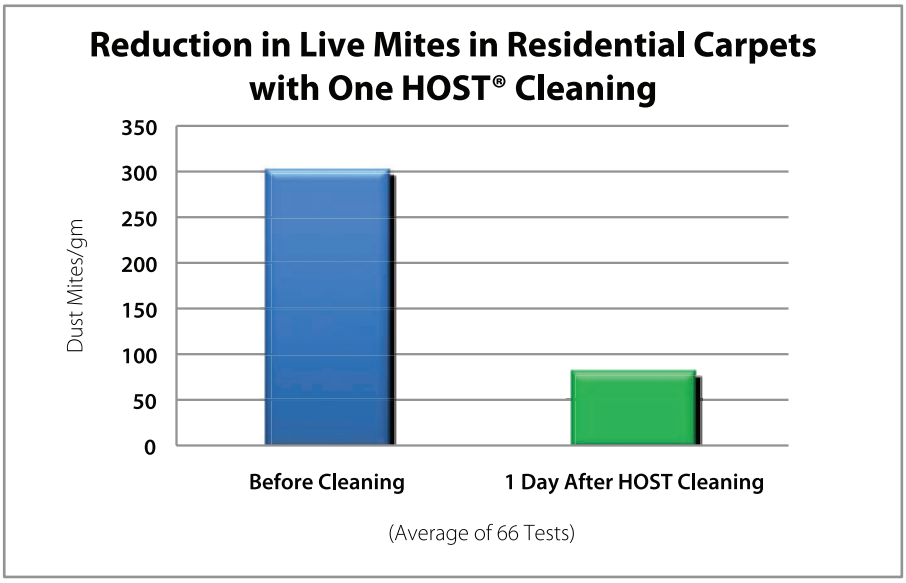
MITE ALLERGEN REMOVAL
With HOST® Dry Extraction Cleaning

RESIDENTIAL CARPET FIELD STUDIES

Racine Industries conducted extensive field tests on allergen removal by the HOST Dry Extraction Cleaning method. The first of these, published in 1993, and presented at Indoor Air '93, the 6th International Conference on Indoor Air Quality and Climate, in Helsinki, Finland, reports on the removal of dust mites and mite allergen from residential carpet in 101 occupied, family homes.[16]

Live mites and mite allergen (scientifically referred to as Der p 1 and Der f 1) in collected carpet dust was determined before and after HOST carpet cleaning in test homes, and during the same time intervals in control homes that received no carpet cleaning. Dust samples were collected in both the test and control groups at 1 day, 1 week, and 1, 2 and 4 months after the single intervention cleaning.

The study spanning a two year period in two states (Wisconsin and Georgia) showed a mean 78% reduction in live mites and 73% reduction of mite allergen. Data is statistically significant to (p=.002) in the Wisconsin group and (p=.036) in the Georgia homes. Mite allergen, when measured one day after cleaning, had dropped from 12,900 ng/gram dust to 3,500 ng/gram dust (mean of 73%, n= 38 homes).



METHODS USED: Dust samples were taken at each site by vacuuming one square meter of carpet for two minutes with a 2.2 hp portable Hoover vacuum (method of Arlian, et al).[18] Dust samples were sent to Wright State University for determination of live mites. Mite allergen (Der p 1 and Der f 1) was analyzed at the Johns Hopkins University.[19] Carpet cleaning in each home was performed by professional HOST

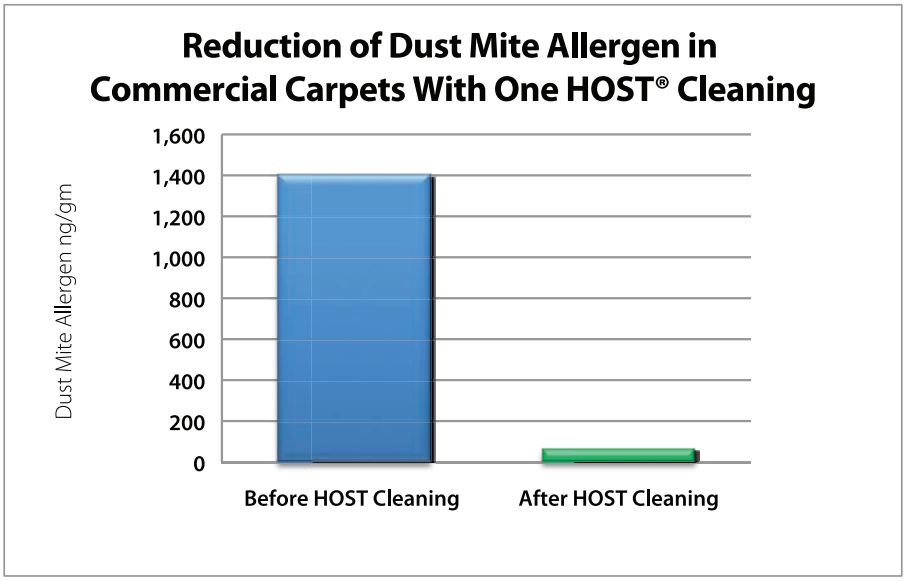
cleaners using Racine Industries' Freestyle® ExtractorVac® (E8) or Reliant® (T5) carpet cleaning machines.

Follow-up sampling at all of the test and control sites was done for four months after the HOST cleaning. **Live mite counts gradually recovered in the cleaned carpets, but were still below pre-cleaning level at the end four months, while during the same time period, dust mites in control homes had increased 94%.** Field trials were conducted in summer months, a seasonal time when mite populations are known to increase due to increasing heat and relative humidity.

COMMERCIAL CARPET FIELD STUDIES

Field trials of HOST cleaning were conducted between 1997 and 2000 with the newer model carpet cleaning machine, the Liberator® ExtractorVac® (EVM). This technology combines pile-lifting and power-vacuuming in one simultaneous operation. Commercial carpet in seven rooms of three schools with no reported indoor air quality problems was sampled for mite allergen before and after HOST cleaning. **The results of this as yet unpublished study show that mite allergen in school carpets dropped from 1,400 to 60 ng/ gram dust, (97%), 24 hours after HOST carpet cleaning**.

These tests used the same sampling methods and analysis laboratories as the residential studies by Racine Industries cited previously. Mite allergen *before cleaning* in these seven classrooms ranged from 200-3,600 ng/ gram dust, which is *substantially lower*, by a factor of ten, than mite allergen measured in the homes of the residential study (12,900 ng/gram dust).

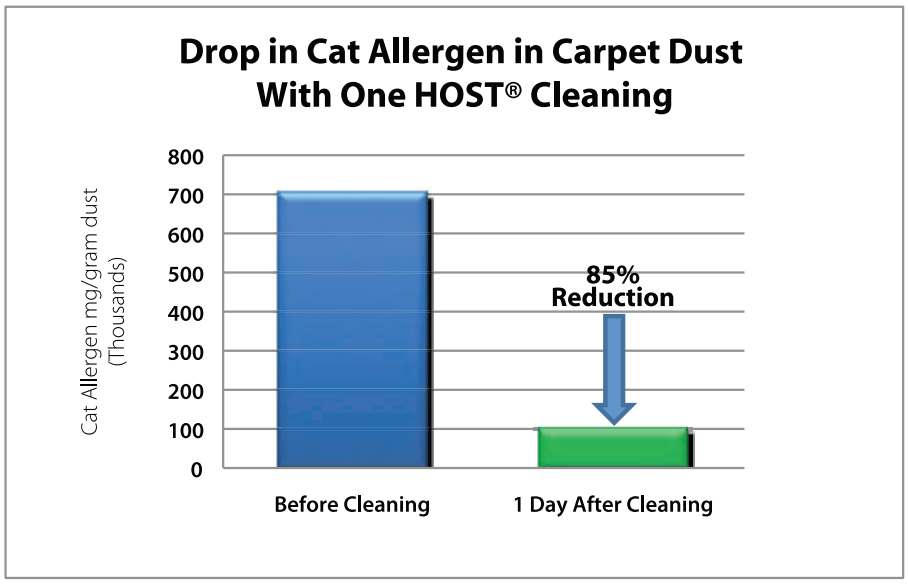


CAT ALLERGEN REMOVAL
With HOST Dry Extraction Cleaning

Unlike mite allergen, which is usually found in localized areas such as mattresses, stuffed animals, and favorite upholstered chairs, cat allergen is widely distributed.[24,25,26] It is found in homes without cats, in schools, on seats and walls of offices, airplanes, and cars. Cat allergen is much smaller and lighter than mite allergen (7 microns vs. 25 microns) and remains suspended in the air for long periods of time. When cat allergen eventually settles out of the air it can be found on most surfaces, window treatments, bedding and clothing. Clothes of cat owners are the main source for dispersal of allergens to cat-free environments.[27]

LOW RISK TO HIGH RISK OF CAT ALLERGEN LEVELS: Cat allergen levels of 8,000 ng/gram dust indicate the presence of at least one cat in a home, and are considered a low risk factor. Cat allergen levels between 8,000 and 80,000 ng/gram dust are considered a moderate risk for allergy symptoms, with levels above 80,000 ng/gram dust considered high risk.

Although soap and water removes cat allergen from walls, furniture, or clothing, vacuuming carpets has been shown to re-suspend more cat allergen into room air than it removes.[28,29] With the exception of research by Racine Industries, few studies have been published that report on removal of cat allergen from carpet by a professional cleaning method.



Cat allergen is so small and light that it can remain suspended in the air for long periods of time causing it to spread around and travel. Often, cat allergen can be found on many surfaces in areas where there are no cats - homes, schools, seats and walls of offices, airplanes and cars!

The new occupants reported no symptoms of cat allergy after they took up residence following the cleanup.

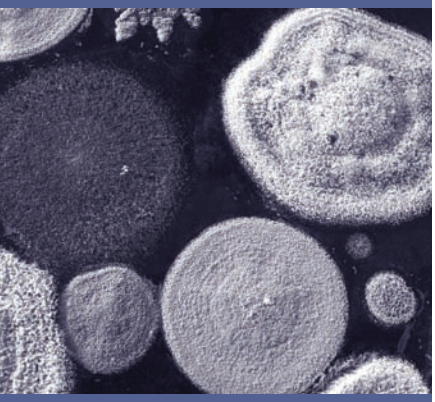
RESIDENTIAL CARPET FIELD STUDIES

An eight home field study conducted by Racine Industries reports an 85% drop (mean) in cat allergen from carpet dust after HOST Dry Extraction Cleaning.[17] The study, which was conducted in homes that had at least one cat for at least one year, collected carpet dust from 16 sites in the homes before and after HOST cleaning. Dust samples were taken from areas that the house cat(s) frequently used for sitting or sleeping. The study was presented at Indoor Air '96, the 7th International Conference on Indoor Air Quality and Climate, in Nagoya, Japan, and published in the Conference Proceedings.

HOST cleaning reduced all high-risk levels for cat allergen to moderate or low risk levels. Initial levels of cat allergen found in the eight homes ranged from 6,802 to 2,190,326 ng/gram dust. Eleven of the sixteen sites in the HOST study had cat allergen levels above 80,000 ng/gram dust, placing owners at high risk for symptoms.[30]

In two of the test homes, the cats and their owners had moved out just prior to the HOST carpet cleaning. New owners of both of these homes reported they were highly allergic to cats. Before the new owners moved in, walls were cleaned, all draperies from previous owners were removed and the carpets were HOST cleaned. The new occupants reported no symptoms of cat allergy after they took up residence following the cleanup, including one new owner who had moved in only six hours after two cats had moved out.

METHODS USED: Dust samples were collected by the method of Arlian, et al. Analysis of cat allergen (Fel d 1) by Johns Hopkins University Center for Allergy and Asthma. Carpet cleaning was done in each test home by a professional HOST cleaner using the HOST Freestyle® ExtractorVac® (E8) or Reliant® (T5)machine.



MOLD ALLERGEN REMOVAL
With HOST Dry Extraction Cleaning

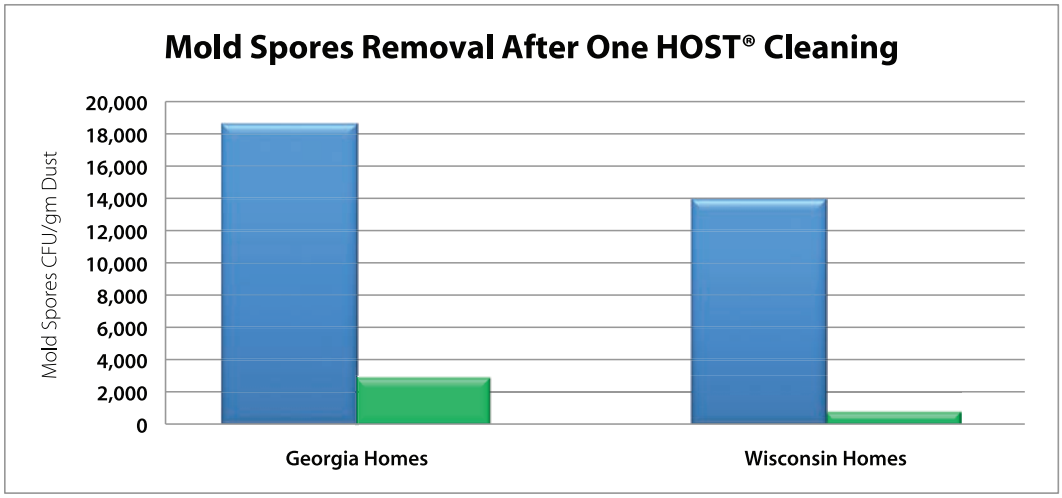
Allergenic mold species have been identified virtually everywhere that sampling devices have been placed. Mold spores (or fungi) are of plant origin, travel with wind currents, and deposit on all indoor and outdoor surfaces. The level of mold spores indoors is a reflection of the outdoor level, unless there is an indoor source. Damp areas from plumbing leaks, condensation, or evaporation (indoor pools), all provide suitable environments for mold growth. When indoor air levels of mold allergen are substantially higher than outdoor levels, there may be excess interior moisture, water damage, or high indoor relative humidity (over 80%). Mold will begin to grow on wet or damp surfaces within 24 to 48 hours. A critical factor in reduction of airborne indoor mold allergen is maintaining dry surfaces.

A body of studies by Hydro Labs specifically focused on carpeting demonstrated that clean carpet does not support mold growth, even at prolonged and elevated temperatures and humidity.[30]

RESIDENTIAL CARPET FIELD STUDIES

Residential, cut-pile carpet in 57 US homes was used in a controlled study to measure the mold allergen in carpet dust before and after HOST cleaning.[17] Control homes in similar locations to test homes were sampled at same times as test homes, but were not cleaned. This field study was done in the summer months, a time when mold spores are high. Homes were located in Wisconsin and Georgia, states with high humidity in summer.

HOST cleaning reduced mold spore levels significantly in all the test homes. Reduction was 94% in the Wisconsin test homes (39 sites in 20 homes, p = .0001). The average drop in the Georgia test homes was 85% (36 sites in 18 homes, p= .04). Mold spore content found in these homes before cleaning varied widely, as is to be expected with airborne allergen. The spore load was higher in the Georgia test homes (200 to 131,200 cfu/gram dust), than in the Wisconsin test homes (200 – 61,600 cfu/gram dust).



All dust samples analyzed at the Johns Hopkins University Asthma and Allergy Center. Carpet cleaning was done by professional HOST cleaners, using either the HOST Freestyle® ExtractorVac® (E8) or Reliant (T5) machine. This field study was part of the work presented by Racine Industries at Indoor Air '96, the 6th International Conference of Indoor Air Quality and Climate, in Nagoya, Japan, and published in the Conference Proceedings.[17]

COMMERCIAL CARPET FIELD STUDIES

Field trials of HOST cleaning on commercial carpet in ten schools were conducted over a three year period. The schools were located in six states in different geographical locations of the country and had a wide range of spore levels before cleaning (11,000 – 200,000 cfu/gram dust). These schools had no reported indoor air quality problems during the school year. One school reported a mold problem after a classroom had been left damp and unventilated over the summer.

In all classrooms tested, HOST cleaning reduced levels of carpet dust by over 90% (91-99%). In 13 classrooms, spore load was reduced by 99%. Carpet dust in 21 classrooms in the ten schools was sampled for mold spore content before and after HOST cleaning. The HOST Liberator® ExtractorVac® (EVM) was used in these studies by either custodians at the schools, or trained HOST cleaners.

A wide range of spore content in carpet dust is normal because outside air levels are highly variable. Air levels change depending on the season, geographical location, and wind currents. In their study Levetin and Shaughnessy[32] sampled outdoor air taken at different times, outside of four schools and found a range of 16 to 15,800 colonies/cubic meter, in 13 samples. Indoor air levels, sampled at the same times, varied from 56 to 2,100. Indoor air concentrations reflect outdoor levels, but are almost always lower, (unless there is an indoor source from persistent moisture or high relative humidity).

FIELD STUDIES IN FLORIDA SCHOOLS

An earlier study in 1995 conducted by Racine Industries of 13 classrooms in six Florida schools also found low mite allergen levels (89 – 663 ng/gram dust) in the carpet of those classrooms with no reported indoor air quality problems.(4) However, mite allergen levels in seven classrooms at four other schools that reported indoor air quality problems were higher - 3,000 -14,700 ng/gram dust.

Mold contamination was also found in the seven classrooms with reported indoor air quality problems, along with a consistently higher relative humidity (60 to 80%) than in classrooms with no reported indoor air quality problems (51 to 64%). Teachers and students in classrooms with documented complaints about indoor air quality reported chronic allergen symptoms of headaches and stuffed sinuses while they were at school**.**

Dampness-related health risks have been identified in an increasing number of school studies.[20,21,22] The World Health Organization reports that people working in damp or moldy building are at increased risk for developing respiratory symptoms, allergic reactions and asthma.[23] Persistent, excessive moisture, which results in mold growth, is almost always the major contributor to indoor mold growth. The importance of moisture management in schools cannot be overemphasized.

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Additional Allergen Studies on School Carpet

Asthma is the most common cause of school absenteeism due to chronic disease.[33] Dust mite allergen is one of the top four indoor allergens that can trigger an asthma attack or allergic reaction, but exposure to dust mite allergen occurs primarily in the home environment.[34,35] Mattresses, pillows, and soft furnishing provide the bulk of exposure.[24,25] Dust mite allergen has not been found to be a major bio-pollutant in schools.[4]

CASE STUDY 1: RELATIONSHIP OF REPORTED ALLERGY SYMPTOMS, RELATIVE HUMIDITY AND AIRBORNE BIOLOGICALS IN THIRTEEN FLORIDA CLASSROOMS.[4]

A multi-school study conducted by Racine Industries examined the relationship between airborne and carpet dust, mold spores and mite allergen in six Florida schools. School was in session during this field study and the students were in the 13 classrooms sampled for the study. Teachers and students in seven of these classrooms (in four of the schools) had reported chronic allergy symptoms while they were at school.

Airborne mold spore counts varied from room-to-room, and from school-to-school. These indoor classroom counts were lower than outdoor levels, and significantly lower than in carpet dust. Spore levels in classroom air did not correlate with complaint classrooms.

Airborne mite allergen was not detected in any of the classrooms sampled. Even in one active, carpeted classroom, where an air sample was collected for eight hours, there was no measurable level of airborne mite allergen. **All classroom carpet cleaned with HOST Dry Extraction after the initial dust samples had been taken showed a 76% reduction in mite allergen level in post-cleaning dust samples taken from the carpet, with no change in airborne allergen levels**.

The Racine Industries study did find a correlation between complaint classrooms

and classroom relative humidity (R.H.). All of the rooms reporting allergy-like problems had an R.H. above 69% (69 to 89%). The R.H. in non-complaint classrooms was lower (51% to 65%).

The complaint classrooms also had musty odors and visible mold growth on ceiling tiles, indicating roof or plumbing leaks. The elevated R.H. in these school classrooms was associated with operation schedules of ventilation systems, and air filtration practices.

MOISTURE AND DAMPNESS IN SCHOOLS

Asthma triggers and respiratory complaints in schools are linked to high humidity and interior dampness associated with mold growth.[36,37,38] Many studies have found that damp or moldy schools were significant risk factors for health outcomes. Smedji and Norback's study of 792 students, in eleven schools, found statistically significant increases in current asthma in classrooms with higher airborne mold counts and higher indoor relative humidity.[22]

Mold grows when airborne spores land on a damp surface. The spores are always present, but require water for growth. Moisture from cooling coils, drip pans, and de-humidifiers or condensation in heating and ventilation ductwork can support continuous growth of mold.[39] Excess water can build up on roofs, bathroom tiles, and around windows. The key to controlling indoor mold growth in schools is to control moisture.[40]

OTHER ASTHMA TRIGGERS

In addition to dampness and mold, asthma triggers in schools are reported from exposure to cat dander or cockroaches, which are both potent allergens. Other irritants that can act as triggers are tobacco smoke, diesel exhaust (from school busses), and airborne dust.[40,41]

The presence, or absence, of carpet in schools has not been found to be associated with asthma or other health effects.[5,42]

CASE STUDY 2: HARD FLOORS VS. CARPET FLOORS IN SCHOOLS WITH NO REPORTED INDOOR AIR QUALITY PROBLEMS: RESULTS OF A YEAR-LONG STUDY[5]

A year-long study of hard floor vs. carpet in two noncomplaint schools in North Carolina found that carpet, due to the trapping and retention characteristics, contained higher dust and contaminant levels, but that **airborne levels of bio-pollutants were significantly lower over the carpeted surfaces than over the hard floor surfaces**.

The study also concluded that flooring was not a major contributor to airborne contaminants in these schools. During this study, the floors were regularly maintained with a cleaning regime that included dust control, vacuuming of carpet and wet mopping of tile floors.

CASE STUDY 3: MITE ALLERGEN LEVELS IN DUST FROM SCHOOLS WITH SMOOTH AND CARPETED CLASSROOMS[41]

Dust mite allergen levels in carpet settled dust vs. smooth floor settled dust was sampled in 49 schools in Rotterdam, Netherlands. **This study found that mite levels in school carpeted flooring was considerably lower than in dust collected from floors in homes**. The study concluded that mite allergen levels were more related to building characteristics such as damp spots, age of floor cover and number of classrooms than to the type of flooring.

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