DRISTEEM®

Humidity and Comfort

When all other factors affecting body heat loss remain constant, increasing the humidity of the surrounding air makes us feel warmer.

Perspiration absorbs heat from our skin as it evaporates, thus cooling us. By controlling the humidity we can vary the evaporation rate and thus affect how warm or cool we feel.

Studies have been done on human comfort under controlled conditions. The resulting criteria are based on skin sensation, psychological responses, and thermal effects.

ASHRAE Comfort Standard 55-75 indicates a preference for a relative humidity ranging between 20 and 50 percent and a dry bulb temperature between 73 and 77 °F.

A comfort analysis was made on groups of subjects under standard conditions (at rest or doing light office work) and wearing standard clothing (long-sleeved shirts and trousers). These individuals submitted comfort votes, which established a range of temperatures compatible with *thermal comfort*. Eighty percent were *thermally comfortable* when all of the following six conditions were present:

- When activity is light office work or its equivalent.
- When *standard* clothing is worn.
- When air motion is 40 feet per minute.
- When relative humidity is 40 percent.
- When mean radiant temperature is equal to the air temperature.
- When air temperature is between 72 ° and 78 °F.

This study found that a 20 percent change in relative humidity was equal to a one-degree F change in dry bulb temperature. Indoor relative humidity maintained between 35 and 40 percent is recommended for optimum comfort during the heating season.

ASHRAE STANDARD 62-1989 recommends: “Relative humidity in habitable spaces preferably should be maintained between 30% and 60% RH to minimize growth of allergenic or pathogenic organisms.”

Individuals have an ideal range of temperature and humidity within which they perform best and feel most comfortable. Excessively high or low humidity causes significant environmental and physiological changes.

Even at higher temperatures, dry air feels colder. When people feel cold, they are uncomfortable and less productive. When the humidity level is ideal, building temperatures can be lowered without changing the comfort or productivity levels.

It has been stated that the energy savings derived from a reduction in room temperature, as a result of proper humidification, will directly offset the cost of the energy consumed in producing that humidity.

Health

The following statements are excerpts from an ASHRAE paper entitled "*The Effect of Indoor Relative Humidity on Colds*," prepared by the late Dr. George Green, Professor of Engineering of the College of Engineering, University of Saskatchewan.

Recommended Indoor Relative Humidity in Winter

"The studies of the influence of relative humidity quoted in this paper demonstrate a reduction in respiratory illness as the relative humidity is increased up to 50%. This would appear to be the optimum for health with our present knowledge.

Most buildings in cold climates will have excessive window and wall condensation at -10 °C, 14 °F outdoor temperature with 50% RH; therefore, this level cannot be maintained constantly. For reasons of health, it would be desirable to hold humidities as high as can be maintained without excessive building condensation. For many buildings with a high occupancy load, controls which keep the maximum humidity, consistent with the outdoor temperature, are justified in view of the high cost of absenteeism resulting from the common cold.

Conclusions

- An increase of indoor relative humidity by humidification in winter significantly decreases the occurrences of absenteeism due to colds.
- With preschool children, the investigation reports reduction of 50% in absenteeism in humidified over non-humidified schools. The reductions in absenteeism of adults was from 6 to 18% in similar investigations.
- It is recommended that winter indoor humidities should be kept as high as possible without causing building damage by condensation, but not to exceed 50% RH.

- The reduction in absenteeism by winter humidification justifies its capital, operating, and energy costs."

Humidity and Skin Disorders

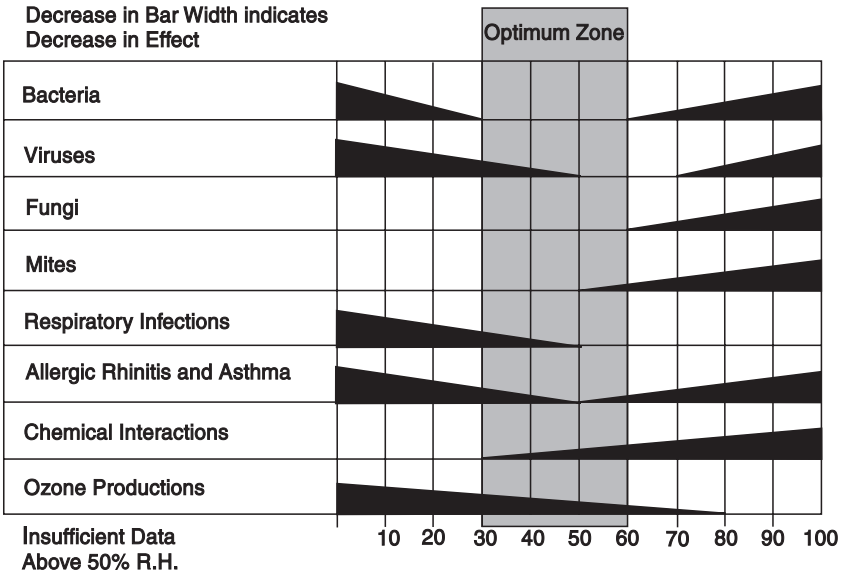
Winter itch, dermatitis, chapping, painful skin cracking at knees and elbows and where the skin meets the fingernails, plus brittleness and splitting of hair and nails can affect almost everyone, but elderly people in particular. Maintaining a relative humidity of 35 to 50 percent may be significantly effective in reducing these troubles.

Hayfever and Asthma

Humidification does little or nothing to alleviate the reaction of the body to specific allergens. It can, however, minimize the formation of house dust, feathers, animal hair, insect scales, etc., which irritate people with allergies.

Some asthmatic individuals have attacks that come on as a result of sudden temperature and/or humidity changes. A constant humidity level seems to help those individuals.

Table 1: The Sterling bar graph



Sterling Study

Further evidence of the health benefits of humidification, is provided by the following information excerpted from an ASHRAE paper prepared by E.M. Sterling, A. Arundel, and T.D. Sterling, Ph.D.

"Unlike most gaseous and particulate contaminants that are primarily affected by indoor and outdoor sources and sinks, relative humidity is also a function of air temperature. In addition to the effect of temperature, the selection of the

most desirable range of humidity is complicated by the conflicting effects of an increase or decrease in humidity levels. For example, increasing humidity may reduce the incidence of common respiratory infections and provide relief for asthmatics. On the other hand, an increase in humidity may increase the prevalence of microorganisms that cause allergies. Criteria for indoor exposure must balance both effects.

The ideal humidity guideline should specify a relative humidity range that minimizes deleterious effects on human health and comfort as well as reducing, as much as possible, the speed of chemical reactions or the growth of biological contaminants (which will impact human health and comfort)."

The Sterling bar graph summarizes the apparent association between relative humidity ranges and factors that affect the health of occupants at normal room temperatures. The figure is constructed as a bar graph relating relative humidity levels from 0% to 100% (shown along the horizontal axis) to (1) biological organisms (bacterial, viruses, fungi, and mites), (2) pathogens causing respiratory problems (respiratory infections, asthma, and allergies), and (3) chemical interactions and ozone production. The decreasing width of the bar represents decreasing effects.

Excerpted Comments:

The bacterial population increases below 30% and above 60% relative humidity. The viral population increases at relative humidity below 50% and above 70%. Fungi do not cause a problem at low humidity; however, growth becomes apparent at 60%, increases between 80% and 90%, and shows a dramatic rise above 90%. Mites require humidity for survival. Growth in the mite population responds directly to humidity levels in excess of 50%.

- Respiratory infections increase at relative humidity below 40%; however, there is little information on effects of humidity in excess of 50%. The incidence of allergic rhinitis due to exposure to allergens increases at relative humidities above 60% and the severity of asthmatic reactions increases at relative humidities below 40%.

- Most chemical interactions increase as the relative humidity rises above 30% though ozone production is inversely proportional to the relative humidity.

- The evidence suggests that the optimal conditions to enhance human health by minimizing the growth of biological organisms and the speed of chemical interactions occur in the narrow range between 30% and 60% relative humidity at normal room temperature. The narrow range is represented by the optimum zone in the shaded region of the graph. Although keeping indoor humidity levels within this region will minimize health problems, there is probably no level of humidity at which some biological or chemical factor that affects health negatively does not flourish. (Note that for many factors, most prominently chemical interactions, effects are still shown within the optimum zone.)"

RH Level Recommendations

ASHRAE standards have long provided guidance for engineers on control of humidity to achieve comfortable conditions. Until 1981 (ASHRAE 1966), the acceptable range of allowable humidity was between 20% and 60%. However, in 1981 the upper limit of that range was expanded to 90% to permit greater air conditioning energy conservation (ASHRAE 1981). But conditions that impact health and comfort through the growth and accumulation of noxious organisms and chemicals suggest a reduction of the existing range of acceptable relative humidity to the region between 30% and 60%. Since this range is much narrower than the former ASHRAE standard it helps to minimize many of the health and comfort problems in buildings, especially those that appear to plague the modern, sealed office structure.

Degradation of the Building Furnishings

There can be little doubt that the interiors of buildings are subjected to expensive damages when the air is not humidified. The fibers of carpeting and upholstered furniture become brittle, causing them to weaken prematurely. Wall coverings shrink, creating unsightly gaps at the seams. Wall paneling, expensive wood furniture, and musical instruments shrink. Framing shrinks, causing cracks and failed joints. Wooden floor boards shrink and the cracks fill with soil, causing the boards to buckle upward when the moisture returns.

Maintaining an adeqate level of humidity eliminates the brittleness of fibers and the cycles of shrinking and expanding that would otherwise occur as the moisture content changes. This then, greatly reduces the deterioration of furnishings and woodwork in the building.

Static Electricity

At one time or another, almost everyone has experienced a *shock* upon touching a door knob after walking across a carpeted room. This *shock* is static electricity, caused in part by low humidity. The phenomenon was first recorded in 600 b.c., but it was not until 1800 a.d. that its cause was identified. It was found that whenever materials of high electrical resistance are moved or rubbed against each other, causing friction, a build-up of a static electrical charge occurs.

Static cling of clothing is another example of static charges. Anti-static treatment of carpeting and clothing reduces, but does not eliminate, static build-up.

Static electricity in our clothing or in our homes may be a nuisance, but it can create more serious problems in certain controlled environments, such as research laboratories or industrial clean rooms.

Among other reasons, hospitals require specific humidity levels, to eliminate static electricity in the presence of mixtures of high concentrations of oxygen and other potentially explosive gases.

Building maintenance is also affected by static electricity. Minute dust particles are present in the air, even in buildings containing high efficiency filters. Some of the room dust is never captured by the air stream to be drawn into the system for filtration. These particles can become "space charged" and adhere to walls, draperies, and other furnishings. Ceiling *stains* surrounding air diffusers are statically charged room dust particles induced by the air-flow pattern and deposited on the ceiling.

Another form of static dust deposit is found where parallel heat transfer takes place, such as at the nails or screws that secure gypsum board to the studding in the exterior walls of buildings. It has been found that the cold nail head becomes negatively charged due to a thermal-electrical static build-up, causing it to attract positively charged dust particles.

All of these static-producing conditions are greatly reduced, if not completely eliminated, by maintaining relative humidity in the 30 to 60 percent range.

Humidity and Odors

Perception of the odor associated with cigarette smoke (suspension of tobacco tar droplets plus vapor) and pure vapors is affected by temperature and humidity. An increase in humidity, at constant dry-bulb temperature, lowers the intensity level of cigarette smoke odor, and that of pure vapors (Kerka and Humphreys; Kuehner). This effect is more pronounced for some odorants than for others. An increase in temperature at a constant specific humidity lowers the odor level of cigarette smoke slightly. Adaptation to odors takes place more rapidly during the initial stage of exposure. While the perceptible odor level of cigarette smoke decreases with exposure time, irritation to the eyes and nose generally increases. The irritation is greatest at low relative humidities.

To keep odor perception and irritation at a minimum, the air conditioned space should be operated at about 45 to 60% RH. Since temperature has only a slight effect on odor level at constant specific humidity, it generally can be ignored. Temperature should be maintained at conditions desired for comfort or economy.

Humidity and Sound Transmission

Sound waves are affected by the level of humidity. Maximum air absorption (or loss) of sound waves occurs at 15 to 20 percent relative humidity. High frequencies are affected more than low. Optimum sound transmission occurs in the range of 40 to 50 percent relative humidity.

References ASHRAE Handbook Fundamentals, 1977.
ASHRAE Journal, June 1981, Are You Comfortable Ralph F. Goldman, PhD.
ASHRAE Handbook, Systems and Equipment, 1996.
ASHRAE Handbook Fundamentals, 1981.
Kerka and Humphreys, 1956
Kuehner, 1956

The Role of Humidification in the Workplace...

For health, comfort and overall productivity humidification plays an important role.

Did you know that proper humidity levels can keep employees at work? Excessively dry air is an ideal environment for a variety of germs that can lead to colds, sore throats and respiratory problems; illnesses that cause considerable discomfort and expensive absenteeism from the workplace. A study done by G.H. Greene shows that raising relative humidity from 22% to 35% can result in a 20% decrease in absenteeism*. Imagine the improvement in productivity if you could cut absenteeism by 20%! In addition, a study by E.M.Sterling revealed that relative humidity levels between 40-60% can enhance human health and minimize many of the health and comfort problems in many buildings.

Even at higher temperatures, dry air feels colder. When people feel cold, they are uncomfortable and less productive. When the humidity level is properly controlled, building temperatures can actually be lowered without changing the comfort or productivity levels.

The right humidity...what it can mean for your building and it's contents.

Dry air literally pulls the moisture out of textiles, carpets, wood, leather, and other hygroscopic materials causing them to shrink, harden or crack. Proper humidity levels help to prolong the life of your buildings and their furnishings. Dry air can also negatively affect computers and other electronics used in the workplace.

Another by-product of dry air is static electricity. Static electricity is not only the nuisance "shock" that you can receive from touching a metal object, it also has impact on the maintenance of your building. For example, low humidity levels can cause minute dust particles to adhere to walls, draperies and furnishings and create stains around ceiling air diffusers.

Humidification doesn't have to cost a fortune

There are many methods that are utilized to humidify commercial office

buildings. Some are more expensive to operate and maintain than others. DRI-STEEM Corporation offers many alternatives for humidifying your facility, including our industry leading gas-to-steam (GTS®) humidifier. The GTS gas fired humidifier allows you to receive the benefits of humidification at the low operating costs associated with gas fired equipment. Compared to an electric humidifier, the GTS can save you as much as 75% in energy costs.

DRI-STEEM Humidifier Company offers a complete line of commercial and industrial quality humidifiers for use in commercial and industrial buildings. We have humidification systems for uses with boiler steam, electricity, hot water or natural gas. All of our humidifiers can be adapted for use in ducts, airhandlers or open spaces without ductwork.

Our technically trained representative sales force or engineering staff can assist you in selecting the proper humidification system for your building.

* *E.M. Sterling, "Criteria for Human Exposure to Humidity in Occupied Building," ASHRAE Winter Meeting 1985.*

DRISTEEM®
The Humidification Experts

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