White Paper

Written by:
Gary L. Berlin
September 3, 2009

Absolute Humidity and the Flu – What is their Relationship?

nortec
humidity.com

"The Flu will be back with a vengeance later this fall because of low humidity."

This was the front page headline in, The Lancaster Intelligencer Journal, a local Pennsylvania newspaper a few weeks ago. Have you seen or heard this in your local news?

This is all related to two recent studies; one from the Mt. Sinai Hospital in 2007, and the other from the University of Oregon in 2008. Both organizations did studies on the relationship of Low Absolute Humidity and the Transmission of the Flu Between Laboratory Animals.

They both state that they were aware of studies that related the detrimental effect of low relative humidity to the transmission and mortality of pneumonia and cold germs. Their studies were to try to find what the relationship humidity and temperature had on the flu virus.

Their basic conclusion was that the absolute humidity not the relative humidity had a highly detrimental effect on the flu virus.

WHAT IS THE DIFFERENCE BETWEEN ABSOLUTE AND RELATIVE HUMIDITY?

Absolute Humidity: Is the amount of water in a volume of air.

Relative Humidity: Is the amount of water in the air in relations to how much water the volume of air can hold at a specific temperature.

The warmer the volume of air the more water vapor it will hold.

Example: One cubic foot of air at 0°F and 100% RH will hold 0.48 grains of water.

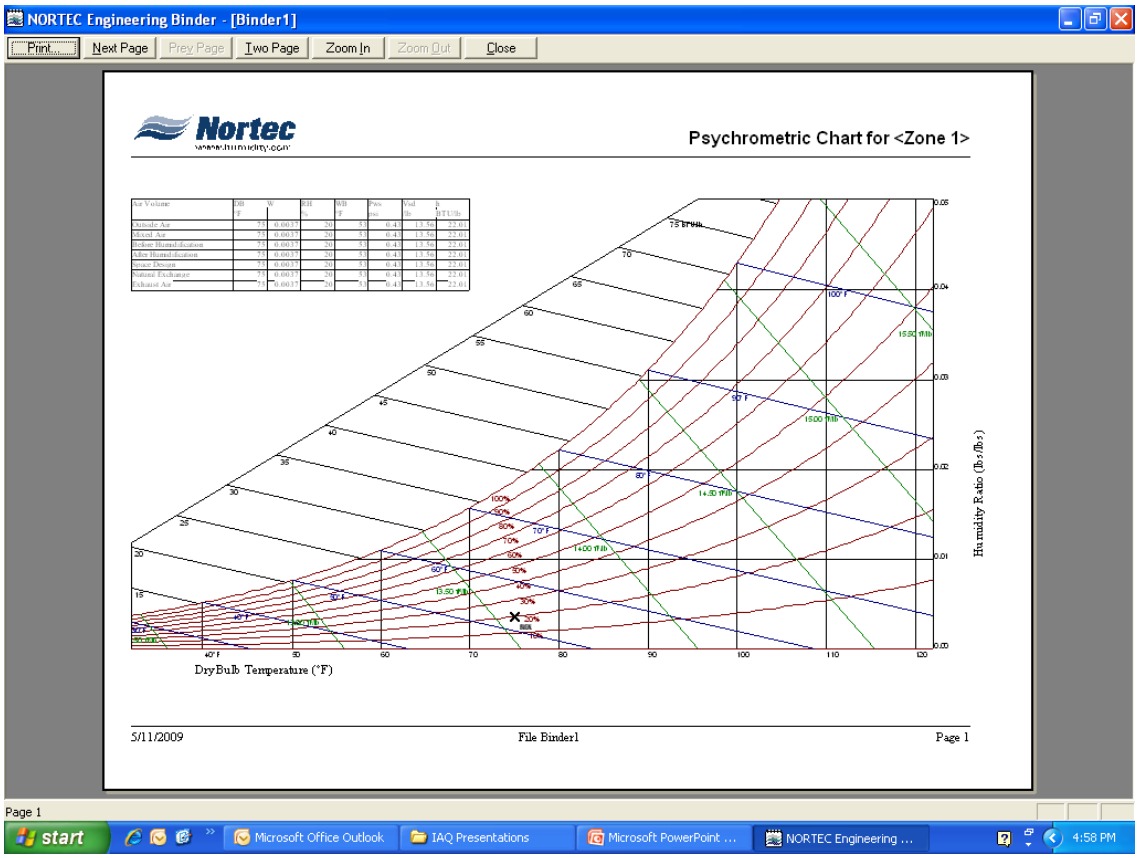
One cubic foot of air at 70°F and 100% RH will hold 8.10 grains of water.

Both of the above have a 100% RH and Absolute Humidity.

However: If one cubic foot of air at 0°F only has 50% RH, it will only hold 0.24 grains of water.

If the cubic foot of 0°F and 50% air is heated to comfort conditions of 70°F this air will only have about 3% relative humidity.

This can easily be seen in the following psychrometric chart.



The Red line shows the absolute humidity at 0°F and 50% and the Blue line shows the absolute humidity at 70°and 50% RH. The weight of water vapor in both stay the same as the temperature is increased or decreased. On the blue line at 50°F the RH is 100% while at 70°F the RH is 50% and at 100°F the RH has dropped to about 20%. All the conditions on the blue line have the same weight of water.

They state that 0°F air at even 100% RH or 70°F air at 3% RH did not have enough moisture to affect the flu virus.

Example: One cubic foot of 70°F 50% RH air will hold 4.05 grains of moisture, approximately 8.5 times the moisture as the same volume of saturated air at 0°F.

They state that absolute humidity should be the measurement criteria rather than relative humidity.

The Black line indicated the humidification process where water is required to raise the 0° and 50% RH to 70°F and 50% RH.

Their conclusions were, as the temperature was increased to comfort levels and the absolute humidity needs to be increased in the air. This increase in water vapor in the air increased the mortality of the flu virus and decreased the transmission rate of the flu virus to the subjects was severely neutralized.

They reference other earlier studies that had similar conclusions using relative humidity at normal comfort conditions. The conclusions of two of these studies are references below.

STUDY #1

The Effects of Relative Humidity on Influenza A

W. Lester – Journal of exptl. Medicine

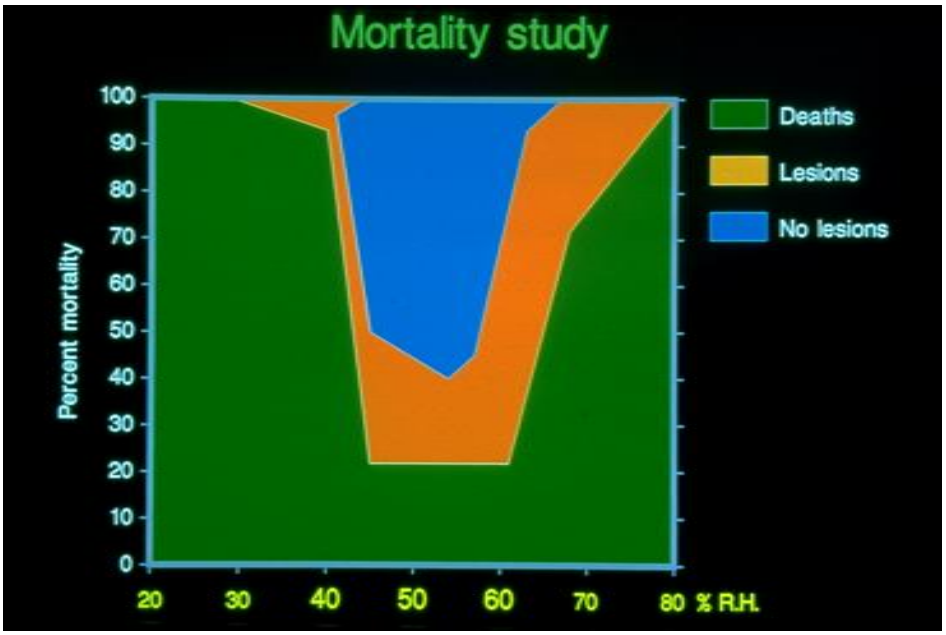


Figure 1: Effect of Relativity on the Infectivity of Air-Borne Influenza A Virus

Conclusion

This study exposed white mice to an atmosphere containing known amounts of atomized influenza A virus of constant potency under conditions of varying RH. It was found that an amount of atomized virus suspension which produced a 100% mortality rate in animals exposed to 30% and 80% relative humidity, respectively, resulted in the death of only 22.5% of the mice at a humidity of 50%. The humidity between these values gave intermediate results.

The infectivity of the air-borne virus decreased so rapidly at a humidity of 50% that it was impossible to secure a 100% mortality rate in the exposed mice even by greatly increasing the dose of the virus atomized.

The findings with influenza virus closely resembled those obtained by Dunklin and Puck with pneumococci, streptococci and staphylococci which would suggest that the factor responsible for the lethal effect of humidity is common to moist particles containing either the above-mentioned bacteria or influenza A virus.

STUDY #2

The Lethal Effect of Relative Humidity on Air–Borne Bacteria

E.W. Dunkin, T.T. Puck – Journal of Exptl. Medicine

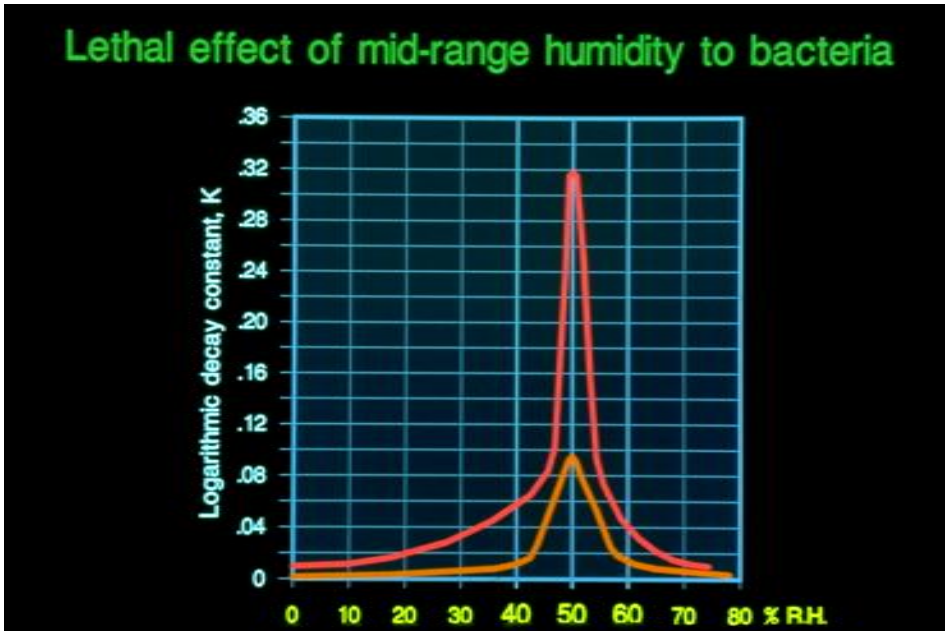


Figure 2: Slopes of the Logarithmic Survival Curves of Pneumococci Sprayed from Broth Suspension into Atmospheres of Various Humidities

K1 is the slope of the initial part of the survival curve and K 2 is the logarithmic decay constant for the final portion of the curve. The values shown for K1 at 50% RH are the average results of more than a dozen experiments. Accurate values for K2 in the central humidity range could not be determined, because so few microorganisms survived beyond 20 minutes.

Conclusion

The viability of pneumococcus, Type 1, sprayed into the atmosphere from a liquid suspension was measured as a function of the relative humidity. When the broth, saliva, or 0.5% saline solution is employed as the suspending medium, a very high mortality rate is observed at relative humidity in the vicinity of 50%. However, at humidity levels above or below this value the microorganisms survive for long periods.

Additional research found the following article in the Feb. 25, 2003 edition of USA Today referencing a study published in the Archives of Internal Medicine of Feb. 23, 2003.

SPEND A FEW BILLION DOLLARS AND CALL ME IN THE MORNING

The common cold costs the U.S economy over $40,000,000,000.00 a year, an amount that is substantially the same as what is spent on other conditions such as asthma, heart failure, and emphysema.

Missed days at school and work, visits to the doctor, and over-the-counter and prescription medications account for the majority of the cost.

Table 1: Dollars Spent in the USA Each Year for Cold Remedies – as per USA Today, February 25, 2003

Remedies	Dollars Spent
Cole remedies	$2.19 Billion
Cough drops / lozenges	$1.88 Billion
Cough syrup / tablets	$423 Million
Nasal products	$426 Million
Sinus remedies	$265 Million
Un-needed antibiotics	$1.1 Billion
TOTAL	**$6,284,000,000.00**

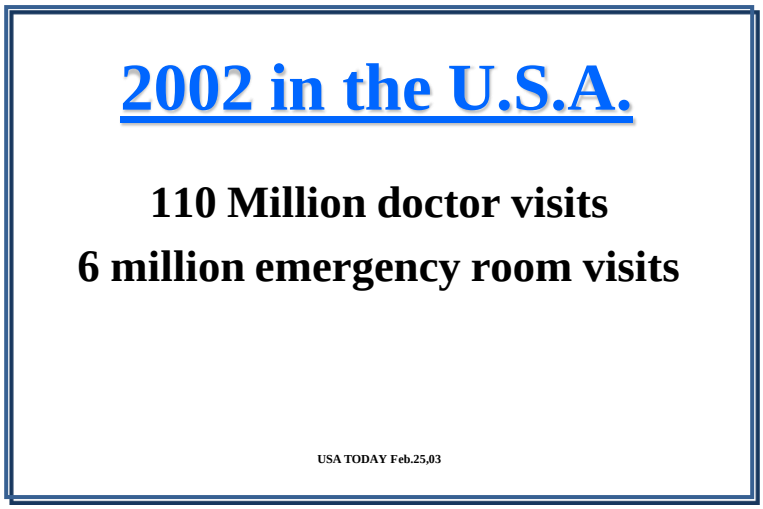


Figure 3: Cold Related Doctor Visits in 2002

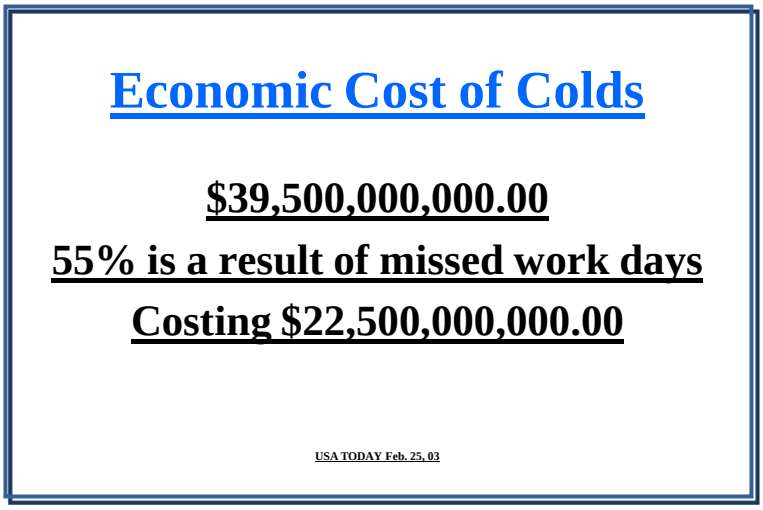


Figure 4: Economic Costs of Colds

Data in the study indicated that about 189,000,000 school days were missed because of colds each year. This caused parents to miss 126,000,000 workdays in order to take care of their children at home and to doctor visits. Including the number of missed work days by adult cold sufferers adds up to a $22,500,000,000.00 in cold related loss each year.

This does not include the dollars related to other health issues and costs not related to this study.

Table 2: Other Health Issues and Costs Not Related to this Study

Flu
Pneumonia
Skin irritations
Eye & contact lens problems
Other

The studies referenced in Figure 1 & 2 and many more were used in the investigation Elia Stirling to develop the chart shown in Figure 5. The new studies confirm the research Stirling used to create this well used chart.

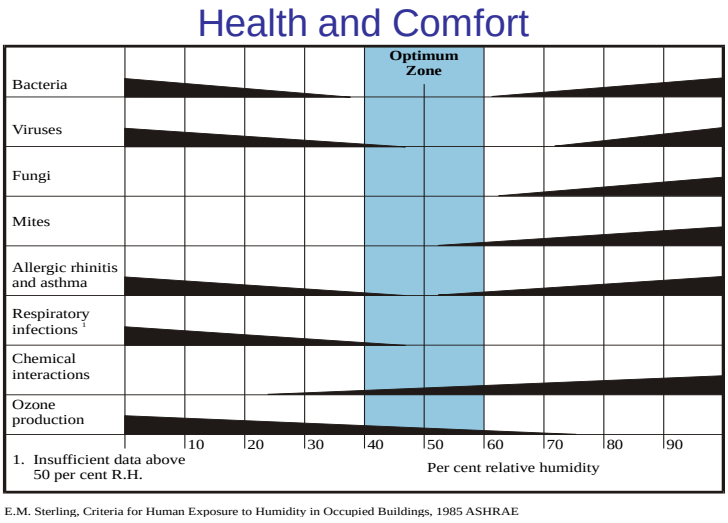


Figure 5: Criteria for Human Exposure to Humidity in Occupied Buildings

The Stirling study relates to the health and comfort issues that affect every person in our work and home environment. The study found that as the RH varied off of the midrange of 40 to 60% other factors in the environment started to affect our wellbeing.

Bacteria, viruses, allergens, chemicals, and indoor ozone all had a detrimental effect on our wellbeing as the relative humidity varies from the medium range. Several of factors increase in their affect as the RH dropped and as it became higher, others were more affected by high or low RH. Chemical interaction is probably because of their interaction with the water vapor in the atmosphere. Normally, indoor ozone is created by static electricity which is usually a wintertime condition.

Many of the above items are interrelated and create the one item that stands out on the chart and shows the direct relationship to the physiological effects of low relative humidity. This is the item titled ”Respiratory Infections”, it relates directly to the above studies on the flu, colds, pneumonia, and other respiratory ailments. This item is the cause of $100’s of billions of dollars in medicines, hospital and doctor’s visits and an increase in healthcare cost nationwide. It is also the cause of millions of lost day at schools, affecting the learning quality for the students. It also relates directly to untold lost dollars due to absenteeism and lost productivity in factories, offices, colleges, universities, laboratories, and other institutions.

WHAT DO ALL THE ABOVE STUDIES HAVE IN COMMON?

Keep the indoor RH in the midrange.

Even in the wintertime!

Low indoor humidity is usually a wintertime condition.

In late spring through early fall normal modern day air conditioning will maintain the indoor relative humidity at a level of about 50% or 60% at normal indoor conditions. Even in the desert, when it is 95°F and 20% RH, the absolute humidity is close to that of 70°F and 50%.

Therefore, if the ventilation air is cooled from the hot arid condition and introduced into the building the indoor conditions will be near the desire level for occupancy. In the tropics there appears to be little concern. In fact, one study indicated **"There is no flu season in the tropics."**

It indicated that there are cases of the flu but not to the extent that they appear in the zones.

Many of the studies relate the "flu season", to the equatorial change of season in the southern and northern hemisphere.

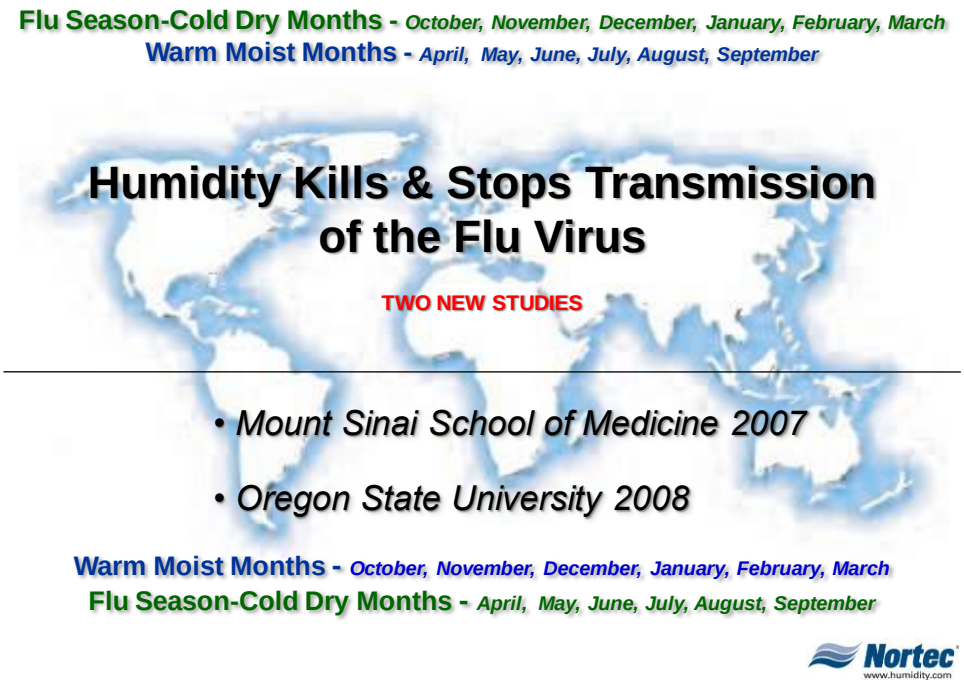


Figure 6: Flu Season Changes in the Northern and Southern Hemispheres

WHY DOES THIS HAPPEN IN THE WINTER?

Table 3: Effect of Introduction of Cold Outdoor Air on the Indoor Relative Humidity

OUTDOOR-INDOOR RELATIVE HUMIDITY CONVERSION

RH	INDOOR RH%													
100	2	4	5	6	7	9	12	17	19	23	29	36	42	53
60	1	2	3	3	4	5	7	9	11	14	17	21	26	31
50	1	1	3	3	4	4	6	8	9	12	14	18	22	26
45	1	1	2	3	3	4	6	7	8	11	13	16	20	24
40	1	1	2	3	3	4	5	7	7	10	12	14	18	21
35	1	1	2	2	2	4	5	6	6	7	10	12	15	18
30	0	1	2	1	2	3	4	5	5	7	9	11	13	15
25	0	1	1	1	2	3	4	4	4	5	7	9	11	13
20	0	1	1	1	2	2	3	3	3	5	5	7	9	10
	-20	-10	-5	0	5	10	15	20	25	30	35	40	45	50

OUTDOOR TEMPERATURE

CHART ASSUMES THE INDOOR TEMPERATURE IS 70 F

As shown in the psychrometric chart and in Figure 7, when the cold dry air outside is introduced to the indoor environment the indoor relative humidity is severely affected. Outdoor air infiltration into a building is usually at a rate of about one air change per hour whether it is introduced through the HVAC system or by simple infiltration. If outdoor air at 0°F 50% is introduced into the structure and heated to 70°F the residual indoor condition will be about 3%.

Even on a nice winter day when the outdoor conditions are 35°F and 50% the residual indoor RH will be only 14% RH.

CONCLUSION

Wash your hands frequently, cover your mouth when coughing, get your flu shot early, and keep the indoor RH as close to the midrange as possible.

Why Nortec Humidity?

Nortec Humidity specializes in the design and production of superior humidification systems. We create the most appropriate solutions to meet your specific needs in the most efficient and cost effective way. To this end, we draw upon our extensive experience to develop an ever growing range of products manufactured to our stringent ISO 9001:2000 certified quality standards that will provide our customers with maximum reliability, minimum maintenance and a choice of energy sources.

When you choose Nortec Humidity, you are choosing the company that has built a reputation for superior quality humidification systems. Only with Nortec Humidity can you select a system operating with electrode steam, subsonic air nozzles, high pressure nozzles, steam injection, steam exchange, or gas-fired technology.

USA 826 Proctor Avenue, Ogdensburg, NY 13669
Canada 2740 Fenton Road, Ottawa, Ontario K1T 3T7
Tel 1.866.NORTEC1 **Fax** 613.822.7964 **Email** nortec@humidity.com

nortec humidity.com