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While it is possible to create those conditions in a laboratory, it is beyond the capabilities of most labs set up for building science experiments. In any event, the purpose of our comment was to make the point that Newman was talking about very dry air, which is not representative of any practical environmental conditions, even in Alaska.

Regarding your question about the units of measurement for absolute humidity, it is the ratio of mass of water to volume of air and yes, you're right, it is therefore somewhat temperature dependent. "Humidity ratio" is the term we should have used. It is the ratio of lbs. moisture per lb. dry air (see graph).

Thanks for your comments.

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RESEARCH & IDEAS

Vapor Retarder Performance in Walls

Two independent laboratory studies of moisture diffusion into walls have shown that without a polyethylene vapor retarder, measurable amounts of moisture will accumulate in wall cavities under typical winter conditions. A third study of 86 tightly built energy-efficient houses found that moisture may accumulate in wall cavities regardless of the type of vapor retarder or the presence of foam sheathing.

Although the results of all three studies are inconclusive, the data suggest that despite the absence of reported damage, moisture accumulation in walls of energy-efficient houses may be significant and that the importance of proper vapor retarders as well as air barriers should not be underestimated.

Manville Tests

At the Manville research center in Denver, a 2x4 test wall was built with no vapor retarder other than two coats of regular latex paint on the interior gypsum board sheathing. The wall was placed in an environmental chamber with room temperature conditions on one side (70°F, 50% relative humidity) and simulated winter conditions on the other. Two separate tests were run. In one test, the cold side temperature was cycled between 20°F and 40°F. In the second test, the cold side temperature was held constant at 20°F for 62 days. To measure moisture accumulation, the test wall was weighed daily. At the end of the experiment the panel was dismantled and inspected.

Results

In both the diurnal experiment and the constant cold experiment, moisture accumulated in the test wall at a rate of about 0.7 lbs. per 100 square feet per day. In the diurnal tests, most of the moisture (97%) was in the sheathing. In the long-term test, 69% of the moisture was in the sheathing and 31% was in the insulation.

Conclusion — Critical of ADA

According to project leader Jack Verschoor, these results underscore the necessity for installing a separate polyethylene vapor retarder to prevent moisture accumulation in wall cavities. During a presentation at the National Institute of Standards and Technology in Washington last month, Verschoor criticized researchers who suggest that a painted drywall air barrier is sufficient to prevent moisture problems in walls. His comments seemed to be directed at proponents of the Airtight Drywall Approach (ADA) developed in Canada and used by many builders in the U.S.

Vapor Retarders in Warm Climates?

Another part of Vershcoor's experiment, now underway, will look at wall behavior in warm climates when the vapor retarder is installed on the outer wall surface. An important question regarding this practice, which is gradually becoming accepted in southern regions, is whether moisture condensation will be a problem during short cold snaps. In contrast to the situation in cold climates, moisture condensation problems develop more quickly in warm climates due to mold growth at warm temperatures.

Sponsored by American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Verschoor's research will be presented at an upcoming ASHRAE meeting. For more information, contact Jack Verschoor, Manville Service Corporation, 1400 Union Meeting Road, Blue Bell, PA 19422.

NIST

Another experiment that investigated moisture accumulation in walls without vapor retarders was just completed by Doug Burch at the National Institute of Standards and Technology (NIST).

A test panel was built similarly to the one in the Manville experiment described above. The interior surface was sheathed with gypsum board and painted with ordinary latex paint. No vapor retarder was installed. The exterior surface was 1/2-inch plywood, painted with an oil-base paint. The 3-1/2-inch cavity was filled with fiberglass batt insulation.

As in the Manville experiment, the test wall was placed in an environmental chamber with simulated indoor conditions on one side (75°F, 50% rh) and outdoor winter conditions on the other (34°F). Unlike the Manville, tests, no cold-side temperature fluctuations were tried in the NIST tests. After 34 days, the panel was dismantled and inspected for moisture.

Results

Although no liquid water accumulated in the wall cavity, the moisture content of the sheathing rose from an initial value of 8.5% at the beginning of the experiment to 18.5% after the 34 days.

Conclusions

The NIST tests show that without a vapor retarder, moisture will build up in a wall cavity during winter. But no liquid water was present in the test wall and Burch was not able to state whether or not a moisture problem would occur in a house with this type of wall system. Since the test was stopped after 34 days, one can only guess whether liquid water might have accumulated over a longer period of time.

For more information on the NIST tests, contact Doug Burch, National Institute for Standards and Technology, Room B114 Bldg. 226, Gaithersburg MD 20899; (301)975-2000.

Field Study in Northwest

A field study of new energy-efficient houses in the Northwest showed excessively high sheathing moisture content, in some cases as high as 55%, in homes with and without vapor retarders. All the houses in this study, conducted by George Tsongas of Portland State University, were built according to the "Minimum Conservation Standards" (MCS), a rigorous set of energy-related specifications devised by the Northwest Power Planning Council.

Tsongas' group removed sections of siding and sheathing on each house, inspected the wall cavity for evidence of moisture condensation and wood rot, and measured the moisture content of the sheathing and framing. A total of 86 houses were inspected during the winter of 1986-87. A few selected houses were revisited during the summer of 1987 and then again during the winter of 1988-89.

Results

Although none of the houses showed any evidence of wood rot, and only one or two showed evidence of past water accumulation (staining of sheathing), a number of houses had sheathing moisture content well above 30% – the fiber saturation point. The average sheathing moisture content was 18.3%. One of the most curious and perhaps most significant observation in Tsongas' study was

Table 1 - Sheathing moisture content of homes in northwest moisture study.
Source: George Tsongas

Wall description	Average sheathing moisture content (%)	# Homes
All	18.3	86
Polyethylene vapor retarder	17.8	50
Noncontinuous vapor retarder such as batt facing	19.6	17
Exterior foam sheathing	17.2	26
Interior foam sheathing	17.4	12
Tyvek housewrap	18.4	48

that the moisture content of the sheathing did not vary much with type of vapor retarder or sheathing (Table 1).

Another curious observation was that during the return visits to several of the study houses, most of the walls which had previously shown high moisture content had dried out. Two possible explanations are 1) the occupants lowered the relative humidity in their homes after the initial inspections, thus reducing vapor drive into the walls; and 2) dry, windy weather which occurred just before the inspections may have dried the walls out.

Conclusions

This study suggests that new tightly built houses may have borderline moisture problems in some climatic regions, but also that drying effects may prevent actual problems from occurring. Since the measured sheathing moisture content appeared to be independent of type or condition of vapor retarder, it raises questions concerning the need and proper design of vapor retarders in walls.

For more information, contact George Tsongas, Portland State University, Mechanical Engineering Dept., Portland OR 97207; (503)464-4292.

The Effect of Thermal Mass on Heating Energy Consumption

A field monitoring study of two test houses in Helsinki, Finland, has shown that thermal mass has no effect on heating energy consumption during winter and only a slight savings effect during spring. The results of this study agree with conclusions from an analysis by Dough Burch at the National Institute of Standards and Technology (see EDU, January 1983).

In the Finnish study, the heating energy consumption of a massive concrete house was compared to a similar light frame house. During the spring months, the massive house used between 5% and 10% less heating energy, but during the winter months, the massive house used between 0% and 2% more heating energy. The net result was that over the entire heating season, the massive house used slightly more heating energy than the light frame house.

For more information, a copy of the research report, "Influence of the Thermal Mass and Heat Distribution System on the Energy Consumption of Small Houses," is available from U.S. Dept. of Commerce, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161; (703)487-4650. Order #DE87753339/WBT.

French Study Pinpoints Occupant-related Ventilation Problems

In France, where mechanical ventilation is required in all new residential buildings, the most common type of ventilation system is the exhaust-only variety with passive air inlets installed in exterior walls.

Two problems that have become evident with these systems after several years of field observation are: 1) occupant complaints about uncomfortable drafts; and 2) malfunctioning air vents due to dust clogging. A field study by D. Bienfait and Cl. Moye of