NAHB National Research Home Park
Resource Conservation Research Home
Insulation System Fact Sheet

The Resource Conservation Research Home constructed in the NAHB National Research Home Park is insulated with modern spray-applied and pneumatically installed loose-fill cellulose insulation. Loose-fill cellulose insulation will be installed in the home's attic area and side walls will be insulated with cellulose wall-spray.

Recycling

Cellulose insulation meets the research objectives of the Resource Conservation Home from several standpoints. Cellulose building thermal insulation is a recycled product made from recovered news-print, one of the largest single components of the residential waste stream. Insulating a typical 1,500 square foot ranch-style home with cellulose insulation productively recycles as much newsprint as an individual will consume in 40 years.[1]

If America's new homes were insulated with cellulose, over 3.2 million tons of waste newsprint could be removed from the refuse stream every year and put to productive use conserving vital energy resources. This projection is based on 1.5 million new homes with an average area of 1,500 square feet, insulated to R-30 in the attics and R-13 in the side walls.[2] If more stringent insulation standards, such as those of the Model Energy Code, were followed even more recyclable material would be removed from the waste stream.

Energy Conservation

Just as significant as its recycling advantage is the superiority of cellulose as an insulating material. Most independent insulation authorities agree that cellulose is the best fiber thermal insulation, and an impressive body of scientific research supports this belief.

Studies at Oak Ridge National Laboratory have proven that cellulose is not subject to the convective effects that degrade the actual R-value of other loose-fill fiber insulation materials at low attic temperatures. Using the Large Scale Climate Simulator at Oak Ridge, scientists have found that the effective R-value of tested mineral fiber insulation dropped from approximately R-18 at +45 degrees F to R-11.1 (and in one test run to R-9.2) at -18 degrees F. Over a similar temperature range nominal R-19 cellulose showed a slight R-value gain of about 10 percent.[3]

Cellulose has long been regarded as superior to other fiber insulation materials in sealing the building envelope against air infiltration. This characteristic was "conventional wisdom" until researchers at the University of Colorado at Denver put the concept to the test in the winter of 1989-90. Two structures identical in every respect, except for the insulation system used, were built.

One building was insulated with R-19 of wet-spray cellulose in the walls and R-30 of loose-fill cellulose over the ceiling. (This is essentially the same insulation system to be used in the NAHB Resource Conservation Research Home.) The second building was insulated with R-19 unfaced mineral fiber batts in the walls and R-30 kraft-faced batts over the ceiling.

Blower door tests demonstrated that the cellulose insulation system tightened the building 36 to 38 percent more than the mineral fiber material. After recording the actual energy performance of the buildings over a period of many weeks the researchers stated:

The research suggests that the performance of cellulose versus fiberglass is as much as 38 percent better. Cellulose achieves a tighter building cavity, allowing less heat loss due to air infiltration and its overall performance appears to be about 26 percent better in tempered climates. It may be concluded that this benefit would become more significant in more severe climates.[4]

Additional energy efficiency factors

Cellulose not only insulates better than mineral fiber materials, it has two other important energy efficiency advantages. The first of these advantages is less "embodied energy." It takes much less energy to make cellulose. Mineral fiber insulation is produced in furnaces that gulp natural gas and release greenhouse gases into the atmosphere. These furnaces burn day and night, month after month, regardless of how much insulation is needed. Cellulose is produced in electrically-driven mills. They consume relatively little energy when they are operating, and they consume no energy once the production day ends.

On a strictly theoretical basis it can be calculated that "R" for "R" mineral fiber insulation takes 15 to 20 times more energy to make than cellulose insulation. Data reported to the Canadian Standards Association suggest mineral fiber production actually requires 59 times more energy than cellulose production, on a pound for pound basis.[5] Adjusting for weight differences, mineral fiber materials take 25 to 30 times more energy to make than cellulose of equivalent R-value.

Adding to this "embodied energy" advantage of cellulose is the fact that cellulose is produced from locally available material. Other than the fire retardants, which represent about 20 percent of cellulose insulation by weight, it is not necessary to transport feedstocks long distances to cellulose insulation plants.

Another collateral energy efficiency advantage of cellulose is its potential to reduce energy expenditures for waste transportation. Many cities and states, especially in the Northeast, are running out of landfill space. There are serious proposals to transport waste from New England and the Middle Atlantic region as far west as Kansas. If substantial amounts of newsprint were removed from this transport stream and recycled locally as cellulose insulation the amount of waste moved to distant landfills could be substantially reduced, with corresponding savings in the amount of energy required to transport the waste.

Safety

Because it is an organic material cellulose is treated with fire retardants. It is the only common residential and light commercial construction material that always receives such treatment. This makes cellulose insulation one of the safest construction materials on the market. Studies of actual fires and demonstration burns have proven that the dense fiber structure of cellulose and the fire retardants slow the spread of fire through a building, giving occupants more time to escape and fire fighters more time to save the structure.[6]

Studies by researchers associated with Oak Ridge National Laboratory have proven that the fire retardants in cellulose do not deteriorate, evaporate, sublime, leech out, or otherwise disappear over time. After studying the permanency of borate-based fire retardant formulas scientists reported that it would take 300 years for there to be significant change in the chemical content of cellulose insulation.[7] A more recent study of ammonium sulfate by the same researchers revealed that this fire retardant was even more stable than the borates. This finding was confirmed by tests of aged cellulose insulation taken from homes in Florida. The tests indicated cellulose treated with ammonium sulfate becomes more fire resistant over time.[8] This may be due to continuing absorption of the fire retardant by the fibers.

History

Cellulose insulation has been produced and installed in new and existing homes for more than 40 years. During the Energy Crisis period of the mid-1970s heavy demand for insulation induced many new producers to enter the cellulose industry. The population of the industry grew from about 50 companies to as many as 750 companies within a few years. Unfortunately, many of these new producers lacked the technical competence — and sometimes possibly the desire — to make high-quality products that conformed to government and industry standards.

Now the number of active cellulose producers has returned to the pre-Energy Crisis level of about 60 companies. Overall quality standards have also improved. Today cellulose is covered by the most

comprehensive and rigorous government and industry standards of any insulation. The vast majority of producers document compliance with these standards through a regular testing program conducted by independent NAVLAP-approved laboratories. The NAHB National Research Center and the Cellulose Industry Standards Enforcement Program have announced a new joint cellulose certification program.

Technology

Cellulose has historically been regarded as a relatively low technology product. That view is gradually changing as cellulose products and installation technology become more sophisticated.

Light density cellulose is one example of this growing sophistication. Ten years ago 2.6 pounds per cubic foot was a typical settled density for cellulose. Introduction of mills incorporating new technologies during the past few years, and refinement of older production equipment, have reduced the typical settled density of cellulose to the 1.8 to 2.0 pcf range. Cellulose products with settled densities of 1.5 or 1.6 pcf are offered by several producers.

Traditionally "open blow" installation of any insulation has been a dusty process, and cellulose has been regarded as especially dusty. Now low-dust cellulose for blown installation is available. This material produces virtually no visible dust during pneumatic installation, resulting in a much cleaner job and more pleasant working conditions for installers.

Wet-spray cellulose, which is installed in wall cavities and covered by sheet rock, is one of the fastest-growing insulation products in new construction. This material is much more effective in preventing air infiltration than insulation batts, as the Colorado study demonstrated, and it is not subject to settling.

Several producers offer similar products for "open blow" installation in attics. These materials use adhesive and a small amount of water to limit settling. The products are marketed under various brand names, and are sometimes referred to as "stabilized cellulose," although this terminology remains unofficial.

The entire matter of settling has been the subject of misconception. Far from being a liability, the settling characteristics of cellulose are one of its greatest strengths. It's because the fine cellulose fibers settle after they are installed that the material is so effective in preventing air infiltration. Other fiber insulation with lighter fibers and a more open structure does not settle into cracks and gaps in the structure as cellulose does. Predictable settling is a favorable cellulose characteristic.

Sellers of other types of insulation occasionally attempt to mislead consumers by stating that the R-Value of a cellulose insulation system will decrease as the material settles. It will, but under federal law and in accordance with the accepted industry standard, cellulose insulation R-values and coverage data are always stated at settled density. Far from being "cheated" out of R-Value as the insulation settles, home owners with cellulose systems actually benefit from an R-Value bonus until the material reaches settled density. There is considerable doubt if most cellulose systems ever reach nominal settled density in the real world of housing.

Standards

Cellulose insulation is covered by the following government and industry standards.

16 CFR Part 1209 — This is the consumer products safety commission safety standard that covers four product attributes, settled density, corrosiveness, critical radiant flux (a measure of surface burning), and smoldering combustion. It is illegal to market cellulose insulation that does not conform with this section of the Code of Federal Regulations.

ASTM Standard C-739 — This is the industry standard for loose-fill cellulose insulation. It covers all the factors of the CPSC regulation and five additional characteristics, R-value, starch content, moisture absorption, odor, and resistance to fungus growth.

ASTM Standard C-1149 — The industry standard for self-supported spray-applied cellulose insulation for exposed or wall cavity application. It covers the following characteristics: density, R-value, surface burning, adhesive strength, smoldering combustion, fungi resistance, corrosion, moisture vapor absorption, odor, flame resistance permanency (no test exists for this characteristic), substrate deflection (for exposed application products), and air erosion (for exposed application products).

16 CFR Part 460 — This Federal Trade Commission regulation, commonly known as the "R-Value Rule," is intended to eliminate dishonest or misleading insulation marketing claims and to insure publication of accurate R-Value and coverage data.

State Regulations — The states of California and Minnesota have state laws and regulations that apply to cellulose insulation and other insulation products. In the case of cellulose both states base their legal requirements on the ASTM standards.

Footnotes

[1] Based on data from the National Solid Wastes Management Association.

[2] Calculation by Koffer and Associates

[3] Wilkes, K., *Proceedings of the International Symposium on Roofing Technology*, 1991
Childs, P.; and Wilkes, K., Report to CISEP on CRADA 90-0029, August 1991

[4] Boonyartikarn, S. and Spiezle, S., University of Colorado 1990

[5] Letters to Canadian Standards Association from G. van der Zanden, Roxul; and B. Wiley, Therm-O-Comfort, Ltd.

[6] "The Big Burn" *Insulators Guide*, September 1978

[7] Chiou, N., and Yarbrough, D., "Permanency of Boric Acid Used as a Fire Retardant in Cellulosic Insulation", *Energy and Buildings*, 14 (1990)

[8] Study by United States Testing Company for Suncoast Insulation 1991