SPECIAL REPORT #1

THE BURNING QUESTION:

the truth about cellulose insulation & fire

Why, with all the truly flammable materials found in a typical home is the safety of the one wood-based construction product that is always manufactured to be fire retardant so frequently questioned? Possibly it is because the makers of other products find it extremely difficult to compete with cellulose on any other basis. Cellulose is simply better insulation.

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Ever since cellulose insulation was first marketed in the late 1940s sellers of competing products have raised questions about the safety of the material. These questions are based on legitimate concerns. Cellulose insulation is an organic material. (It's made from recycled paper pulp.) Without special processing organic materials will burn.

Of course, if organic materials are automatically assumed to be fire hazards, most building materials used in the United States are hazardous, and most residential and commercial buildings are dangerous structures.

Cellulose insulation is one of the few wood fiber building materials that is always treated for fire retardancy and is covered by government and industry standards. Wood framing members, wood floor and roof underlayment, wood siding, wood casegoods, and many other common wood items are not usually treated for fire resistance. Petroleum-based materials in siding, roofing, ducts, flooring, floor coverings, wall coverings, and upholstery are not usually fire resistant.

Why, with all the truly flammable materials found in a typical home, is the safety of the one construction product that is always manufactured to be fire resistant so frequently questioned? Possibly it's because other products find it difficult to compete with cellulose insulation on any other basis. Cellulose is simply better insulation.

The facts on fire

The Fire Hazard Case Against Cellulose Insulation is based on a few surveys that apparently found a high incidence of non-compliance with government and industry standards in samples of cellulose insulation taken from homes. These studies were done by the U.S. Consumer Products Safety Commission in the late 1970s, and more recently by the California Bureau of Home Furnishings and by the CertainTeed Corporation, a maker of glass fiber insulation.

None of the studies have had rigorous scientific review and independent confirmation, but they do merit careful assessment. The CPSC is one organization that has made such an assessment.

Because of its findings CPSC kept close watch on the cellulose insulation issue. As more and more experience accumulated it became apparent there was no significant increase in the number of so-called "insulation-related fires" involving cellulose.

In the fall of 1985 CPSC requested Congress to repeal the federal cellulose flammability standard. Representatives of the Commission testified that the "cellulose flammability standard was not necessary to assure the safety of cellulose insulation and should be repealed by the Congress."

While CPSC was arriving at this conclusion a fire official in Oklahoma became concerned about the "cellulose hazard."

To his surprise a study of "insulation-related fires" revealed that such fires involved mineral fiber insulation and cellulose at rates that paralleled the market shares of the materials. Cellulose, turned out to be no more hazardous than mineral fiber insulation! He looked farther and found there was a common factor in virtually all "insulation-related fires" — recessed lighting. The hazard arbitrarily attributed to cellulose insulation was equally applicable to all insulation.

These findings have been confirmed in other states. In California, where another study apparently revealed a high incidence of non-complying cellulose, a state task force studied over 2 million house fires and reported:

1) There does not appear to be a significant number of fires related to any particular manufacturer's product, and

2) Heat-producing devices and electrical short circuits were major factors in insulated-related fires.

Even when a fire is classified as "insulation-related," the insulation is seldom the first material to ignite. In the vast majority of cases a heat-producing device, such as a recessed lighting fixture, is covered by insulation. Heat builds up and is conducted through wiring or metal brackets to a wood structural member. The wood, or electrical insulation, usually ignites first.

Exploiting fear

The makers of mineral fiber insulation represent fire as a "given" hazard of cellulose insulation, in spite of the vast amount of contradictory data. In 1980 the Mineral Insulation Manufacturers Association, now known as the North American Insulation Manufacturers Association, published a "technical bulletin" based on the original CPSC study. Additional MIMA/NAIMA publications with distorted fire hazard claims have appeared at regular intervals since then.

One bulletin contains such unsubstantiated claims as: "nearly everyone is aware of incidents of cellulose insulation fires." In this case NAIMA was challenged in a critical review of the document by building materials experts at Oak Ridge National Laboratory. In an article based on this review *Energy Design Update*, the energy conservation newsletter for the construction industry, asked editorially: "Is anyone aware of fires starting in cellulose wall insulation? For that matter, are there documented cases of cellulose insulation fires in attics? Not to our knowledge."

In another bulletin NAIMA claimed that "Independent Tests Confirm Potential Fire Hazards of Cellulose Insulation," even though all six cellulose products tested exceeded the requirements of

the only material standard that references the test method used in the study. The NAIMA tests actually proved the safety of cellulose insulation.

Chemical permanency

Since most cellulose insulation sold today carries the labels of credible independent testing laboratories and certification agencies, such as Underwriters Laboratories, United States Testing Company, or the National Association of Home Builders Research Center, a new variation on the basic fire hazard story has been introduced. According to this version cellulose insulation may be safe initially, but over time the fire retardants bake out, leech out, settle out, break down, sublime, evaporate, or somehow disappear.

Following an extensive literature search, the Forest Products Laboratory of the University of Claifornia at Berkeley reviewed all relevant published studies on cellulose insulation chemical permanency and concluded: "The only substantive report that indicated an aging effect is that recently reported by the California Bureau of Home Furnishings and Thermal Insulation."

If organic materials are automatically assumed to be fire hazards, most building materials used in the United States are hazardous, and most residential and commercial buildings are dangerous structures.

CBHF said of its study: "The results are inconclusive and variable, and certainly cannot be used to condemn this material."

Numerous other studies, including tests by scientists and technicians at Oak Ridge National Laboratory, Tennessee Technological University, Allied Signal Corp., US Borax Corp., Underwriters Laboratories, and United States Testing Company, found no sign of "disappearing fire retardants."

Most significantly, no increase in fires involving cellulose insulation has been reported, in spite the fact that every year cellulose insulation in tens of millions of homes gets older and older.

What about those test failures?

Even though laboratory studies do not seem to reflect a "real world" hazard, they should not be ignored. Either they indicate it's pure luck that cellulose-insulated homes are not going up in smoke on a daily basis, or they suggest that the standards for cellulose insulation -- standards current products routinely meet -- are higher than actually necessary to assure safety in real buildings.

Since there are millions of cellulose-insulated homes — many of them over 20 years old and some nearly 50 years old — indications are it's more than good luck they don't have a higher fire risk than homes insulated with other materials.

The Critical Radiant Flux surface burning requirement for cellulose insulation is an example of the stringency of the standards. The minimum of 0.12 w/cm^2 was established by CPSC and ASTM by comparing CRF values with the performance of insulation in full-scale attic assembly burn tests. It has a 50% added safety factor. In addition, unlike most other building material requirements, the CRF of cellulose insulation is not based on the average of several test runs, but on the lowest (worst) value reported for three test runs.

This explains why the high incidence of non-conforming cellulose reported by CPSC in the early 1980s -- but not observed in the market today -- has not equated to a greater hazard in real buildings. In fact, when using actual fire data it's possible to build a convincing case that cellulose insulation makes buildings safer.

What really happens outside the laboratory

Never mentioned by the proponents of cellulose insulation as a fire hazard is overwhelming contrary evidence derived from actual fires. Also never mentioned are the demonstrations in which houses — small sheds, actually — insulated with various materials have been deliberately burned. In every case cellulose-insulated structures remained more or less intact, while uninsulated and fiber glass-insulated structures burned to the ground.

In the so-called "Big Burn" demonstration conducted in 1978 the ceiling of the fiber glass-insulated structure collapsed 21 minutes into the burn. The ceiling of the cellulose-insulated "house" finally collapsed an hour and ten minutes after the fires were ignited. In just over two hours the fiber glass-insulated building was reduced to smoking rubble. At the three hour mark all four walls of the cellulose building were still standing and the fire had essentially burned itself out.

This happens because the dense fiber structure of cellulose, and its fire-retardant characteristics, slow the spread of fire. Hot gasses and flames roar right through the open fiber structure of fiber glass insulation. Because of this, many knowledgeable fire officials and insurance underwriters regard properly-installed cellulose insulation as a positive fire safety factor. By slowing the spread of fire, cellulose gives occupants more time to escape and fire fighters more time to save the structure.

Even the surface burning characteristics of

cellulose may actually reflect favorable performance under fire conditions. The critical radiant flux test — the test most often used to brand cellulose as a fire hazard — is similar to the flame spread tests used to classify construction materials based on how far a flame front advances across the surface when it is heated and ignited.

Implicit in the logic behind such tests is the assumption that the material will keep burning until the fuel source is totally consumed. While this may be true with fabrics, various wood-based and plastic boardstocks, and kraft-faced mineral fiber insulation batts it's not the way cellulose behaves. Once the surface of a cellulose insulation layer is charred it no longer flames, and the charred material actually becomes a barrier against rapid combustion deeper in the insulation. Smoldering combustion may continue, but its progress through the insulation will be very slow.

In the case of a fire inside the house cellulose helps slow its spread through outside walls and the ceiling. (This has been proven in the actual burn demonstrations previously described.) Surface burning is not a factor since the material is not exposed. Kraft-faced mineral fiber batts with flame spreads so high they can't be measured by current methods are also not considered to be a fire hazard when installed in walls.

Conclusions

Mineral fiber insulation will not burn. It's made out of sand, rock, or slag. These are inorganic materials and they are non-combustible. Cellulose insulation is an organic material, and all organic materials are combustible to some extent. However, ascribing a fire hazard to cellulose as a "given" on the basis of this elementary fact of chemistry is a gross oversimplification of chemistry, construction, and fire science.

If organic materials are regarded as inherently unsafe most of the structural members and furnishings of virtually every home, most apartments and condominiums, and many commercial buildings are by definition unsafe. Cellulose, in fact, is arguably the safest organic building material since it is always treated with fire retardants.

The United States Consumer Products Safety Commission does not believe cellulose insulation is a hazardous product. Fire statistics do not support the claim that cellulose insulation is a hazardous product, and knowledgeable fire officials who have studied the matter agree. The preponderance of "real world" evidence indicates cellulose is a positive factor in residential building fire safety.

The vast majority of fire and insulation experts agree that proper installation of insulation, not the specific material used, determines the safety of the insulation system in any building.

Fiber glass reduces fire resistance

The killing blow to cellulose fire hazard claims may have come from the National Research Council Canada in 1994. After extensive tests sponsored by the cellulose industry and the mineral fiber insulation industry NRCC reported that fiber glass slightly decreased the fire resistance of insulated walls, while cellulose produced a 22% to 55% increase in fire resistance.

The other story

The *natural* superiority of cellulose

Higher R-per-inch values than most comparable mineral fiber materials.

Tightens buildings against air infiltration much better than mineral fiber materials. (Colorado University found cellulose at least 36 percent better than fiber glass in tighteneing buildings.)

Not subject to convective heat loss, which has been shown to reduce the actual R-value of comparable mineral fiber materials from 20 to 40 percent in cold weather. (Oak Ridge National Laboratory measured actual values as low as R-12 at nine degrees F for an "R-19" fiber glass installation. Oak Ridge found no R-value erosion with cellulose.)

"R" for "R" requires much less energy to produce than mineral fiber materials, which are made in gas-fired furnaces.

Productively recycles the largest single component of the residential waste stream.

Rationalizes use of resources by putting trees cut to produce an ephemeral product to long-term use saving energy.

Overall, insulates homes better. (Colorado University reported cellulose performs 26 percent better than fiber glass in temperate climates and as much as 38 percent better in cold climates.)

Cellulose. . . .it's naturally better insulation

A supplement: More truth about cellulose insulation

In August 1992 The National Institute of Standards and Technology sent CIMA a letter objecting to the paragraph in *The Burning Question* relating to research conducted by the National Bureau of Standards (as NIST was formerly known) in 1984. NIST states that comments by a member of the research team were "misconstrued" by *Energy Design Update*, the publication in which they initially appeared. To maintain the integrity of *The Burning Question* we feel it is necessary report this communication, however we invite you to evaluate it along with the following facts:

Although it was addressed to CIMA the NIST letter was sent first to members of the fiber glass industry, who have used it extensively as part of an anti-cellulose negative marketing campaign. It was actually read to the executive director of CIMA by a reporter from *The Philadelphia Inquirer* before it reached the CIMA office by mail.

No complaint or objection has ever been sent to *Energy Design Update*, in spite of the fact that the quote attributed to the NBS (NIST) researcher not only appeared in this respected newsletter but was also reprinted in a 1988 *Residential Building Design and Construction Workbook* issued by the publisher of *EDU*.

The editor of *EDU* has notes from the original interview in 1986 on file and stands by both the literal and subjective accuracy of the quote.

The NBS paper itself describes the results as "mixed" — some samples showed increased fire resistance under some conditions — but concluded that cycling through high temperature can adversely influence the chemical fire retardants in cellulosic thermal insulation. Of this conclusion Dr. David Yarbrough, of Oak Ridge National Laboratory and Tennessee Technological University, said: "NBS made stronger statements in their report than they could actually support."

The NBS study was not done with real cellulose insulation as generally available on the market, but involved six specially-formulated material samples, some of which were intended to fail fire tests. It was part of a research program initiated by the American Society for Testing & Materials to determine if environmental cycling in a laboratory environment is an appropriate accelerated aging test for cellulose insulation. The conclusion was that it is not, and no further effort was made to design an environmental cycling procedure for the permanency of fire retardant chemicals.

Subsequent studies by Dr. Yarbrough using acutal cellulose insulation as generally available on the market and involving much more extreme temperature and humidity cycling over longer periods contradict the NBS conclusions.

In addition to this information about the NBS study the California Bureau of Home Furnishings, the source of another study mentioned in *The Burning Question* and often cited by those involved in negative marketing against cellulose, has stated, in writing to CIMA: "Our results should be considered experimental studies to better understand the characteristics of cellulose and go no further than that. The *long term aging studies show the samples maintain their ability to pass the smoldering test normally administered on new materials*. We consider the smoldering test a much more important test than the critical radiant panel in predicting in-field fire performance. We have not received a significant number of reports from California fire departments indicating that insulation materials constitute a fire hazard of major consequence."

Cellulose. . .honest insulation, honest performance, honest safety