Daniel Lea
Cellulose Insulation Manufacturers Association
Building a Greener New Jersey Conference
October 4, 2000

Insulation

The first thing we need to make clear about insulation is that it is not a simple subject. This is Volume 4.06 of the Annual Book of ASTM Standards. It's the volume that covers thermal insulation. It contains more than 950 pages and just about 200 individual standards.

Here are volumes one and two of a series on Insulation Materials: Testing and Applications. Together they have over 1500 pages. There's another volume that's just as big as these two, so we have over 2,000 pages. These are actually the proceedings of a series of symposia ASTM Committee C16 on Thermal Insulation has sponsored over the past decade. This committee, by the way, is one of the larger ASTM technical committees. It has about 370 members. Every year there are several conferences, workshops, and symposia devoted exclusively or in part to thermal insulation.

This tells us is there are a lot of different insulation materials; most of them are available in several different forms; they have a wide range of applications.

Back in 1986 — or thereabouts — USEPA initiated a study to identify building insulation materials that were produced with recycled materials — or which could be produced with recovered materials. They found a few. Using proven, practical technology recycled materials can be used to produce cellulose loose fill and spray-on insulation, cellulosic fiberboard insulation, perlite composit board insulation, slag wool and rock wool, fiber glass insulation, several types of plastic foam insulation, and some fiber glass-reinforced plastic insulation products. The recycled feedstocks are:

- Paper, which is used to make cellulose fiber insulation, some cellulosic fiberboard insulation and perlite composit board insulation.

- Glass, which, as you might expect, goes into fiber glass insulation. Plastic of several different varieties, recycled into plastic insulation.

- Metallurgical slag and spent aluminum potliner, which are used in the production of slag wool

As you might expect, of the several insulation materials that have, or may have, recovered content I know most about cellulose insulation. Fortunately, that is what I've been asked to talk about today.

Cellulose

Many people are surprised to learn that cellulose is the most common building material in the world. That's really not surprising when you understand that cellulose forms the cell walls of plants. Wood is cellulose, and wood is the most widely-used building material. The word "cellulose" is a combination of "cellule," the French word for a living cell and "glucose," which, of course, is sugar. Obviously there's nothing exotic or scary here.

All sorts of cellulosic materials have been used as insulation, including, corncobs, straw, cotton, sawdust, hemp, and probably several things I've never heard of. The material known as "cellulose insulation" today is recovered paper fiber that is treated with fire retardants.

Cellulose is one of the two oldest insulation materials commonly used in residential construction. The other is rock wool. Thomas Jefferson used an early form of cellulose insulation in Monticello. Modern cellulose insulation dates from the 1920s, and it came into general use during the post World War II building boom. Cellulose insulation was used extensively in electrically-heated homes during the 1950s. It was the only thing that made them affordable to heat.

Not only is cellulose insulation a product with a long history, the contemporary industry has a half century track record. The oldest CIMA member has been in business since 1949. Most of the others have been around 25 years, or more.

Throughout the 1980s cellulose probably qualified as "the sleepy backwater" of the insulation industry. There were few significant changes in the products, in the markets for cellulose insulation, and in the ranks of major cellulose insulation producers. By the end of that decade, however, there were definite signs of stirrings in the cellulose segment of the insulation industry. The new light density mills that are now standard were coming into use;

improved wall cavity spray products and the material that has come to be known as “stabilized cellulose” opened new opportunities in conventional home building and manufactured housing; growing public interest in and awareness of so called “green” products all combined to create a favorable environment for cellulose insulation.

Current Cellulose Products and Their Application

Cellulose insulation has been widely regarded as a fairly low-tech material. The fact is most current cellulose products represent extremely sophisticated technology.

This technical sophistication starts with the production process, which now employs mills designed especially for making cellulose insulation. In virtually every plant, computers control most stages of the process, including the chemical feed system. Most producers test the product continuously and adjust the process controls to assure uniformity.

In the area of specific product categories, the newest growth area is low dust cellulose. There are actually two types of low dust products. The latest type of low dust cellulose insulation is loose-fill material especially formulated to produce low dust levels during pneumatic installation. This type of low dust cellulose is installed just as any loose-fill insulation would be. No special techniques or equipment is required

The other type of low-dust cellulose insulation is so-called stabilized cellulose, which use a very small amount of water during the application process. The primary purpose of the water mist is to activate an adhesive that stabilizes the material at a lighter density than conventional low density loose-fill cellulose insulation. This added moisture has the additional effect of greatly reducing the dust level.

Some stabilized cellulose products require proprietary application equipment, but most can be installed using standard blowing machines along with a water nozzle and water flow controls at the machine end of the hose. The water mist is added at the machine so the mixing action that occurs within the hose will distribute the moisture uniformly.

Finally, there is cellulose wall cavity spray. Wall spray isn’t a new material. It has actually been available for nearly 30 years. It is new, however, in the sense that it has recently been one of the high growth areas for cellulose insulation, and a number of improvements in application techniques and the products themselves have been introduced in the last five years.

The biggest difference between today’s wall cavity spray products and those of 20 years ago, or even 10 years ago, is the moisture add-on level. The older products were often called “wet-spray” cellulose, and for good reason. The material was typically sprayed with a 50 or 60% moisture content. It was not uncommon for water to be observed running out of walls after installation.

Contemporary wall sprays are significantly different. The term “damp-spray” is now used because the moisture add-on may be half of what was typically found just a few years ago. The recently published CIMA technical bulletin “Standard Practice for the Installation of Sprayed Cellulosic Wall Cavity Insulation” calls for a moisture add-on as low as 30%.

As with stabilized cellulose, some wall spray products require proprietary application equipment, but most can be installed using standard hardware.

There have recently been significant improvements in wall spray installation equipment. One of the most important developments is two-hopper blowing machines designed especially for cellulose wall cavity spray. These machines overcome a major problem that occurs with conventional single hopper equipment.

For efficiency and economy most installers recycle oversprayed material by collecting it and running it through the installation equipment again. Since water has already been added to this recovered material maintaining the correct moisture level is a difficult task that requires considerable experience and judgment. The new machines eliminate this problem by providing a hopper for dry insulation right from the bag and a separate hopper for recovered overspray that already contains moisture. Thus, the operator does not have to make constant adjustments to compensate for the water-containing insulation that is being recycled.

Other wall installation methods

- Drill and fill
- Membrane or netting

Installation equipment

Cellulose insulation is installed using conventional insulation blowing machines. Even very basic equipment can be adapted for wall spray installation by adding a water feed system at the output side of the machine. Very sophisticated, state-of-the-art equipment is also available. There are machines that not only keep recycled overspray separate from dry material, they actually collect the overspray and convey it back to the blowing machine.

Codes, standards, regulations and specifications

One of the difficult challenges for people not directly involved in the building industry -- and often for many people who are -- is making sense of the often long list of material specifications, regulations, code references, and other items that apply to building materials. The fact that many of these things change on a regular basis complicates the challenge.

For cellulose insulation all requirements start with the Consumer Products Safety Commission standard 16 CFR 1209 and 1404. This federal regulation applies to all cellulose insulation that is marketed as a consumer product, regardless of where in the building it is used or how it is installed. Loose fill cellulose, stabilized cellulose, and cellulose wall cavity spray all must conform to the CPSC standard.

The CPSC standard covers smoldering combustion, surface burning, and corrosiveness. No local or state jurisdiction or other federal agency can adopt or enforce regulations that conflict with the CPSC standard with regard to these performance characteristics. Cellulose insulation that conforms to the CPSC standard can be legally installed in any attic or wall in the United States. Building officials can enforce this standard, if the local building code empowers them to do so.

The insulation industry, working within ASTM Technical Committee C16, has determined that in addition to the performance requirements of the CPSC standard cellulose insulation should meet several other criteria.

ASTM C739-97, the industry standard for loose fill cellulose insulation, adds four product attributes to the four covered by CPSC -- odor, fungi resistance, moisture vapor sorption, and R-factor. The 1997 version of the standard omits a starch test, which has been determined to be unnecessary. It also substitutes a reference to E-970-89 for an internal critical radiant flux test that has been in the standard.

ASTM C1149-97 is the current version of the ASTM Standard Specification for Self-Supported Spray Applied Cellulosic Insulation. This standard, which was also reapproved in 1997, defines three different types of spray-applied cellulose. Type I material is intended for either exposed or enclosed application. This is type of cellulose insulation is often known as “commercial spray.” It’s used for fire proofing and acoustical purposes, as well as as thermal insulation. You often see it sprayed on the underside of roofs and their steel supports in gymnasiums, exhibit halls, factories, and similar buildings. Type II material is intended only for enclosed installation. Wall cavity spray is Type II self-supported cellulosic insulation. Type III material is intended for attic floor application.

C1149 covers all the product attributes addressed by CPSC and C739, but adds an adhesive/cohesive strength requirement. Type II material must support twice its own weight. There is also a test requirement for a flame spread index as determined by ASTM E84, in addition to the critical radiant flux test, so this standard actually requires two different surface burning tests.

Building code requirements

Because of a number of changes in the model building codes over the past few years there is now widespread confusion as to exactly what the codes do require with regard to cellulose insulation. Here in New Jersey the National Building Code, developed by Building Officials and Code Administrators International (BOCA) is the prevailing model code. Here’s the exact language of the sections of the BOCA code that apply to cellulose insulation.

BOCA National Building Code
723.5 Cellulose loose-fill insulation: Cellulose loose-fill insulation shall meet the requirements of CPSC 16 CFR Parts 1209 and 1404, listed in Chapter 35, and shall have a smoke-developed rating of 450 or less when tested in accordance with ASTM E84 listed in Chapter 35.

723.5.1 Labels: Each package of cellulose loose-fill insulation shall be clearly labeled in accordance with CPSC 16 CFR Parts 1209 and 1404 listed in Chapter 35.

This language was adopted by the members of BOCA at the 82nd Annual Conference, held September 29-October 2, 1997, in Norfolk, Virginia.

From now on all the building code action will be in the International Code Council codes. CIMA has been actively involved in the ICC code development process from the start. As a result, the 2000 International Building Code contains the following language:

717.6 Cellulose Loose-Fill Insulation. Cellulose loose-fill insulation shall comply with CPSC 16 CFR Parts 1209 and 1404. Each package of such insulating material shall be clearly labeled in accordance with CPSC 16 CFR Parts 1209 and 1404.

And CIMA has proposed some important code changes to the new international codes that have been adopted by ICC delegates. These changes include:

- Adding "other accepted moisture control methods" to the moisture control sections of several I-codes. The purpose of this is to weaken the prescriptive vapor retarder requirement now found in most codes so a performance-based approach to moisture control can be implemented.

- Putting cellulose insulation on an equal footing with fiber glass and rock wool in calculating wall fire resistance ratings.

- And permitting installation of electrical boxes in the same cavity on opposite sides of fire-rated walls, if the boxes are separated by cellulose or rock wool insulation equal in thickness to the depth of the wall cavity.

- Permitting cellulose insulation to be used as a fire stop around steel through penetrations in fire-rated walls.

CIMA technical bulletins

As of about October 15 CIMA will have five technical bulletins to help specifiers and contractors use cellulose insulation correctly. Bulletin 1 covers in detail the standards and specifications that apply to the material. Bulletin 2 is a general review of basic installation information.

In response to requests from contractors, specifiers, and government CIMA has published "Standard Practice for the Installation of Sprayed Cellulosic Wall Cavity Insulation." This document, which is designated as CIMA Technical Bulletin No. 3, is written in a form suitable for referencing by designers and specifiers. In fact, the Department of Housing and Urban Development has replaced a very voluminous use of materials bulletin, UMB 80, with a greatly simplified UMB 80A, which essentially says see ASTM C1149 and CIMA Technical Bulletin No. 3.

Early this year CIMA published Technical Bulletin No. 4, "Properties and Performance Guideline for Cellulosic Fiber Stabilized Thermal Insulation." This document finally brings some standards to a product category that has been around for more than 15 years.

October 15 is significant, because that's the deadline for proposing changes to Technical Bulletin No. 5 "Standard Practice for Installing Cellulosic Fiber Stabilized Thermal Insulation." When this bulletin is issued we will have closed an important gap in the specifications for our products.

Summary

Cellulose should be your residential thermal insulation choice because it:

- Has more R-per-inch than other fiber insulation materials
- Eliminates air exfiltration into the cavity
- Eliminated convection within the cavity
- Offers better fire resistance
- Has superior moisture handling characteristics
- Is an inherently recycled product.
- Requires 20 to 40 times less energy to produce than furnace-made insulation materials and petrochemical-based insulation.

All thermal insulation is "green," because it results in global net energy savings, and much of it contains recovered material. I think, however, that based on recovered content, installed performance, and embodied energy a careful assessment leads inevitably to the conclusion that, when it comes to insulation, cellulose is the "greenest" of the "green."