SWRP 0465

EPA Insulation Guideline, Part 3

Editor's note: The U.S. EPA's *Guideline for Procurement of Building Insulation Products Containing Recovered Materials* was printed in the Feb. 17, 1989, *Federal Register*. This is the third of three excerpts from the guideline.

The third EPA criterion for selection of reclaimed materials for affirmative procurement under Section 6002 of the Resource Conservation and Recovery Act is that the material has technically proven uses in the designated items. Recovered materials currently are commercially acceptable feedstocks in four types of insulating materials covered by the guideline issued today: cellulose, composites, plastic rigid foams, and rock wool.

Cellulose

For purposes of this guideline, cellulose is defined as vegetable fiber such as paper, wood, or cane. There are two types of cellulose insulation products: cellulose loosefill and fiberboards made from cellulose.

Cellulose loosefill and spray-on insulation: Cellulose insulation is made from approximately 75% waste paper; the remaining portion consists of chemicals to retard flammability and to deter insects and pests. While there is some spray-on cellulose insulation made from waste paper, the industry predominately makes loosefill insulation, which is blown into walls and attics.

Cellulose insulation comprises about 3% of the insulation market, according to a 1987 industry estimate. The cellulose insulation produced in 1984 consumed approximately 480,000 tons of recycled paper. More recent data have not been obtained.

The U.S. Department of Commerce listed 371 manufacturers of cellulose insulation in 1983. Four years later, in July, 1987, the Cellulose Industry Standards Enforcement Program (CISEP) identified 138 active firms. This indicates continued shrinkage in the cellulose insulation industry.

Thirteen of the companies identified by CISEP produced approximately 20% of the cellulose insulation manufactured in 1987. Cellulose insulation manufacturers are located all across the country; consequently, availability to procurement agencies should present no problems.

Fiberboard made with cellulose: These fiberboards are made in panels of varying thicknesses from wood, cane, or paper fibers. They are often called insulating boards, although they are frequently used for structural reasons rather than for their insulation properties.

Fiberboard manufacturers no longer have a trade association, and data regarding market share are not available. The American Paper Institute groups data about "insulating boards" within the construction paper and board category.

Estimated production of insulating board for 1986 to 1989 remained flat at 1,178,000 tons. The entire construction paper and board category was estimated at 2.2 million tons, with estimated consumption of recovered paper materials growing from 929,000 tons in 1986 to just over 1 million tons in 1989. The recovered paper feedstocks were predominantly postconsumer newspapers, mixed paper, and corrugated.

There is no estimate of recovered paper consumption for insulating boards alone.

Perlite composite board

Some composite boards are made with expanded perlite aggregate (a virgin mineral), small amounts selected binders, and waste newspapers. The materials are mixed together and formed into rigid, flat, rectangular units that may have facings on one or both sides according to the ASTM (American Society for Testing and Materials) C-728-82 standard specification.

Perlite composite board is primarily used for commercial and industrial roof insulation. Market growth follows growth in the gross national product and is expected to remain at 1987 levels for the next few years.

Approximately 0.2 pound of newspapers is used per board foot of the finished product. Approximately 500 million board feet were produced in 1987 by the only two known manufacturers, consuming about 50,000 tons of waste newspaper. The percentage of newspapers in the final product varies from 23% to 30%, with the average about 24%. Product availability to government procuring agencies is limited only because it is manufactured by just two companies.

Fiberglass insulation

Fiberglass insulation is primarily made from sand, limestone, soda ash, and boron. Other materials are added to product mixes in small quantities. The materials are melted together and spun into filaments called "batt."

Cullet is a substitute for sand, limestone, and soda ash. Boron, the most expensive primary ingredient, is not contained in bottle or plate glass cullet.

Recovered materials used in fiberglass insulation products include preconsumer waste glass from other manufacturing processes, such as plate glass, container glass, and transition cullet (material from glass furnaces produced while mixes are being changed), as well as postconsumer bottle cullet in isolated instances. Home scrap produced in the manufacturing process is called refeed by the fiberglass industry and is usually consumed by the generator.

The fiberglass industry states that mixed-color waste glass (pre or postconsumer) can be used if the mixtures are consistent batch to batch. The industry further states, however, that green and amber bottle cullet introduce trace metals used to create the colors, which can cause difficulties in fiberglass furnaces. Variation in quantities of the colors can change the characteristics of the melt, and therefore require costly process adjustments.

Some manufacturers have stated that there are production advantages in using recycled glass. Melting cullet instead of melting virgin materials provides energy savings. In the proposed guideline, the EPA states the energy savings to be 10% to 15%. Industry comments state that the savings are considerable lower. One producer estimates 0.3% per each 1% of cullet in the batch; another has found 1% of energy savings for each 10% of cullet used.

Cullet use is also said to speed up production lines, increasing the production rate. At least one fiberglass plant intermittently has experimented with 40% or more cullet, including postconsumer bottle cullet, in 1986. However, this is not common to the industry and was discontinued by the parent company when the plant was closed. Another company, using a European fiberizing process, has been experimenting with using low percentages of cullet; according to the company, however, the expected production advantages have not been realized.

Other manufacturers consider bottle cullet to be an unacceptable feedstock for a number or reasons.

First, and most important, it is not consistently available, which would interrupt long-term contracts from feedstock suppliers of limestone, soda ash, and sand. Second, as discussed above, batches of postconsumer mixed-color bottle cullet do not con-

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sistently contain the same percentages of individual colors, which causes processing disruptions.

Third, price is a restraint on using bottle cullet. At 1986 costs of production, a price of 2 cents to 25 cents per pound ($40-$50 per ton) for green glass cullet was said to be acceptable.

The fourth factor is contaminants. While cullet does not have to be color-sorted, even minor contamination with metal, plastics, ceramics, or carbon causes problems in fiberglass processing lines.

While data are not gathered, knowledgeable sources estimate 175,000 tons of preconsumer cullet are sold to the fiberglass industry annually.

Unlike the glass container industry, which favors bottle cullet partly because it contains the key ingredient soda ash, the fiberglass industry obtains much of the needed soda value from other raw materials containing alumina and boron. Therefore, neither soda ash costs nor scarcities have much impact on the costs of producing fiberglass.

Some fiberglass manufacturers have indicated interest in using postconsumer cullet if it were to become available in consistent quantities and qualities at competitive prices. These companies believe that cullet-processing technology would have to be improved to meet their specifications for consistent color mix and low contaminant levels.

With nearly a 70% market share, fiberglass dominates the total insulation industry. In 1987, there were six companies producing fiberglass insulation at 26 locations.

Plastic rigid foams

Plastic rigid foam insulation is made by expanding resins to create cells. Blowing agents are used to enhance the formation of cells and, in some cases, the blowing agent remains trapped within the cells to increase insulating properties.

Rigid foam insulations have higher R-values than equivalent thicknesses of other insulations, although they tend to cost more. The higher the R-value, the better the insulating properties.

There are several basic types of plastic rigid foams in general use, including polyurethane, polyisocyanurate, polystyrene, and phenolics. The use of plastic rigid foam insulation appears to be the most rapidly growing of all types of insulation.

Polyurethane and polyisocyanurate insulation: References to polyurethane (PU) and polyisocyanurate (PIR) insulations tend to be confusing. For simplification in this guideline, the term polyisocyanurate/polyurethane (PIR/PU) will be used.

PIR/PU insulation is primarily board and laminated board products used to insulate walls, roofing, and doors in residential and com-

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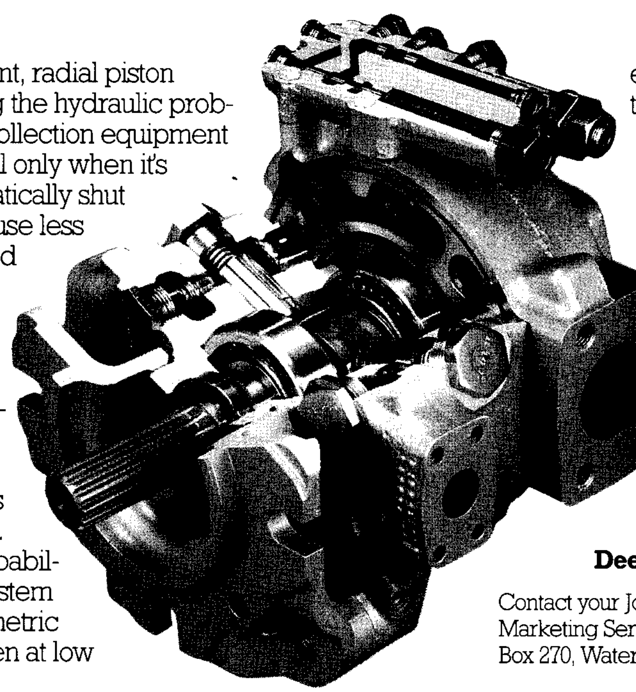

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mercial buildings. PIR/PU board insulation is made with various formulas, depending on the requirements of the final product.

Ingredients are used in the following ranges: isocyanate, 53%-57%; aromatic polyester polyol, 20%-30%; blowing agent, 15%-20%; and surfactants and catalysts, 2%-3%.

PIR/PU foam-in-place insulation (with two subcategories, spray-in-place and pour-in-place) is a smaller segment of the market. It is used primarily for roofing insulation and injection into cavities, with some used in wall insulation. The formulation percentages of PIR/PU foam-in-place are basically 40% isocyanate to 40% polyol to 20% blowing agent and other ingredients.

Unlike boardstock, in which the ingredients are mixed as they are used, PIR/PU foam-in-place is premixed and sold to installers in drums. A shelf-life of six months is the industry standard. According to the industry, formulations with more than 30% polyester in the polyol fraction break down in less than six months, and viscosity is seriously impaired.

Polyol is the component in all types of PIR/PU rigid foam insulation that can contain recovered materials. ASTM defines polyol in cellular plastic usage to "include compounds containing alcoholic hydroxyl groups such as polyethers, glycols, polyesters, and castor oil used in urethane foam."

Industry sources state that the foam insulation market for polyol is approximately 100 million to 120 million pounds per year. Two types of polyol are used by the PIR/PU industry: aromatic polyester polyol and polyether polyol.

Aromatic polyester polyol can be derived from recycled pre and postconsumer polyethylene terephthalate (PET) or from the chemicals DMT and phthalic anhydride. The polyol is made by reacting glycol with the other ingredients. In some cases, waste DMT bottoms are used; phthalic anhydride bottoms may be used as well.

Various manufacturers contacted between 1986 and 1988 suggested that DMT bottoms and possibly phthalic anhydride bottoms were commonly recovered to produce feedstock resins for plastic rigid foam insulation products. PET polyols are 45% PET to 55% glycol; DMT polyols are 50% DMT to 50% glycol.

Polyether polyol is derived from polypropylene oxide, a virgin material process.

At least one company is marketing polyols made from both postconsumer and manufacturing waste PET bottles, as well as X-ray and other films. Other companies are marketing polyols derived from chemical bottoms. A third of the polyols currently marketed for PIR/PU rigid foam insulation are said to be derived from recovered materials.

Glass-fiber-reinforced PIR/PU foam: A special type of PIR/PU board is reinforced with glass fibers and is designed to improve fire retardancy. This product is produced by only one company to date, which may limit availability.

Polystyrene insulation: Polystyrene insulation for building construction is produced by two processes. Representatives from several manufacturers of polystyrene insulation indicate that the use of recovered material content is technically feasible.

However, one source says that polystyrene with flame retardants could not be reused, which would appear to restrict the use of home scrap in polystyrene insulation manufacture. Despite indications that research and development efforts may be underway, current use of recovered materials could not be documented.

Phenolic insulation: Phenolic rigid foam insulation is said to have very high R-values per inch, good fire retardation, and potentially low cost, among other characteristics. It is a fairly new product, but the relative market share is expected to grow rapidly from its current small base.

Phenolic foam production is similar to PIR/PU foam, although the ingredients differ. Aromatic polyester polyols are used in small quantities as plasticizers. The product formations vary according to the specific product.

Product mixes are also guarded competitive secrets because the product is new. Therefore, the following list of ingredients do not add to 100%: phenolic resin, 65%-85%; blowing agent, 5%-15%; catalyst and surfactants, 5.5%-21.5%; and polyester polyol, 3%-10%.

Unlike the approximate 1-to-1 ratio of glycol to other ingredients in PIR/PU polyols, aromatic polyester polyol in phenolic foam manufacture uses 10% glycol to other ingredients. The 90% fraction of the polyol contains the recovered material.

However, one manufacturer states that larger percentages of polyol used as a plasticizer produce an end product that is too soft for commercial application with mechanized roofing equipment, and therefore a higher percentage of recovered material is technically impracticable.

Rock wool

Rock wool is used as loosefill insulation and also is sold in batts and blankets, although production of batts and blankets is phasing out. Rock wool insulation is most frequently made from metallurgical slag, such as slag from steel mills. Approximately 70% of the rock wool produced in 1980 was primarily made from blast furnace slag, with the other 30% primarily made from steel and copper slag.

The rock wool industry is shrinking, and data are no longer consistently gathered. However, conversations with manufacturers in 1988 indicated that more companies are using higher percentages of natural rock than were in 1980. Natural rock is said to have a lower comparative yield. Slag has a higher melting alumina silicate than natural rock, which makes slag-based insulation attractive in commercial and residential installations where fire protection is important.

There are no sources of postconsumer recovered material for rock wool insulation. Some rock wool manufacturers have also begun to use spent aluminum potliner as a fuel substitute.

Conclusions

The EPA concludes that six of the principal insulation products used in the United States are commercially available with recovered materials content: cellulose, fiberboard made with cellulose, perlite composite boards, PIR/PU rigid foam, phenolic rigid foam, and rock wool. A specialty product, glass-fiber-reinforced PIR/PU rigid foam, also uses recovered materials.

Based on the evidence reviewed above, the EPA notes that insulation meeting a wide range of construction design applications is available with recovered materials content. The EPA did not evaluate the potential for recovered materials used in specialty types of insulation made with virgin materials because they represent such a small portion of the insulation market. ▮