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FIRE IMPACT ON WOOD: THE NEXT FIVE YEARS[1]

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ABSTRACT

A forecast of effects of fire regulations on ten wood product categories in the next five years is presented. With more federal regulations anticipated, fire properties of products sold in the marketplace will be affected. Each product is discussed with emphasis on significant fire performance categories. If tests demonstrate potential hazards such as flamespread, ease of ignition, or toxicity of combustion products for any wood products, appropriate improvements must be made.

Keywords: Fire performance, flamespread, toxicity, fire penetration, fire endurance, smoke density, rate of heat release, ease of ignition, interior finish, cabinets, trim, insulation, doors, windows, flooring, furniture, structural members, siding, roofing, sheathing, underlayment.

INTRODUCTION

A forecast of the effects that fire regulations will have on markets for wood products over the next five years will be presented. The objective is to indicate those areas where work needs to be conducted to influence codes, develop realistic test methods, and modify the fire performance of wood products. This evaluation reflects the impact of fire restrictions on markets by 1981, provided present trends continue and the amount of effort by the industry remains at its present level.

Seven important measurements of fire performance will be described and then used to discuss ten product categories.

Significant fire performance categories include:

1. Flamespread
2. Toxicity of combustion products
3. Penetration-endurance
4. Rate of heat release
5. Ease of ignition
6. Smoke density
7. Rate of smoke release

Wood products categories are:

1. Structural members
2. Exterior siding and roofing
3. Sheathing and underlayment
4. Insulation
5. Doors and windows
6. Interior finish
7. Trim
8. Flooring
9. Cabinets
10. Furniture and case goods

Several fire performance categories were omitted from this analysis, such as potential heat and smoldering, because they are not expected to have the same influence as the ones listed.

MEASUREMENT OF FIRE PROPERTIES

Flamespread

Flamespread is presently determined by the ASTM E-84 tunnel test. Occasionally, the radiant panel is used, but this is primarily a research and development tool. Recently, much work has been devoted to evaluating flamespread by room or corner burns, but no generally accepted standard test method yet exists. The National Bureau of Standards (NBS) has indicated in their five-year research plan (1976) for the Center of Fire Research that a new flamespread test method may be required. What this may involve is as yet unknown.

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Toxicity of combustion products

Toxicity of combustion products promises to be one of the largest and most important areas of fire investigation over the next five years. Fire deaths are due primarily to smoke and toxic products of combustion. Because of the complexity of this type of work and the difficulty of testing for these properties, this area has largely been ignored by regulations. With the advent of synthetic polymers in the last ten to fifteen years, however, the problem has become more acute. Currently, there is much activity aimed at controlling sources of smoke and toxic gases in fires.

Many experts in the field have decided that only a biological assay will be adequate to measure the hazard of any given material or situation. Some say that animals must be exposed to the products of combustion, their responses measured and they then must be subjected to post-mortem examination. NBS has announced that such a test protocol will be available by September 1977. Analytical methods can be employed to determine the quantities of hazardous gases present once the principal offenders have been identified by biological tests. Work on both of those approaches is currently progressing in ASTM E-5.

Fire penetration and endurance

Penetration-endurance tests result in hourly ratings for walls, floors, and doors. ASTM E-119, E-152, and E-162 will probably continue to be the test methods utilized for determining these ratings.

Rate of heat release

Currently, the Ohio State University rate of heat release apparatus is under consideration by ASTM E-5 as the basis for a new standard. NBS also has a test under development, and one or both of these may be "on the books" within a year or two. A rate of heat release test for assemblies, as opposed to a material test, is being considered by ASTM. It would provide a measure of the heat released by an assembly, such as stud wall, in a given period of time. Rate of heat release should be a more reliable and meaningful guide to fire safety than potential heat or the simple combustible versus noncombustible designation.

Ease of ignition

If a material does not ignite in a fire, its potential for smoke development or heat release is mainly of academic interest. However, even a material with otherwise favorable fire properties can be hazardous if it ignites very easily. Therefore, a reliable test for ease of ignition is needed.

A Gypsum Association Research Associate at NBS is presently working to develop an ease of ignition test. The OSU RHR test can be used to measure ease of ignition. It appears that a test should be available by 1978.

Smoke density

Smoke density is an important property because smoke can lead to panic, disorientation, and prevention of egress as well as overcoming a fire victim because of inhalation of the particulate matter. Two test methods available today include the NBS Smoke Density Chamber and the E-84 tunnel method modified to measure optical density. However, neither of these methods enjoys widespread acceptance.

Rate of smoke release

Rate of smoke release is probably the most important measure of smoke hazard. Several test methods are or will soon be available to provide such data, including the OSU RHR and NBS RHR methods and the E-84 tunnel method modified for this purpose. Obviously, a material that gives off large quantities of black smoke very quickly after exposure to a fire is more hazardous than one that gives off the same quantity of smoke but over a longer period of time. This property is expected to become more important over the next few years.

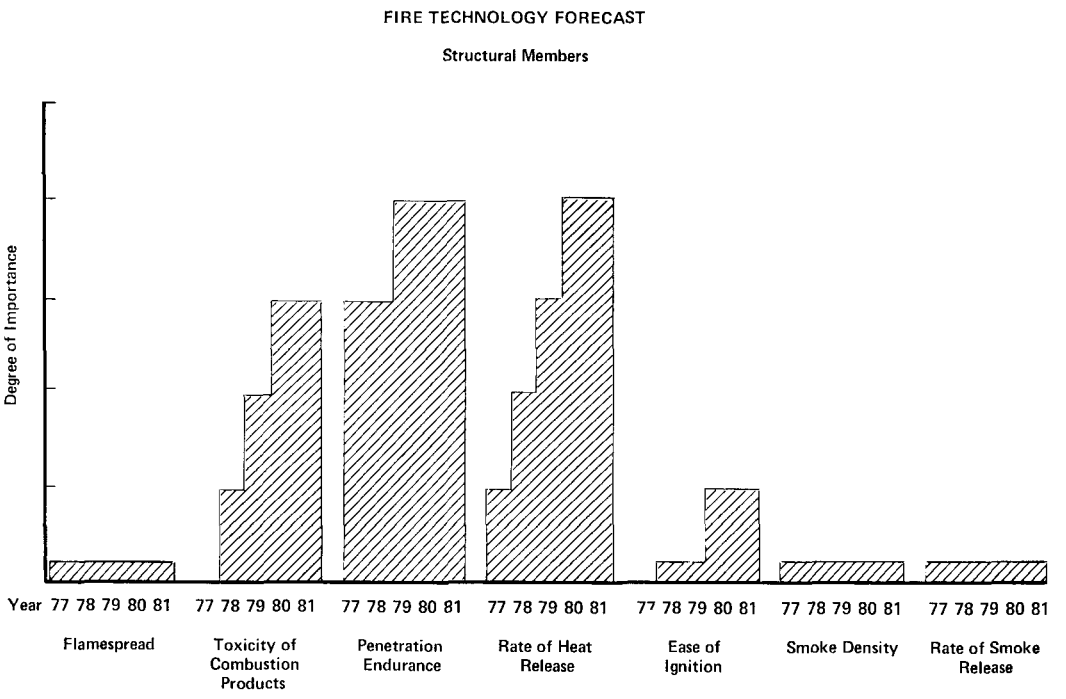

FIG. 1. Five-year forecast for the impact of fire technology and fire regulations on structural members.

REGULATORY EFFECTS ON WOOD PRODUCTS

Structural members (Fig. 1)

Because structural members are generally unexposed in building construction, flamespread, ease of ignition, smoke density, and rate of smoke release are expected to be relatively unimportant. However, penetration-endurance is now important and will continue to be a key factor in marketing these products.

While toxicity of combustion products is not critical in 1977, by 1980 it will probably be evaluated for all combustible building products and will affect sales of these products. Therefore, attention should be directed in the next two years to measuring the toxic products of combustion of structural members and then to improving these properties if necessary.

Rate of heat release, particularly of assemblies, will be an increasing concern. The industry should assist in developing a rate of heat release test for assemblies and should work to decrease the rate at which heat is provided to a fire.

Exterior siding and roofing (Fig. 2)

In 1976, when I made the first of these forecasts, the fire properties of exterior siding and roofing were not a great concern. Since then, however, an NBS report entitled "A Study of Fire Spread in Multi-Family Residences: The Causes—The Remedies," which is a report on garden apartment fires, has raised questions concerning these properties (Vogel 1977). It is suggested, for example, that the flamespread rate of exterior siding materials can be a factor in spreading fire from one window, up the side of a building, and into a window on the floor above. Based on this, there are now proposals for building codes to limit flamespread of certain exterior siding materials to 75.

Because these products are used on the exterior of buildings, problems of toxicity

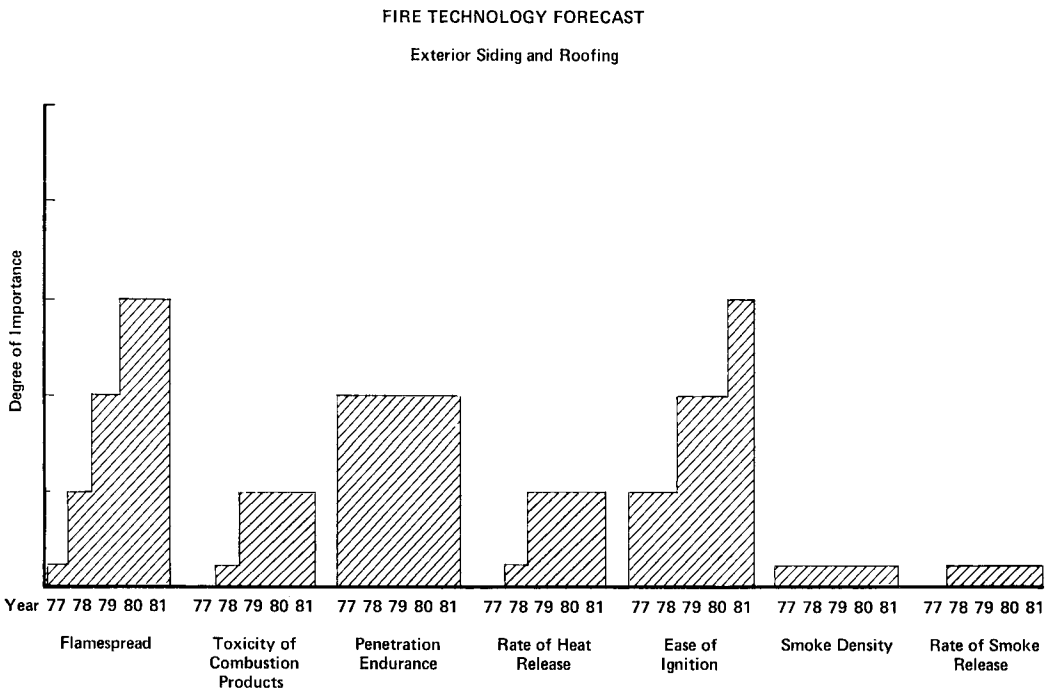

FIG. 2. Five-year forecast for the impact of fire technology and fire regulations on exterior siding and roofing.

and smoke are not as great as with many other building materials. However, penetration-endurance and ease of ignition will be a greater concern in the years ahead since these are involved with the spread of fire from one unit to the next.

The forest products industry should investigate the effect of flamespread of exterior materials on fire safety. If it proves to be a factor, a diligent effort should be made to control flamespread through modifications in the materials and through redesign of systems. Consideration should also be given to means for restricting ignition of exteriors when exposed to fire sources that can reasonably be expected to occur.

Sheathing and underlayment (Fig. 3)

Since sheathing and underlayment are never exposed on the outside nor the inside of a building, its flamespread is normally not important except during construction. Toxicity may become a greater factor since toxic gases from a fire that has penetrated the walls and floors could permeate throughout an entire building and endanger other areas.

Naturally, any material in a wall or floor system will have an effect on penetration of fire through that system, so this rates a moderate ranking. Although the rate of heat release will have some importance, it will not be as critical as for furnishings. The other fire properties will not be a great concern over the next five years.

Work should be done to evaluate the products of combustion of particleboard, insulation board, and softwood plywood. Although smoldering was not included as a fire property, it should be investigated and improvements made if so indicated.

Insulation (Fig. 4)

Insulation is an area where one powerful movement, the drive for energy conserva-

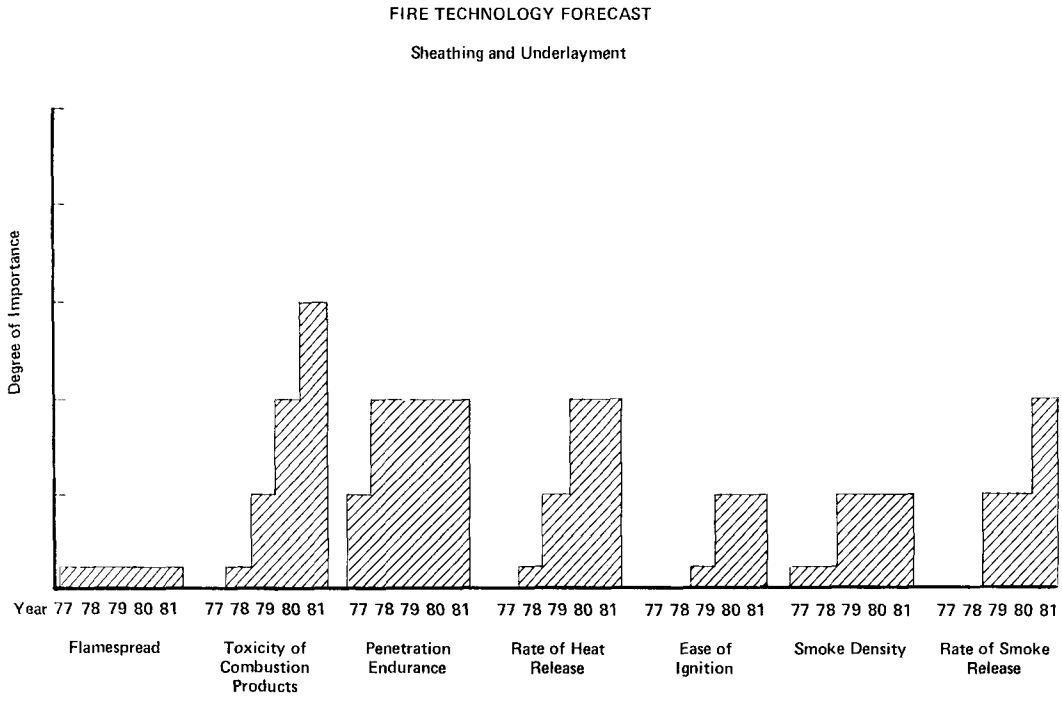

FIG. 3. Five-year forecast for the impact of fire technology and fire regulations on sheathing and underlayment.

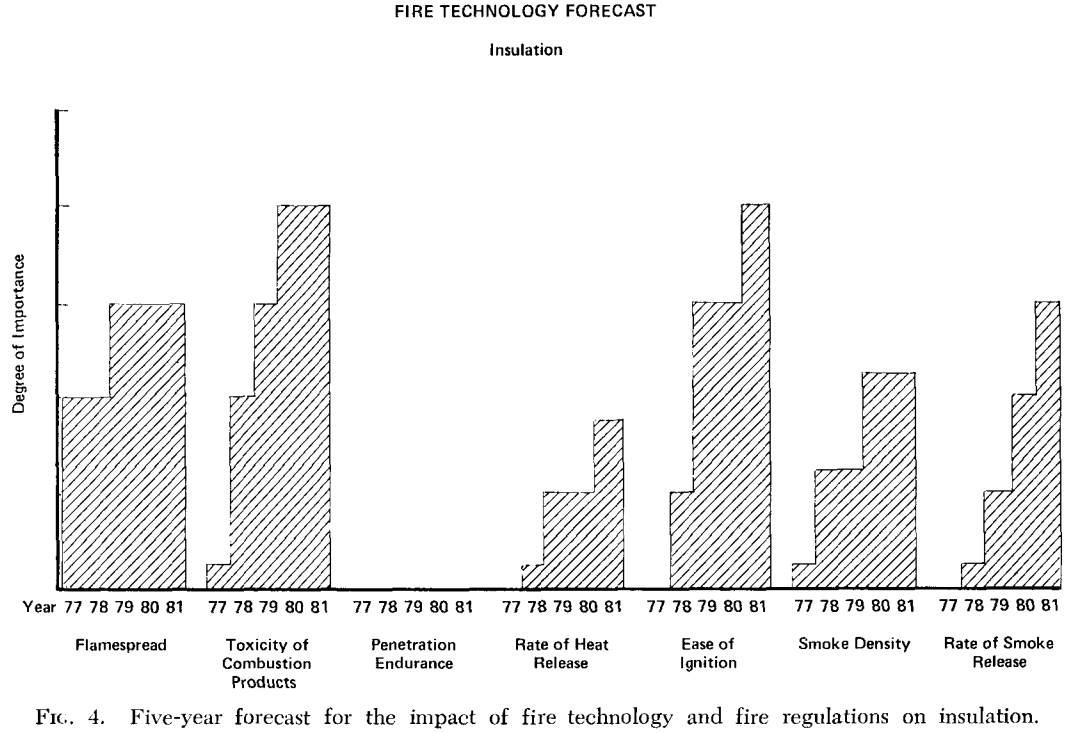

FIG. 4. Five-year forecast for the impact of fire technology and fire regulations on insulation.

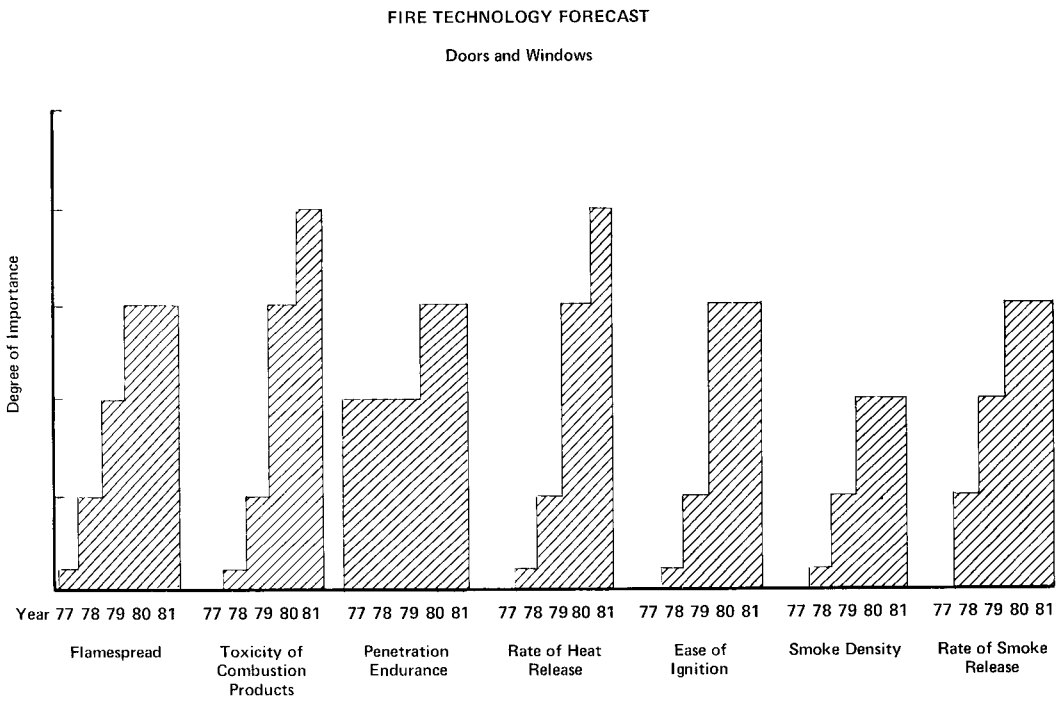

FIG. 5. Five-year forecast for the impact of fire technology and fire regulations on doors and windows.

tion, is impacting another movement, that of fire safety. As more attics and walls are insulated, the fire properties of insulation will become more important. Several ways in which adding insulation can increase fire hazards will be explored.

Since insulation can be a means of spreading fire throughout the walls and into the ceiling or attic, its flamespread will gain increasing attention. Another related point is ease of ignition, since electrical shorts and hot light fixtures can cause ignition of insulation materials. The use of additional quantities of insulation, particularly in ceilings, can lead to higher temperatures above light fixtures and additional fires. Controls in these areas can be expected to be tightened.

Toxicity will also be considered more frequently in the next few years, because a fire in the walls or ceiling can fill a building with deadly products of combustion before the more common signs of fire are recognized. For the same reason, rate of smoke release will affect the tenability of the area.

There is an immediate need for work to understand and assess whatever hazards may exist for insulation. Efforts to reduce flamespread, toxicity, and ease of ignition of some products are probably required within the year. Work on smoke problems will be required within three years.

Doors and windows (Fig. 5)

Since doors and windows could be considered a part of the interior finish, increasing attention will probably be paid to fire properties such as flamespread, toxicity, rate of heat release, and ease of ignition in the next five years. Of course, penetration-endurance tests of these building elements have been important for some time. They will probably become more significant as restrictions on fire penetration are applied to residences, particularly between residences or between residences and garages.

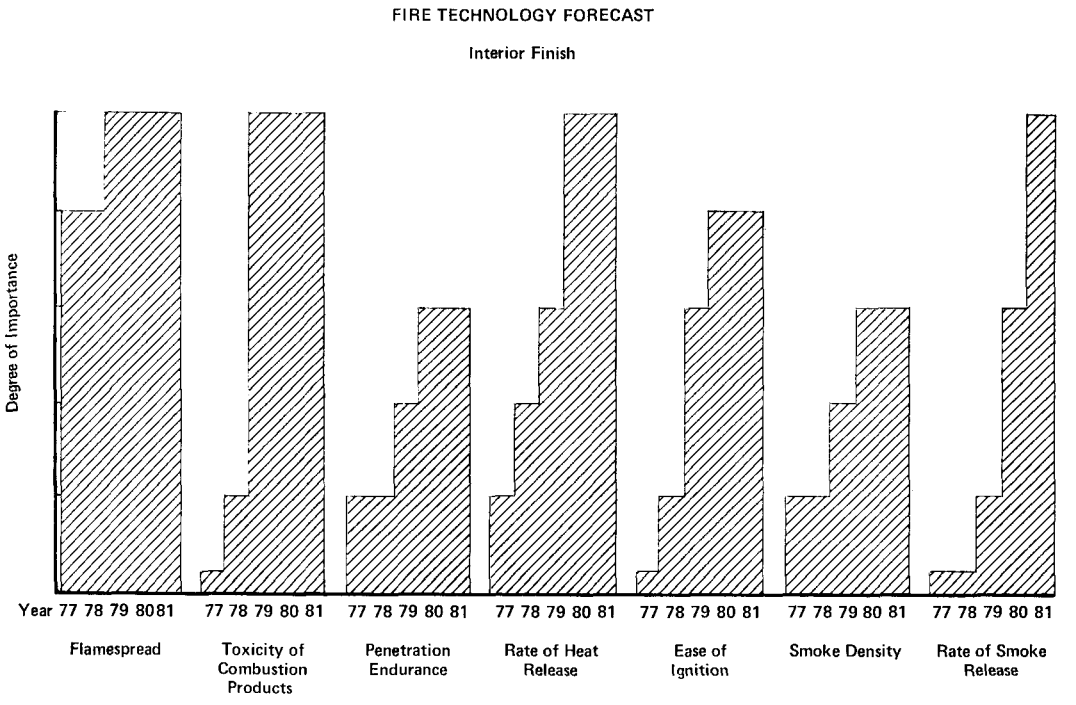

FIG. 6. Five-year forecast for the impact of fire technology and fire regulations on interior finish.

While the flamespread of doors is generally not a problem, work in this area should continue. Toxicity of combustion products, particularly of plastic door faces, may become a problem within two or three years. This should be evaluated as soon as a toxicity test is standardized. Work should also begin soon to modify rate of heat and smoke release. Ease of ignition can probably be reduced through use of a special coating for doors, and work on this should commence by 1979.

Interior finish (Fig. 6)

Interior finish is an area that has been affected by flamespread ratings for some time. Model codes, the Federal Housing Administration, and the Federal Mobile Home Construction and Safety Standards have all imposed flamespread limits of 200 maximum. There is now a movement underway to lower the permissible FSC in mobile homes to 75 or even to 25. There are sound arguments against such action, including well-documented tests, but nevertheless, the pressure is there to move in that direction, and we must be aware that the possibility exists.

Since products of combustion are the main killers, toxicity of combustion products of interior finish will also be of prime importance. It can be expected that most interior finish materials will be subjected to biological toxicity tests by 1979. It is not known how well wood products measure up, since a standard test method, or even a widely recognized test method to utilize in evaluating the products, has not been developed. However, a method should be available by 1978.

Both rate of heat release and ease of ignition will be of great importance for interior finish by 1979–1980. While interior finish is not as critical to fire safety as are furnishings and contents in most cases, finish fire properties are easier to measure and regulate and this may be done. Smoke

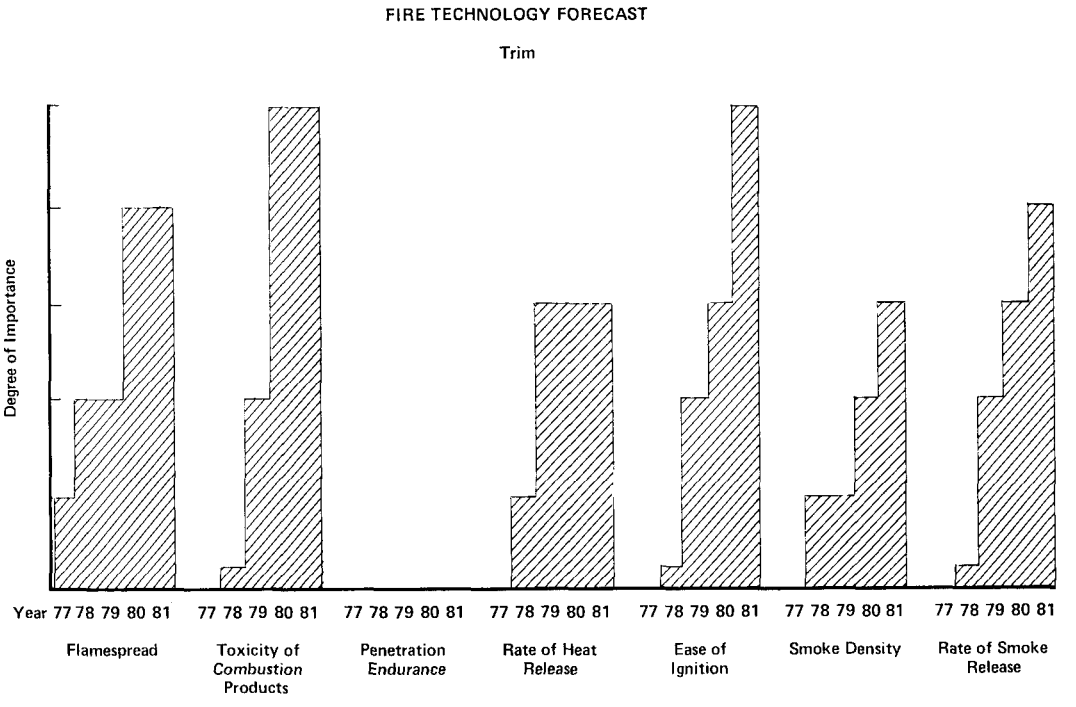

FIG. 7. Five-year forecast for the impact of fire technology and fire regulations on trim.

is also important. It bears the same relationship to furnishings as other fire properties, and results in regulations should be similar.

Immediate efforts must be made to obtain and keep flamespread ratings of all interior finish below 200. Work is also required immediately to devise means for economically reducing flamespread to 75 for some special applications.

When the toxicity test method is available, all interior finish products should be evaluated. Any that fail to measure up to the new requirements must be modified to make them acceptable. This could be a task of considerable magnitude, but one that must be faced within the next two years.

Rate of heat release of wood interior finish materials may be difficult to adjust, but efforts will be required to retard the rate, possibly through use of special coatings or surface impregnants. This work should be coordinated with that on flamespread. Reduction of ease of ignition may also be possible through the use of special coatings or barrier sheets. Immediate consideration should be given to this approach.

The work on flamespread and rate of heat release may adversely affect rate of smoke release as well as toxic products of combustion. However, the barrier concept may also provide additional time here.

Immediate efforts are required to improve most fire properties of interior finish within the next few years. These properties are not independent of each other and efforts must be coordinated. This will be one of the most critical areas for wood products in the next five years.

Trim (Fig. 7)

Trim frequently has been excluded from control, but with the advent of more synthetic polymer trim materials, this area will be more highly regulated in the future. This is especially true for toxic gases. The toxic gas emanating from even a relatively small amount of some plastic trim materials could prove fatal in a fire environment.

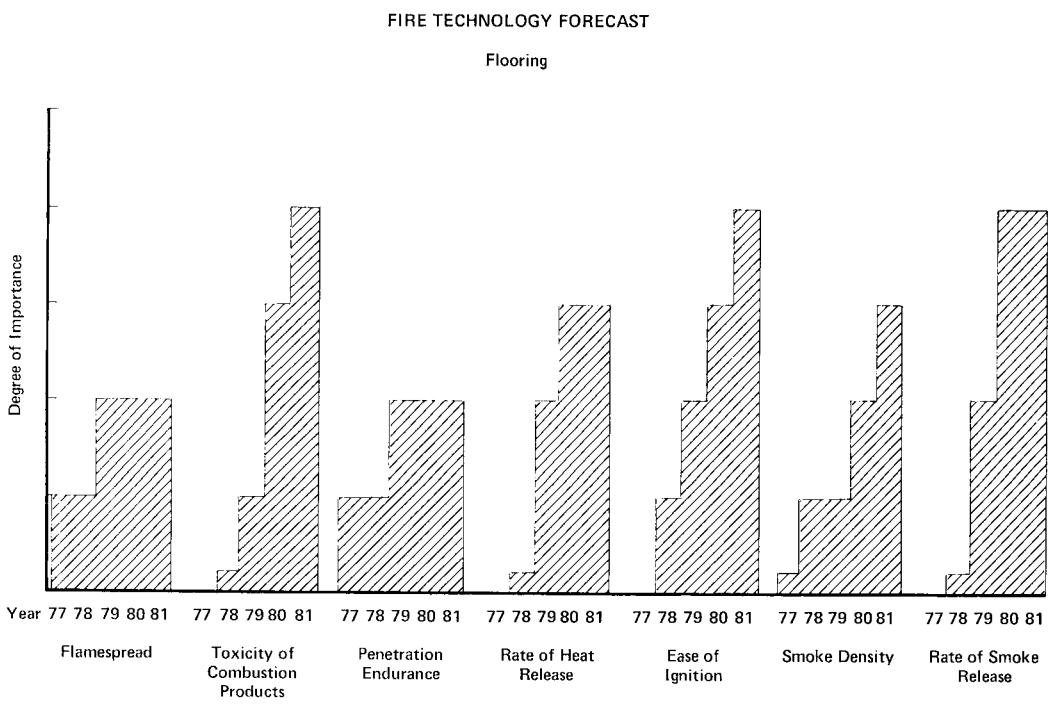

FIG. 8. Five-year forecast for the impact of fire technology and fire regulations on flooring.

Thus, controls on trim can be expected to be tighter by 1980 with special emphasis on toxicity and ease of ignition.

Anyone in the business of providing trim materials should be working now to restrict ease of ignition and should be prepared to run toxicity evaluations as soon as a suitable test method is developed. Approaches to retard flamespread of interior finish should also be effective on trim materials, and this should be monitored closely.

Flooring (Fig. 8)

Although little evidence exists that wood flooring is a hazard in fires, there have been moves to restrict the use of combustible flooring materials. Once again, this is largely the result of some of the newer materials being implicated in serious fires, and wood being associated with them. However, it must be faced that these products will be regulated and depending on where limits are set, wood may be excluded from some markets. Toxicity, ease of ignition, and rate of smoke release can be expected to be of principal importance.

Cabinets (Fig. 9)

Cabinets can almost be considered as interior finish. However, in some cases they are in an even more critical area since they may overhang a kitchen range, countertops, or work benches. Cabinets are now regulated by the Federal Mobile Home Construction and Safety Standards, and regulation can be expected to become universal in time. As indicated in Fig. 9, many of the fire properties of cabinets will be of major concern by 1980. It can be expected that there will be concerted attempts to lower the acceptable FSC limit to 75 or less. Ease of ignition will be controlled, because cabinets are often in places vulnerable to ignition.

As in the case of interior finish, work should be directed immediately to reducing flamespread, measuring and adjusting toxicity of combustion products, retarding

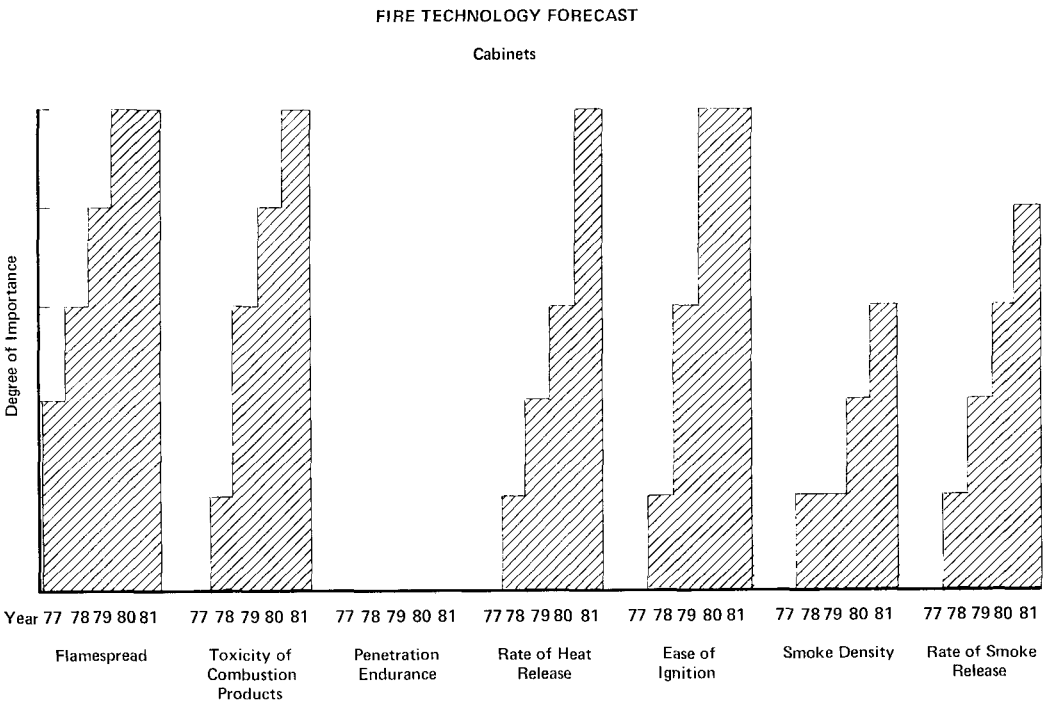

FIG. 9. Five-year forecast for the impact of fire technology and fire regulations on cabinets.

rate of heat and smoke release, and restricting ease of ignition. Many of the approaches suggested for interior finish should also apply here. Here, as in many other categories, the time to have begun work on the fire problem was several years ago.

Furniture, case goods (Fig. 10)

If regulators heed the evidence, they cannot ignore the fact that furnishings and contents are the most susceptible to ignition and are the greatest contributors to fire load of any items commonly found in buildings. Therefore, it follows that these items must one day be regulated. Although regulations are inevitable, it can be expected that these areas will take longer than for the more easily controlled interior finishes.

However, when regulations are eventually implemented, they will bring problems for suppliers of wood components to the furniture and case goods business. The projections for impact on these markets are shown in Fig. 10.

If this forecast were extended further in time, it would have shown most of these fire properties for furniture and case goods peaking out before 1985. There already are examples of fire properties of furniture being regulated in California and bedding for institutions being controlled nationwide. Specifications for other fire properties of these items will soon follow.

While the need for work here by the wood industry is not as immediate as in some other areas, by 1980 and 1981 regulations could begin to be binding. Studies of toxicity, rate of heat release, and ease of ignition should commence soon for this class of products, with required work in modifications to begin by 1980.

CONCLUSIONS

With the federal government's promise to reduce fire fatalities in the United States by 50% by 1995, comes also the implicit promise of closer regulation of our lives and activities. One way this will affect the wood

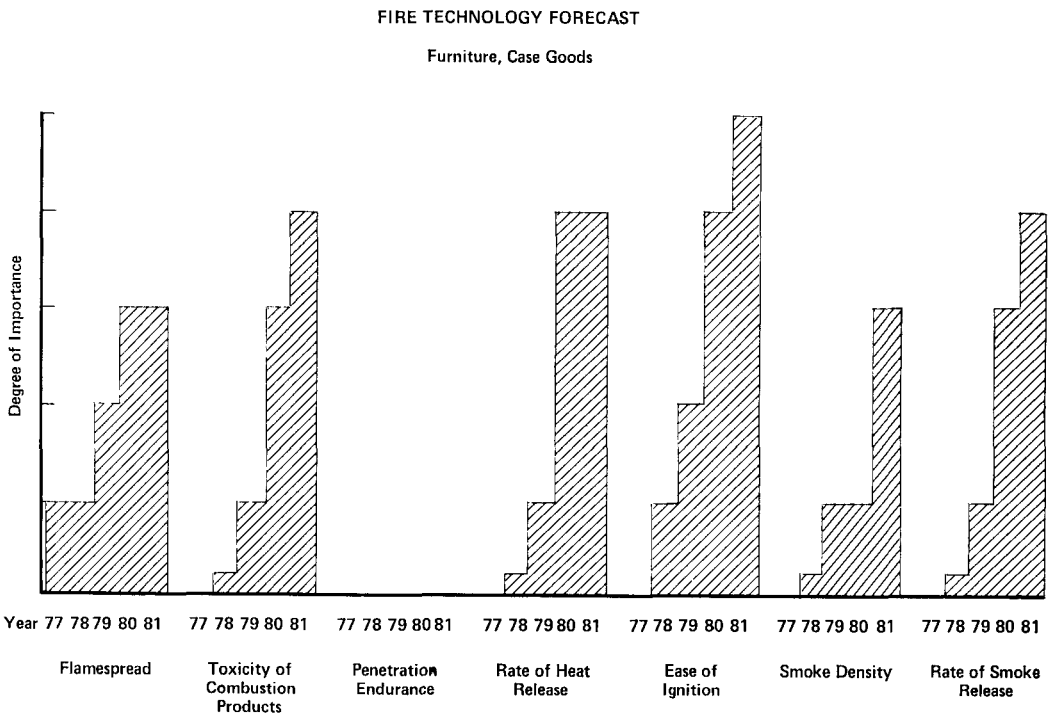

FIG. 10. Five-year forecast for the impact of fire technology and fire regulations on furniture and case goods.

industry is in the nature of the products that will be allowed to be sold on the open market. I have tried to present here my forecast of how this may affect us in the next five years.

The following is a list of recommendations that the wood industry should act upon:

1. Support fire record data studies and large-scale burn-outs to determine classes of products that may be a fire hazard.
2. If a potential hazard is indicated for any product lines, conduct appropriate tests of the fire properties of each of those products. This might include flamespread tests of interior finish and cabinets, ease of ignition of cabinets and trim, and toxicity of combustion products for all materials.
3. If these tests demonstrate a deficiency, work to develop products that are more fire-safe.
4. Remain active in standards making bodies such as the American Society for Testing and Materials and the National Fire Protection Association.
5. Maintain liaison and input to the fire protection community, including the model codes, universities, independent testing agencies, and government bodies.

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