U.S. CONSUMER PRODUCT SAFETY COMMISSION

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CPSC Executive Session
March 25, 1976

1750 K Street, N.W.
Washington, D.C.

Presiding: Chairman Simpson

Present : Commissioner Franklin
Commissioner Pittle

ITEM

Environmental Issues Raised by the Proposed Matchbook Standard

(Briefing materials transmitted by Office of Secretary 1/15/76)

DECISION

The Commission concludes at the present time that the proposed matchbook standard will not cause significant adverse impacts on the environment and that no environmental impact statement is necessary. This decision is based on environmental studies and evaluations performed by the Battelle Columbus Laboratories under contract to the Commission and by the Commission's staff during the development of the proposed standard. These are discussed and summarized in the attached February 1976 Summary Environmental Analysis which concluded on page 13 as follows:

> Although there are uncertainties about the nature of synergistic effects and decomposition products of combustion, there is no evidence to suggest that conditions any more hazardous than currently prevail would be produced through the use of such chemicals to meet the requirements of the standard. Therefore, we conclude that the proposed standard will not cause significant adverse impacts on the environment.

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The Commission is seeking comments from the public on potential environmental impacts, in particular. Based on any evidence or other comments received on this subject during the comment period, the Commission will make a final decision on the need for an environmental impact statement before a final matchbook standard becomes effective.

VOTE

Concurring: Chairman Simpson Richard O. Simpson
Commissioner Franklin Barbara H. Franklin
Commissioner Kushner (3/29/76) [signature]
Commissioner Pittle R. David Pittle

Attachment

Submitted by: Office of the General Counsel

PROPOSAL TO ESTABLISH A SAFETY STANDARD FOR MATCHBOOKS

Summary Environmental Analysis

Bureau of Economic Analysis
Consumer Product Safety Commission

February 1976

Judith M. Pitcher

Tab A

Contents

Appendices

PROPOSAL TO ESTABLISH A SAFETY STANDARD FOR MATCHBOOKS[1]
SUMMARY ENVIRONMENTAL ANALYSIS

Background

In the Federal Register of September 4, 1974 (39FR 32050), the Commission began a proceeding under Section 7 of the Consumer Product Safety Act (15 U.S.C. 2056) for the development of a safety standard applicable to matchbooks. Cited in this notice as the primary hazard to be addressed was burn injuries sustained by children and others, including mentally or physically impaired persons, who play with or otherwise improperly use bookmatches. Other hazards and the nature of the risk of injury cited include:

- Burn injuries sustained by persons who use bookmatches that spark or fragment, or have delayed ignition.

- Eye injuries sustained by persons who use bookmatches that fragment and cause particles from such matches to lodge in a person's eye.

- Burn injuries sustained by persons who use bookmatches that, when struck, ignite the remaining matches in the book.

- Burn injuries sustained by persons, including children, using bookmatches that, after ignition, have been dropped on exposed parts of the body, or that have been dropped on and have ignited clothing, because such bookmatches have failed to extinguish in time to avoid such injuries.

- Burn injuries sustained by persons from fires that have resulted from unexpected ignition of bookmatches with no deliberate action by the user.

- Burn injuries that have been sustained by persons from fires that have been set by the after-glow of extinguished bookmatches.

The American Society for Testing and Materials (ASTM) became the successful offeror, and developed and submitted for Commission consideration a recommended standard containing a number of provisions, one or more of which are directed toward

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[1]In the proceedings leading to the proposal, the articles were referred to as "Bookmatches". The name was changed to conform with current English usage and to permit distinction between the entire article, a "matchbook," and an individual lighting device, a "bookmatch".

each of the cited hazards. Commission staff subsequently modified certain provisions and test methods in the ASTM recommended standard and developed requirements for a child-resistant matchbook cover for incorporation into a proposed standard.[2] The resulting proposal under consideration by the Commission contains:

(1) Requirements for a child-resistant cover (Proposed Section 1202.4);

(2) Matchbook general requirements relating to placement of the friction material, appearance of the heads, and placement of the staple, among other provisions (Proposed Section 1202.5); and

(3) Matchbook performance requirements relating to delayed ignition, fragmentation, afterglow, and length and duration of burning, ("time-burn" provision) among others (Proposed Section 1202.6).

A listing of the full text of these requirements is contained in Appendix A. The full text of the "time-burn" provision (Proposed Section 1202.6[b]) is as follows:

> "A bookmatch shall be so constructed, when tested in accordance with §1202.8, that the flame goes out within 12.7 mm (.05 in.) down from the top of the splint and within a 15-second burn time."

Throughout the development period by ASTM, potential adverse environmental effects were considered when such issues were raised during the discussion of possible ways of addressing the cited hazards associated with the use of matchbooks. Although no formal environmental study or assessment of the recommended ASTM standard was made by the offeror, it was observed that, with the exception of the time-burn provision, there was little likelihood of adverse environmental effects arising from the recommended requirements. As child-resistant requirements were developed by the staff, health and safety benefits and potential adverse environmental effects of alternative designs, approaches, and child-resistant features were considered.

During the course of staff evaluation and modification of ASTM recommended provisions and test methods, questions were raised concerning the technical and economic feasibility of achieving a "time-burn" match by the application of chemical flame retardants, the method most often discussed by the offeror

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[2] A complete chronology of the events leading to the proposal for the safety standard is contained in the preamble to the draft proposal submitted for Commission consideration in the staff briefing package dated November 20, 1975.

and others. The Bureau of Economic Analysis (BEA), therefore, requested its contractor, Battelle Columbus Laboratories (BCL) to undertake a study reviewing the state of the art of chemical fire retardants and their application to the matchbook industry.[3] BCL's report on this study dated October 10, 1975, indicated that the production of fire-retardant paperboard is technically feasible, but that the application of the technology to match stemboard poses certain special problems concerning uniformity of the burning and its limits, physical changes affecting process and product performance, and the ability of treated stemboard to maintain match functionality. In addition, the BCL report expressed concern about the uncertainty of the impacts of fire-retardant additives on health and safety, noting that, since matches may sometimes be chewed, oral toxicity is a concern, and that there might exist the possiblity of generating toxic fumes from the combustion or pyrolysis products from fire retardants. (A copy of the BCL report is contained as Appendix B).

Prior to receiving the BCL state-of-the-art report, CPSC's BEA conducted a review and evaluation directed toward identifying and assessing the potential environmental impacts of all provisions in the proposal except the provision for a "time-burn" match (proposed Section 1202.6[b]). Although there may be certain economic effects related to production, employment and consumption patterns (discussed in various BEA economic analysis reports), all identifiable potential adverse effects on the physical environment were judged to be minor and not significant. To conduct this review, BEA employed a screening system for identification of possible impacts and a matrix system for evaluating them. These systems are also helpful in revealing where additional information may be required. This method of approach and the systems used are described in detail in a report, Development of a Methodology for Environmental Impact Assessment, contained in Appendix C.

After receiving the state-of-the-art report on October 10, 1975, BEA conducted a second review and evaluation of potential environmental impacts of proposed provisions, this time including the provision for a "time-burn" match. This screening process identified areas in which more information was required to assess the effects, and it indicated that, with the addition of the "time-burn" provision, environmental impacts in significant areas of concern might now exist. As a result, BEA concluded that a further examination of the potential environmental effects of the proposed action would need to be undertaken to ensure that any significant effects had been identified and properly assessed. (A copy of a BEA Memorandum to this effect, dated Oct. 17, 1975, is attached as Appendix D).

[3] CPSC-C-75-0098, Task 8046.

In October 1975, BEA requested Battelle Columbus Laboratories to undertake a study to review and assess the potential significance of possible environmental impacts resulting from the provisions under consideration for inclusion in the proposed standard.[4] The study was directed toward identifying and assessing possible impacts in the following topic areas:

- Air quality
- Water quality
- Solid waste disposal
- Land use
- Health

A panel of BCL researchers, each with expertise in one of these topic areas, used the methodology and systems previously described (contained in Appendix C) as a framework for this study.

As work on the task progressed, it became evident that considerably more information concerning the "time-burn" provision would be required before the potential environmental effects of this provision could be adequately identified and assessed. Accordingly, BEA authorized an additional task to investigate alternative means of meeting the provision and to determine the economic feasibility and toxicity characteristics of potential fire-retardant additives.[5] The results from the initial study task and the additional task comprise Phase I and Phase II, respectively, of the study reported in the BCL (draft) final report, Environmental Assessment Analysis of a Proposed Safety Standard for Matchbooks. This report, dated January 30, 1976 is contained in Appendix E.

Identification and Assessment of Impacts - General

Since the requirements of a consumer product safety standard are designed, in general, to reduce or eliminate the unreasonable risks of death, personal injury, or serious or frequent illness, beneficial environmental impacts in the impact area of health and human safety will result from the promulgation of these standards. The relationships between the provisions of the proposed matchbook standard and the nature of the risks of injury associated with the use of matchbooks are discussed in detail in the preamble to the proposal and its supporting documentation, and will, therefore, not be repeated in this analysis.

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[4] CPSC-C-75-0098, Task 8056.

[5] CPSC-C-75-0098, Task 8061.

In addition to injury reduction, beneficial environmental impacts of a secondary nature may also be expected to result from the proposed requirements to the extent that they result in a lower incidence of accidental fires, with their concommitant toll in terms of property damage, resource usage, and the like.

In general, environmental impacts can potentially be associated with any or all of the following processes associated with a consumer product:

-Manufacture, including pre-manufacture research, development and testing
-distribution
-consumption
-disposal

It is possible that changes in any of these processes, occasioned by the requirements or provisions of a consumer product safety standard, might result in adverse environmental impacts within any of the impact areas of air quality, water quality, solid wastes, land use, or health.

Preliminary studies by the Bureau of Economic Analysis and further studies by BCL indicate that provisions in the proposed matchbook standard, other than the "time-burn", provision, will not result in changes likely to have a significant adverse effect on the environment. Most of these provisions are performance requirements which are not expected to affect, significantly, basic manufacturing methods or materials. And, even where process changes may be required, for example, by the provision for a child-resistant matchbook cover, all potential adverse environmental effects are minor and insignificant. Many of the requirements are already met by a substantial number of firms in the industry, for example, the requirement for reverse friction had recently been adopted on a voluntary basis.

"Time-Burn" Provision

Research done in the early phase of Battelle's study of potential environmental, impacts resulting from the matchbook standard proposal indicated that human health hazards might exist, depending upon fire-retardant chemicals that conceivably might be used by the match industry to meet the "time-burn" provision of the proposal. As previously discussed, BEA requested Battelle to investigate in greater depth, possible impacts of potential alternative ways of meeting the "time-burn" provision, (BCL's report: Appendix E).

BCL identified four alternative techniques that may be considered as ways to satisfy the proposed requirement:

- -Aluminum foil lamination
- -Inorganic fillers or coatings
- -Densification of stemboard
- -Addition of chemical fire retardants

While the first three techniques are candidates for meeting the "time-burn" provision, all three present a number of technical and operational problems that must be solved.[6] BCL scientists, knowledgeable individuals in the matchbook industry and their stemboard suppliers, and scientists familiar with combustion of materials indicated that the potentially most practical and economical technique for meeting the "time-burn" provision was through the addition of chemical fire-retardants.

Chemical additives were examined by the assessment procedure[7] discussed previously, and possible impacts on air quality, water quality, solid wastes, land use, and health were considered.

Air Quality Impacts

The potential for additional air pollution occurring from chemical manufacture, application of fire-retardant chemicals to stemboard, and from bookmatch testing was examined. In each and all cases, the impact, if any, will be minor and is not expected to result in any significant increase in air pollutants.[8] The potential increased production of chemical fire-retardants to supply the match industry's needs is quite small relative to production levels of these chemicals for all uses and, thus, affords little opportunity for increased air emissions. In stemboard manufacturing, the small volume of fire-retardants required and the small volume of stemboard production relative to total papermill board production indicates that any potential emissions, whether from vents during application or from dryer exhausts, would result in relatively minor impacts. Since the quantity of bookmatches tested by manufacturers is relatively small, this testing is not expected to result in any significant increase of air pollutants.

Water Quality Impacts

No direct alterations to water quality are expected to result from the distribution, consumption, or disposal of

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[6] See Appendix E, pp. E4-E7.

[7] Appendix C.

[8] Appendix E, pp. E-8, E-9.

complying matchbooks. Only minor adverse impacts might be associated with premanufacture, testing, and possible water demands connected with the use of air pollution control equipment.

There is a possibility that changes in the manufacturing process, such as an increased use of chemical additives, might result in direct water quality impacts. Influences on the water environment could conceivably arise from increased waste heat loads associated with added drying requirements, and from increased losses of carryover constituents from the wet process employed during stemboard manufacturing.[9] Increased drying requirements that may result have been estimated to range from 5% to 20%. If present stemboard production volume is maintained, present heat loads on the environment associated with this production volume might be increased by the same 5% to 20%. However, because the volume of match stemboard manufactured is very small relative to total paperboard production, associated water quality impacts will be insignificant, or too small to be measured.

If there is additional release of chemicals to the water during stemboard manufacturing and if increased releases raise the total dissolved solids concentrations of receiving water, then there may be stresses on the water environment. Thus, after manufacturers develop a time-burn match, it may be necessary to examine the magnitude of effluents. However, at present, it is too early to hypothesize whether there will be measurable effects on water quality or to estimate their magnitude.

Solid Waste Impacts

If any solid waste impacts result from the standard for matchbooks, they will be secondary or later order. For example, if consumers were to substitute the use of disposable lighters or wooden matches for matchbooks, the presence of fewer discarded matchbooks would be offset by the disposal of inexpensive lighters. This effect, should it occur, would be minor.

Since fire-retardant chemicals will make matches resistant to incineration, alternate disposal methods, such as landfills, would be more appropriate for large quantities of unburned or partially burned matches. However, even at the manufacturing level, it is unlikely that large enough quantities to pose disposal problems would ever exist.

If the manufacture of matchbooks ceased or was sufficiently curtailed, an additional impact would occur. Presently, some

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[9] For a discussion of this process, see Appendix B, pp. B-8 through B-12.

100 to 140 million pounds of waste paper are recycled annually in matches. Alternate disposal for the waste paper currently used by the match industry would need to be considered.

Land Use Impacts

No major land use impacts are expected. Some very minor land use impacts might result if matchbook manufacturing processes had to be altered to accommodate the addition of fire-retardant chemicals at this processing stage. Secondary beneficial impacts could result if the presence of matches with a "self-extinguishing" feature reduces the incidence of unintentional forest fires or other fires affecting land use.

Health Impacts

If match stemboard is to be treated with chemical additives, humans could be exposed to these chemicals in at least the following ways:

-During the manufacturing process, industrial workers may come into contact with the newly added chemicals. Contact could be often and repetitive and exposure could be at relatively high concentration levels.

-When burned, matches may produce pyrolyzed and oxidized compounds that could be inhaled by consumers when lighting cigarettes or other smoking materials.

-Small children may chew on or ingest matches.

The proposed "time-burn" provision is a performance requirement, and the proposed standard does not specify how this requirement is to be met. Theoretically, therefore, any of the compounds suggested in the BCL report "Review of the State of the Art of Chemical Fire Retardants and Their Application to the Matchbook Industry"[10] might be candidates for meeting the standard. Since the potential for health hazard as well as the degree of hazard, if any, will depend on the specific chemicals and the amounts used, Battelle researchers collected more information on the known fire retardants. These data were reviewed with knowledgeable individuals in the paperboard and match industries, fire-retardant experts, and BCL scientists to identify processing problems and theoretical pyrolysis and oxidation hazards. In addition, the specific,

[10] Appendix B.

known fire-retardants were subjected to a multiple phase screening process[11] to identify potential risks to human health, technical feasibility, and economic practicability of adoption.

The primary concern of the preliminary screening was to identify compounds that might become potentially hazardous upon pyrolysis or oxidation or upon prolonged exposure by workers. Interest was directed toward general irritating effects, ingestion effects, inhalation effects, and skin absorption characteristics. Subjective judgments about potential hazard characteristics were made on the basis of Toxic Hazard Ratings and other toxicity data from a recent edition of a standard reference work by Sax.[12] Of some 35 general and specific compounds screened, 17 can be rejected for use on the basis of Sax's moderate to severe toxicity ratings.

It should be noted that the rating system used was developed from work on essentially "pure" specific compounds, that is, rejection is predicated on the use of sufficient, "pure" quantities of a single, specific compound to achieve the desired level of fire-retardancy. In practice, however, several compounds are combined to yield a fire-retardant compound having the appropriate properties. Therefore, concentrations of the specific compounds will be at significantly lower orders of magnitude than the concentrations on which the toxicity ratings used in this screening process were established. As Dr. Hehir, Director of the Commission's Bureau of Biomedical Science points out in a memo dated February 13, 1976 (Attached at Appendix F), "this empirical screening process is most stringent in view of the fact that the compounds that will eventually be used will most likely be a mixture of several inorganic salts." Citing a study on Flame Retardants for Textiles[13], Dr. Hehir also notes that the most common treatment is a mixture of two or more inorganic salts. Because of synergistic effects, lower concentrations of these chemical combinations are more effective than would be higher concentrations of a single compound.

For 13 of the 35 compounds, data were available on costs per ton, which range from $49 to $3,300. Chemical additive costs in excess of $300 per ton were judged to be prohibitively expensive for the stemboard and match industries. Thus, 8 of the compounds can be rejected for use solely on the basis of cost. Since 6 of these costly compounds had already been judged as moderately to severely toxic, a total of 19 compounds were rejected on the basis of the preliminary screening on toxicity and cost.

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11 The screening process used is discussed in detail in Appendix E, pp.E-14 through E-26.

12 Sax, N. Irving, Dangerous Properties of Industrial Materials, Fourth Edition, Van Nostrand Reinhold Co., N.Y. (1975).

13 "A Study of Flame Retardants for Textiles," Final Report, AUER-ZZOO TR-4, December 31, 1975, Prepared for EPA by Auerbach Asso.

Of 10 compounds for which toxicity data are not listed in the reference by Sax, 2 can be rejected on the basis of toxicity information contained in the US DHEW Toxic Substances List.[14] Compounds remaining after the first two screening steps were subjected to a third screening on the basis of their potential disaster hazard rating, as defined by Sax. This rating considers, among other factors, the risk to safety and health when the compound is exposed to high temperatures. Six compounds can be rejected on the basis of danger in disaster circumstances.

Although processing difficulty was not formally part of the screening process, during the course of the research study, a number of technical and processing problems surfaced with respect to the use of certain chemical additives. While some of these are operational problems requiring time to adapt equipment and processes, others pose difficulties sufficiently severe to preclude the use of certain chemicals by stemboard manufacturers. For example, Boric acid was rejected as perhaps moderately toxic, but at only $199 a ton, it cannot be considered prohibitively costly. It is, however, corrosive to equipment, and for this reason, if none other, can be discounted as a sole candidate fire-retardant material. Silicates, too, although laboratory experiments indicated these may be promising candidates, present innumerable processing problems, tending to migrate from stemboard to paperboard equipment on which they produce a glass-like surface. In the concentrations required to achieve fire-retardancy, silicate treated stemboard is highly abrasive to cutting equipment, stamping dies, and the like. These processing difficulties reinforce the judgment that many fire-retardant chemicals which might pose significant hazards to health and safety will not in any case be used to meet the "time-burn" provision of the proposed standard for technical or economic reasons.

At the conclusion of the screening process, seven candidate fire-retardant compounds remain:

- Ammonium phosphates (monobasic)
- Ammonium phosphates (dibasic) (DAP)
- Ammonium polyphosphates
- Urea phosphates
- Guanyl urea phosphates
- Ammonium sulfates
- Urea Sulfamate

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[14] Toxic Substances List - 1974 Edition, US DHEW, National Institute for Occupational Safety and Health, Rockville, Maryland, (June, 1974).

Sax notes that ammonium and diammonium phosphates and ammonium sulfate are all general purpose food additives. Ammonium and diammonium phosphates are presently added to stemboard (levels of 1.5 - 2.5%) as an afterglow control. On the basis of known toxicity data, there is no indication that these seven candidate fire-retardant chemicals would pose any significant health hazard.

Since little, however, is known about the types and quantities of decomposition products produced by "burning" matches, BCL scientists estimated, on a theoretical basis, the quantities of gas that would be liberated during a 15-second burn of a match treated with ammonium phosphates in the concentrations theoretically necessary to meet the "burn-time" provision. The calculations indicated that the approximate average amount of liberated phosphorous pentoxide would be 2.75 ppm in a space of 30 cubic feet.[15] BCL researchers did not find data that would indicate such quantities of phosphorous pentoxide would be harmful. Nor is there evidence to state that such quantities would be completely safe.

Although direct comparisons cannot readily be made to industrial situations, in Volume II of Industrial Hygiene and Toxicology[16] it is reported that the hygienic standard of permissable exposure recommended in the AIHA Guide (American Industrial Hygienists Association) is 1 mg. of P_2O_5 per cubic meter of air. The American Conference of Governmental Industrial Hygienists (ACGIH)[17] reports that fumes of P_2O_5 at concentrations ranging from 0.8 to 5.4 mg per cubic meter of air were noticeable, but not uncomfortable, and concentrations between 3.6 and 11.3 mg/m^3 caused coughing among inexperienced workers, but could be tolerated. Concentrations of 100 mg/m^3 were reported to be unendurable except to hardened workers. The Threshold Limit Value (TLV) of 1 mg/m^3 is stated to be below the concentration that causes throat irritation among unacclimated workers and to be well below that which is easily tolerated by acclimated workers. According to the ACGIH, threshold limit values "represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day, without adverse effect."

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[15] The assumptions, calculations and theoretical decomposition products are discussed in Appendix E, pp. E-21 to E-24.

[16] Patty, Frank A., Industrial Hygiene and Toxicology, Second Revised Edition, Volume II, Interscience Publishers, John Wiley & Sons, New York.

[17] In, Documentation of the Threshold Limit Values for Substances in Workroom Air, Third Edition, 1971.

In addition to indicating that little is known about types and quantities of decomposition products, BCL researchers point out that there may also be unknown synergistic effects of products during pyrolysis or oxidation. What these effects may be, and whether or not the synergisms would result in decreased or increased potential risks is unknown. As previously indicated, synergistic effects of two or more fire-retardant compounds used in combination result in effectiveness at lower concentrations than would be the case with these compounds used alone. And, as indicated by the Bureau of Biomedical Sciences,[18] there may well be certain other positive, synergistic effects. For example, the use of chemical additives to alter the burning process of the match is expected to diminish significantly the heat release of a treated match compared to that of the current product.

It is also known that large quantities of the seven candidate chemicals are used and consumed daily in many diverse applications. The use as food additives has already been mentioned. In addition, phosphates are still used extensively in detergents, and ammonium phosphates have a primary use in agricultural fertilizers. In 1974, for example, about 2,000 tons of ammonium phosphates were used in match manufacturing, while according to USDA figures, some 756,309 tons were used in fertilizer. Even if the amount of phosphates used in matches increased 600% (an increase estimated as what might be necessary to meet the burn-time provision), the match industry would represent only about 2% of the total ammonium phosphate consumed. At such a level, it is unlikely that humans would be exposed to any more hazardous situation than now exists in their general environment.

[18] See Appendix F, p. F-2.

CONCLUSIONS

A careful assessment of the potential effects of the proposed matchbook standard leads to the conclusion that the only potentially significant adverse effects are related to the "time-burn" provision. Further examination of that aspect of the standard suggests that the two basic means of meeting the "time-burn" specification are mechanical and chemical and that chemical additives are the most likely means to be adopted. Certain such chemicals that are theoretically available for use could have adverse effects on human health. However, those chemicals would not be used either because of their obvious toxicity or because of reasons of economic and technical feasibility. Excluding these, there remain several chemicals that are not known to result in adverse human health effects and are feasible on technical and economic grounds. Although there are uncertainties about the nature of synergistic effects and decomposition products of combustion, there is no evidence to suggest that conditions any more hazardous than currently prevail would be produced through the use of such chemicals to meet the requirements of the standard. Therefore, we conclude that the proposed standard will not cause significant adverse impacts on the environment.