



Proceedings of the Furniture Flammability and Human Health Summit

May 20 -22, 2014 • Atlanta, GA



SAFETY CONVERGENCE
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2nd Annual Furniture Flammability and Human Health Summit

May 20 – 22, 2014 • Atlanta, GA



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INTRODUCTION

With gratitude, we acknowledge the esteemed members of the Summit Steering Committee for their engaging, passionate and professional commitment to achieving a successful 2014 Summit on Flammability and Human Health. We also recognize the expert faculty for sharing their knowledge and encouraging discussion on the issues of furniture flammability, testing and performance measures, policy and regulations, flame retardants, and human health relative to chemical exposure.

We also acknowledge the general participants who contributed their knowledge and interests as key stakeholders in this open and engaging dialogue.

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PREFACE

The following proceedings provide a summary of technical information exchange as recorded by third party sources during the Furniture Flammability and Human Health Summit held in Atlanta, Georgia, May 20 – 22, 2014. The summary is not intended to provide an accurate or complete transcription of each speaker's presentation or participant specific comments. Speakers may be contacted directly for details of their presentations and subject expertise.

These proceedings are provided to share summaries of the presentations and technical discussions among all stakeholders. We hope this exchange of information will enable more collaborative discussions, research, innovation, informed policy advancement, and science based initiatives leading to fire and chemical safe products.

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Day 1

Welcome

SPEAKER

Marilyn Black, Ph.D., VP & Senior Technical Advisor, Underwriters Laboratories Inc.

Founder GREENGUARD

On behalf of Underwriters Laboratories, and our co-conveners, we extended a warm welcome to everyone gathered in Atlanta on May 20-22, 2014, for the second annual Furniture Flammability and Human Health Leadership Summit.

We recognize that ongoing research, market awareness, communications and policy updates regarding the safety and health impacts of flame retardants in upholstered furniture have elevated the need for managing the intersecting risks of chemical exposure and product flammability. While these issues impact upholstered furniture, they also expand to diverse product categories including electronics, insulations, construction materials, home décor, and children specific products.

With the public's increasing concern of chemicals in our everyday products and the consumer expectation of safe products, this summit platform is critical for bringing sound science, practices and professional expertise. Together we can advance the initiative of achieving fire and chemical safe products.

To foster this dialogue on the safety convergence of flammability protection while simultaneously preventing hazardous chemical exposures, Underwriters Laboratories is pleased to partner with the Centers for Disease Control, the National Institute of Environmental Health Sciences, and the United States Fire Administration to host this second focused Leadership Summit. Our goal is to enable an open, honest, and respectful dialogue and discovery about the issues among interested stakeholders.

Key objectives of this year's summit include:

- Review most current fire statistics of injuries and deaths in the US and EU.
- Establish most current knowledge of acute and chronic health impacts of flame retardants used in furniture and consumer products, as related to child and general consumer exposure.
- Review the latest research on chemical exposure risks to firefighters and potential links to flame retardants, other chemicals, and byproducts of combustion.

- Establish most current flammability codes and safety standards for upholstered furniture and how they are addressing flame retardants, safe chemicals, and fire characteristics.
- Review fire characteristics of products and their impact on building fires, and emerging needs for performance verifications.
- Review the latest research and developments in flame retardant chemistries and the feasibility of alternative technologies and safer chemicals with consideration of applications to components, finished products, and manufacturing.
- Identify next steps in research, product development, manufacturing, and verification processes for converging the fire and chemical safe requirements of furniture for today's market.

We have a power house of leadership and knowledge this year, and we look forward to examining the intersection of fire prevention, furniture flammability, and human health. Most importantly, together we will discuss the evolving paradigm of human safety in seeking safe living and working environments for all.



Dr. Marilyn Black

Opening Address: Product Safety Convergence

AUGUST SCHAEFER, PUBLIC SAFETY OFFICER OF UNDERWRITERS LABORATORIES (RETIRED)

We welcome all participants and thank the conference partners and the strong leadership of the steering committee for bringing together such a diverse group of experts.

Safety convergence has led to rapidly evolving technologies, and products are evolving even faster. Individuals are more interconnected than ever before. With the Internet, so much more can be shared. For the past 150 years, safety was immediate—fire, electrical shock, car safety, collision. Safety was often simply a good lock. But with the advent of the Internet, the world is interconnected, and cyber security and transactional security are concerns. The world of human physical safety is changing as well. In addition to immediate human physical safety, we must also consider long-term safety for years, decades, and generations. Safety convergence is the intersection of fire safety and chemical safety.

Expert Panel: Current Fire and Flammability Statistics

MODERATOR

Tom Chapin, Ph.D., Underwriters Laboratories

PANELISTS:

Marty Ahrens, Manager, Fire Analysis Services, National Fire Protection Association

Ida Larsson, Fire Researcher, SP Technical Research Institute of Sweden

Marty Ahrens - Panelist

Statistics separate fact from fiction and provide grounding for what we study. They are how we can understand and see unforeseen insights. We look forward to coming together to explore what it takes to create safer environments in homes, offices, schools, and public spaces.

The National Fire Protection Association (NFPA) uses the national estimates methodology to quantify the scope of fire problems in the United States. Specifically, the NFPA develops estimates of the size, nature, and trends of the U.S. fire problem by combining detailed incident and casualty report data from the United States Fire Administration's (USFA) National Fire Incident Reporting System (NFIRS) with calibrating data from the NFPA's annual fire experience survey.

In 1999, the USFA introduced NFIRS 5.0. This new version of NFIRS contains a data element identifying the primary item contributing to fire spread. Sofas are often covered by blankets, pillows, maybe magazines or newspapers. Any of these could be the item first ignited (primary fuel). Before this data element, we could only estimate the fires and losses in which upholstered furniture was the primary fuel. Now we can quantify its impact as the secondary fuel.

Upholstered furniture is a significant contributor to fire deaths. Based on fires reported to local fire departments from 2006 to 2010, including fires with upholstered furniture as the first item

ignited or the primary item contributing to fire spread, there were 610 civilian deaths per year. Nearly one in four home fire deaths are attributable to upholstered furniture.

These numbers represent progress. Comparing estimated annual averages from 1980-1984 with those from 2006-2010 for fires that began with upholstered furniture shows that. The number of upholstered furniture fires decreased by 77%, and the number of deaths from these fires is down 61%. Upholstered furniture remains the number one burnable item for home fire losses.

Upholstered furniture fires may be started by small open flames, such as matches, lighters or candles; smoldering sources such as lighted tobacco products, hot embers and ashes, or unclassified smoldering objects; operating equipment, or from flames from another fire. Fifty-five percent of the home upholstered furniture fire deaths resulted from fires started by a smoldering heat source; including 45% involving lighted tobacco products. One in five deaths resulted from fires in which upholstered furniture was a secondary fuel. Ten percent of the deaths were caused by fires starting with small open flames, and 12% of the upholstered furniture

One in five home upholstered furniture *fires* were started by a lighted tobacco product.

Cigarette burn resistant fabric is one way to reduce fire deaths and loss, and testing standards and regulations can help. The type and composition of covering fabrics and incorporated flame retardants are also important factors when considering how to reduce ignitions caused by tobacco products.

The primary driver of flame retardants is the small open flame resistance test and newer regulations may lift the requirements for small flame testing, and most upholstered furniture can pass cigarette smoldering tests without flame retardants. Deaths caused by small open flame fires have also decreased, but it is unclear if this decrease is due to flame-resistant treatments or other characteristics that have been introduced to pass the small open flame tests. If current small open flame testing is stopped, it is unclear what will happen if this standard is not replaced by another test.

Flaming ignition by another burning item accounts for twice as many fire deaths as flaming ignition by a small open flame. Other burning items will be more challenging than small open flames. It may not be possible to prevent ignition by another burning item.

Upholstered furniture remains America's largest product-related fire problem. Past progress and research have reshaped understanding of the upholstered fire problem, and it remains the highest priority.

A comprehensive strategy is needed. Much has been achieved, but there are promising leads to even greater success. The different parts of the upholstered furniture fire problem are each too large to be ignored. We need tests and strategies that address all parts of the issue to be successful.

Ida Larsson – Panelist

Fire requirements and regulations in the European Union, must involve general product safety. The sale of dangerous products is prohibited, but it is up to each country to establish its own safety instructions.

There are currently no EU standards for flammability of furniture and furnishings. In 1993, the European Commission issued a research program, Combustion Behaviour of Upholstered Furniture (CBUF). The CBUF program covered fire modeling, methods for risk assessment, and test methods for burning behavior. The results were to be used for the implementation of possible EU national legislation or EU standardization. However, the draft directive was withdrawn, and there is no common legislation. Some countries have their own flammability standards, for example the United Kingdom, Sweden, Germany, and France.

The United Kingdom has the most stringent regulations for fire protection. In the 1980s, the United Kingdom saw alarmingly high numbers of fire deaths because of upholstered furniture. The UK regulations require all furniture for domestic environments to be tested with multiple ignition sources, such as cigarettes, matches, and larger ignition sources.

Just as the high rate of fire deaths in the 1980s led the United Kingdom to develop fire regulations, in 2003 a fire in a psychiatric facility lead Sweden to institute fire regulations. Sweden developed flammability recommendations for public places. Though these standards are not legally mandated, all health facilities and prisons are using them. It may take another major fire event to improve flammability standards across the EU.

The EU has no combined fire statistics, and there is no real attempt to collect this data, although some individual countries do collect fire data. In 2010, the United Kingdom commissioned a study as a contribution to the EU Fire Safety Network. *Comparison of European Fire Statistics* collected data from 24 member states. In Germany, France, and Spain, no national data is collected.

Smoking as a cause of ignition is still a big problem, but the root cause is unknown. In 2011, reduced ignition propensity (RIP) cigarettes were introduced in Europe. They have not seen a decline in rates, and the government wants to know why.

In 2009, the United Kingdom commissioned a study to determine whether the reduction in fire deaths was related to UK regulations. The study discovered that the frequency and lethality of furniture and furnishing fires have decreased since 1988. Matches and cigarettes remain the main source of ignition. The United Kingdom has experienced a decline in the number of adult smokers, but this decline was less than the decline in furniture and furnishing fires, indicating that the regulations have made a real impact.

General Discussion with Panel

Question: One participant indicated that while the focus of the symposium is on residential fires, in her state, the focus of most regulations is on gathering places. Panelists were asked if they had statistics on public assembly fires.

Comments:

- The NFPA representative did not have statistics immediately available, but said a major public assembly fire like the nightclub fire (in Rhode Island) seems to occur every decade. In general, places have fewer deaths because of the stricter regulations and regular inspections, whereas anyone is free to do almost anything in their own home.
- There is no data on this topic from the EU.
- There is still the question of who it is we are trying to protect. Fire kills the young, the old, and the drunk. People who die in fires mainly have little ability to escape.
- Victim characteristics are very important. Certainly closeness to the fire determines death. Older adults take much longer than younger adults to get out; their egress time is much slower than is recommended for survival. That is a major concern, especially in a fire occurring with upholstered furniture because so much upholstered furniture is located near the primary exits. The threat is not always the smoking person, but rather a cigarette left on upholstered furniture. This type of fire can leave people trapped upstairs.
- Another problem is that as people age, they lose their ability to hear the frequency of fire alarms. There are plenty of people who can leave but become trapped and die in a fire. There is also the issue of firefighters who must go in to rescue them.

Question: Is the SP Technical Research Institute of Sweden involved with firefighters, and if so, what concerns does the firefighter community have with the contents of homes and the health risk to them?

Comments:

- Presenter was not aware of firefighter health concerns, but indicated they are very concerned with the elderly in fire situations. People over 65 account for 60% of fire deaths.
- Proportional allocation is a problem. If the unknown source of ignition cases can be allocated as proportionally as the known source of ignition cases are, it helps, but this is not generally true. The unknowns are not like the knowns. Using the example of a fire started by a pot left on a stove. The fire services will successfully determine how the fire started. However, if the “unknown” box is checked, it is a very different situation. It is

likely to be incendiary or electrical, and electrical in particular requires more sophistication to detect as an ignition source.

- Statistics cover the unknown cases. The 40% reported as unknown are a huge but disguised part of the problem that is kept from the public dialogue.
- There are unknowns and there are a variety of reasons that “unknown” may have been checked: fear of litigation, new rules, and uncertainty around regulations. If the fire is referred to an investigator or if it is assigned to law enforcement, the field will be left blank. We must assume that allocating proportionally is more accurate. A fire may have been started by a cigarette, but it couldn’t be determined if it was intentional or unintentional.
- The NFPA analyzes “causes confirmed” and “causes non-confirmed” records separately. If you only analyze the knowns, you exclude significant numbers of fires from consideration. We need to look at trends over time for the same data. When you do this, you see that the trend lines are very similar. You can give estimates based on methods that are consistent and can see how we’re doing. Not to record this data would be harmful.

Question: Are data available on factors like victims’ age and impairments?

Comments:

- There has been a shift. Before, children were at a greater risk. Now people over 50 are at a greater risk than children under five. Black children are at a greater risk than white children. Alcohol consumption is a big factor, but that data comes from autopsies and not from firefighters. The NFPA is currently working on data regarding victim characteristics.

Question: What about early fire data versus the more recent data, noting that fires associated with upholstered furniture have seen a greater decrease than fire deaths in general?

Comments:

- Cases of upholstered furniture as the source of ignition have decreased, but fire deaths have not decreased as much.
- Upholstered furniture remains the leading item first ignited in home fire deaths despite the progress made

Question: Does this mean there was now a greater risk of death from smoke inhalation, and how does that impact regulations for flame retardants?

Comments:

- The NFPA has not looked at smoke inhalation and upholstered furniture. With smoke alarms, victims are seen more in the room of origin. Autopsy data would have information about changes consistent with smoke inhalation.
- Health statistics are more trusted than firefighter statistics in this case because, if a victim dies in the fire while the fire is still spreading, it is hard to tell whether that person died before or after burning.
- The system does not work. The system is only as good as the data that is put into it. Firefighters have multiple fires on a shift. They must complete the forms quickly because they have to go out on another call. For example, decisions about upholstered furniture may be made based on data that is not good.
- The NFPA is far from perfect, but the database is large so it has value.

Question: Do firefighters ever put something in the form just to be done with the form?

Comments:

- Firefighters do their best to be accurate, and entry errors will often cancel each other out. For example, they will group mattress and bedding together.
- Point was well taken. The system can be improved, but even with its faults, it is better than nothing at all.

Question: How can we use this data to make public policy? The evolution of the data and new ways to look at the data must be considered. It is important to look at education for the firefighter community and improve the way fire services are trained in completing the form.

Comments:

- A participant from the fire services community indicated that he was part of a research study of firefighter data evaluating the extent of damage in a fire. Researchers set up scenarios in which they already knew the ignition source and other details, and asked firefighters to determine the facts. The study found the less the damage, the better the data collected, and conversely, the worse the fire damage, the worse the data collected. He said it would be helpful to look at the extent of damage in a fire. He also agreed looking at trends is a useful tool. He said the questionnaire was better in the case of smaller rather than larger fires.

Question: Were fire investigators in that study allowed to interview people and do they look at the unknowns?

Comments:

- Participant replied they were not. However, investigators are generally a part of most fire investigations and do help.
- The fire services member said his part of the investigation looked at fatalities and the extent of damage. For example, in a fire causing death contained to the room of origin only, the data would be more accurate than the data from a larger fire.
- Often a lot of information is missing, and a small subset of data regarding the extent of damage would help answer some of the unknowns.

Question: Is there a trained principal investigator at most fires?

Comments:

- In cases of arson which are considered homicides, and in cases of larger fires, more investigators are involved.
- With larger fires, because of the potential for litigation, insurance companies are also involved and this affects the investigation, too.
- While this data is not perfect, it is the only data they have. In the event of a change that actually increased fire deaths, given the introduction of upholstered furniture over time, he asked how long would it take for data to reflect the impact.

Plenary: Changing Flammability Standards in the United States and the United Kingdom

Avery Lindeman, MSc, Green Science Policy Institute

Flammability standards can be improved while allowing for a reduction in the use of flame retardants. Organizations like the Green Science Policy Institute include scientists who translate science into public policy to improve flammability standards and human health.

The origins and impacts of Technical Bulletin 117 (TB 117) were outlined, including how it led to the production and sale across the United States and Canada of upholstered home products containing flame retardants.

The use of flame retardant chemicals to meet TB 117 was examined from two different angles: potential human and ecological health impacts, and potential fire safety impacts.

Multiple chemicals are used as flame retardants, and the use of these chemicals is associated with known and potential human health risks. These organic compounds can migrate out of furniture over its lifetime, resulting in exposure to humans, pets, and the environment. These

chemicals have historically been used without adequate toxicological data to demonstrate safety. Exposure to certain flame retardant chemicals has been associated with, for example, decreased birth weight, impaired attention, poorer coordination, and decreased cognitive function.

It is important to examine the fire safety impacts of fire retardants. Studies have shown that there is no significant, consistent difference in fire behavior between furniture treated with flame retardants to meet TB 117 and products that do not contain added flame retardants.

In March 2012, the *Chicago Tribune* published a series of articles outlining the health hazards of flame retardants. In June 2012, California Governor Jerry Brown directed state agencies to revise home furniture flammability standards so that fire safety could be achieved, where possible, without added flame retardants. The new regulation, TB 117-2013, does not prohibit use of flame retardants, but it can be met without them. TB 117-2013 is a semi-component test that evaluates resistance to smoldering ignition of small mock-up assemblies of furniture cover fabric, optional interliner, and filling materials. It is a robust and reproducible fire test standard.

There is some concern about the fire safety of upholstered furniture. This new California regulation addresses smoldering ignitions, the leading cause of upholstered furniture fires.

With the new flammability requirements in California, the question remains of whether manufacturers will remove flame retardant chemicals from home furniture products. A large producer of flame retardants filed a lawsuit against the state of California claiming that the State does not have the right to update TB 117. This lawsuit has been postponed. [Note: the State of California won this lawsuit in fall 2014.]

Flammability standards in the United Kingdom and Ireland differ from those in the European Union. The United Kingdom has various tests, including ignition from cigarettes, small open flames such as matches, and larger open flames. In order to meet these requirements, furniture in the United Kingdom contains high loadings of flame retardant chemicals. Home furniture manufacturers in the United Kingdom use much higher levels in fabric and in foam compared with U.S. manufacturers.

The U.K. Department for Business Innovation and Skills (BIS) is considering changes to its furniture flammability requirements in order to bring them into closer alignment with standards throughout Europe. While the United Kingdom credits its existing furniture flammability regulations with a decrease in fire deaths, they are concerned about possible health impacts from flame retardants used to meet these regulations. There is growing consumer concern in the U.K., as well as resistance from other EU countries to the use of harmful or potentially harmful flame retardants in furniture. Many EU countries are worried about the health and ecological impacts of flame retardant use, including the disposal of old furniture containing these chemicals.

Proposed changes in U.K. regulations include changing the small open flame test for fabrics. This test has historically been carried out on fabrics over standard foam; BIS proposes amending the protocol to test fabrics over combustion-modified foam (which better resembles the filling materials typically used in finished furnishings). BIS estimates that this change could reduce the amount of flame retardant chemicals used on cover fabrics by 30–50%. BIS is also considering eliminating the smolder test for fabrics that meet the match test requirement, saying that typically fabrics that pass the match test also pass the smolder test. This would decrease costs for the U.K. furniture industry.

Another major use of flame retardant chemicals is in foam plastic building insulation used in construction. Flammability standards for these materials are contained in model codes that are adopted at the state and local level. Current flammability requirements in the U.S. mandate a certain level of performance for foam plastic insulation when tested to ASTM E84 (the Steiner Tunnel test). Flame retardant chemicals are added to foam plastic insulations in order to meet these requirements, though studies have shown that this test is not appropriate for use on foamed plastics. It is possible to maintain fire safety and update building code requirements to allow for the use of foam plastic insulation without added flame retardant chemicals.

Overall, many flame retardants have been linked with adverse human health and ecological outcomes; studies have shown that there is no significant fire safety benefit from the use of flame retardants to meet TB 117; and flammability standards for upholstered furniture and foam plastic building insulation may be updated to allow for a decreased use of flame retardant chemicals while still maintaining safety.

General Discussion

Question: Please comment on Proposition 65 and the series of settlements that went beyond the statutes in Proposition 65 to eliminate flame retardants and other compounds.

Comments:

- The speaker acknowledged that this was not her area of expertise.
- The Center for Environmental Health did not ban their use but offered companies the option of reduced settlements if they voluntarily eliminated the chemicals.

Question: What about foam insulation? Codes require that insulation be protected by a thermal barrier for at least 15 minutes post-flashover, but there is no regulation around wall penetrations, such as outlets, for example, and no consideration of external fires, aluminum siding, and so on.

Comments:

- Studies have shown that the use of added flame retardants in foam plastic insulation is not a determining factor in the spread of flames within a wall cavity. A more significant

factor is the size of the air gap between the wall and the insulation. It has not been demonstrated that flame retardants added to foam insulation reduce fire spread within wall cavities.

Question: Should the decision be left up to builders, since one homeowner's choice affects every owner afterwards?

Comments:

- A house may be a societal choice because of how long it will remain in the community.

Question: What about TB 133 testing requirements since TB 133 is used in other states?

Comments:

- A different test method is used for that requirement, a full-scale burn of assembled furniture. In California, there is a sprinkler exclusion, so that TB 133 is not required if an automatic sprinkler system is in place. Thanks to a recent change in the regulated spaces in Boston, certain business and mercantile spaces no longer require furnishings to meet TB 133.

Question: Firefighters like TB 133 because it tests whole furniture rather than parts. Are there studies showing whether a small-scale test is as accurate as whole-piece testing for furniture?

Comments:

- Small-scale test performance does not always correlate to fire behaviour of assembled furniture. California's Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation conducted correlation tests to support the adoption of the new smolder test. In addition, they conducted interlaboratory testing to demonstrate that the test method is reliable and reproducible.
- A participant from the fire services industry questioned the idea of choice: the whole discussion is about a safer environment for all; whether flame retardants actually do the job they say they do; and whether there are better, safer ways to get the same results.

Plenary: Is Firefighting Carcinogenic? Chemical Exposure and Cancer Risks among Firefighters

Susan D. Shaw, DrPH, Marine & Environmental Research Institute

Fires today are much more toxic than in the past. Residential fires are considered more like hazmat events because of the high usage of brominated flame retardants (BFRs) and other halogenated chemicals in treated foam furniture, plastics, and other products. When these flame-retarded items burn, large amounts of carcinogenic combustion by-products are released into soot and smoke – such as brominated dibenzo-p-dioxins and dibenzofurans (PBDD/Fs) –

that fire fighters cannot avoid inhaling, ingesting, and absorbing through their skin while responding to structure fires.

A Trustee of the International Association of Fire Fighters (IAFF) recently stated, "Fire fighters are present-day chimney sweeps, covered in carcinogens."

Cancer is the leading cause of line-of-duty deaths in the fire service today, causing, on average, 56% of all deaths among fire fighters. Since 1990, as the usage of chemicals in homes and buildings has increased, cancer-related deaths among fire fighters have risen exponentially. Since 2005, cancer deaths have averaged 50–60% of fire fighter deaths from all causes, including cardiac events. In 2007, the International Agency for Research on Cancer classified firefighting as *possibly carcinogenic* to humans (Group 2B). In light of the rising cancer rates among fire fighters, the classification may be upgraded to *probably carcinogenic* to humans (Group 2A). Since 2006, several large-scale epidemiological (cancer mortality) studies have been conducted among fire fighters. The data show that fire fighters are at increased risk for cancers and their cancer risk increases significantly with the duration of firefighting.

The fact that fire fighters are at elevated risk for many types of cancer is thought to be due to their exposure to multiple chemicals through multiple exposure routes. Firefighters inhale, ingest, and absorb hundreds of toxic, carcinogenic chemicals during every phase of firefighting – suppression, knockdown/ ventilation, and overhaul (clean-up). Moreover, young fire fighters are developing more aggressive cancers such as brain cancer at an earlier age than the general population. Cancer is a looming personal catastrophe for each and every fire fighter.

In the past, it was common practice for fire fighters to remove their respirators after fire suppression, resulting in exposure during overhaul. Wearing contaminated bunker gear after a fire or taking dirty gear into a vehicle or living quarters can result in ongoing exposure, and can extend to the whole family. Today fire departments across the country are emphasizing protective measures such as requiring respirators during overhaul and using new technology to decontaminate gear after fire events.

Previous investigations of fire fighter exposure have focused on a limited number of compounds (e.g., polychlorinated biphenyls, PCBs) following acute fire events. A recent pilot study (Shaw et al. 2013) of 12 fire fighters from northern California was the first study to investigate multiple chemicals, and showed that fire fighters accumulate high serum levels of brominated flame retardants (PBDEs, polybrominated diphenyl ethers) and brominated dioxins and furans (PBDD/Fs) while firefighting. The California fire fighters also had elevated levels of perfluorinated chemicals (PFCs) in their blood after a fire event, similar to World Trade Center first responders. The data suggest that their occupational exposure placed these fire fighters at increased risk for cancer, stroke, and other serious health effects.

The California study has received attention from Congressional leaders and national media. A large-scale, longitudinal study is planned to examine links between chemical exposure and biomarkers of health effects including pre-cancer and cancer in fire fighters across the US.

General Discussion

Question:

What about nano particles? In teardowns fire fighters see nano particles. They are now using gear because carbon nano particles are risky in air that appears clean.

Comments:

- Plastics are a problem, especially when they burn during house fires and release combustion products, some of which are nano particles. Samples of dust and soot analyzed after a house fire show extremely high concentrations of chemical residues near TVs and big pieces of foam furniture. There is a need for education and innovation in product design.

Question: Will ongoing studies include wildland fire fighters as they might be a good control for chemical exposures? Is the study quantitatively measuring exposure risk through gear?

Comments:

- The national study focuses only on structure fires, because the exposure is much more complex than that in wildland fires. Exposure from contaminated gear needs to be studied. The plans are to measure a comprehensive list of chemicals in wipes collected from fire fighter skin and all parts of gear.

Question: What about available exposure measurement instrumentation for fire fighters while in a fire?

Comments:

- No such equipment is currently readily available.

Question: What about Nordic countries and do they have a similar pattern of cancer risks since Nordic countries do not have flame retardants in their furnishings?

Comments:

- It is incorrect to state that Nordic countries do not have ANY flame retardant in their furniture. They banned certain flame retardants (PBDEs) in the 1990s, but older furniture contains those chemicals. Strikingly, certain cancers in Nordic fire fighters had a longer latency, appearing in fire fighters at age 70 or older, which is similar to the general population. But excess risk for other cancers was found in younger men ages 30 to 49.

Question: What about DecaBDE flame retardant exposure and Nordic fire fighter data? Could exposure in Nordic countries be from plastics and not furniture?

Comments:

- The Nordic study was a cancer mortality study, not an exposure assessment. But with regard to plastics, the exposure to the DecaBDE flame retardant in Nordic countries would be similar to that in the United States.

Question: What about two fire fighters in the pilot study who had an increased exposure based on their job function? Will individual job functions be considered in the larger study?

- **Comments:** Those two fire fighters with the highest levels of brominated dioxins and furans had entirely different firefighting roles. However, all of those possible contributing factors, including wearing of protective gear, would be important to consider in the larger study.

Question: Will other states be included in the larger study?

Comments:

- Other states including Minnesota and New York are interested in participating, so the study will not be limited to New England. Another study is currently focusing on exposure of women firefighters in San Francisco because of their high rates of breast cancer.

Plenary: PBDEs and Persistent Organic Pollutants in Serum from the National Health and Nutrition Examination Survey (2001–2008)

Andreas Sjodin, Ph.D., Centers for Disease Control and Prevention

Methods for studying polybrominated diphenyl ethers (PBDEs) and other persistent organic pollutants (POPs) found in blood as measured in the National Health and Nutrition Examination Survey (NHANES) 2001–2008 were presented. Human biomonitoring is a technique for determining the internal dose or amount of a toxin by measuring the concentrations of its metabolite in human tissue such as blood, urine, adipose, and saliva. Human exposure to toxins may come from food, air, water, soil, dust, and so on. After such exposure, an internal dosage may be measured. For more information on the NHANES study, please see <http://www.cdc.gov/nchs/nhanes.htm>

Expert Panel: Flammability Codes and Standards

MODERATOR

Pravin Gandhi, Ph.D., Underwriters Laboratories

PANELISTS

Said Nurbakhsh, Ph.D., State of California, Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation

Rik Khanna, Consumer Product Safety Commission

Gordon Damant, Inter-City Testing and Consulting

Said Nurbakhsh – Panelist

Provisions were presented of California Technical Bulletin 117-2013 (TB 117-2013), a rule designed to make upholstered furniture safer from the hazard of a smoldering fire, such as a burning cigarette. It was noted the rule was based on ASTM E1353-08ae1, with some changes. The final version is dated June 2013.

TB 117-2013 outlines how to test the cover fabric, barrier material, resilient filling material and decking material of upholstered furniture. Each component is tested separately on a mock-up of a chair that is made of plywood. The materials must pass a set of three tests to meet the standard. If one specimen fails, the test can be repeated three more times, but the material must pass each of those additional tests.

For example, cover fabric fails if it smolders beyond the 45-minute test period with the burning cigarette or if the resulting char length measures more than 2 inches. It also fails if an open flame develops.

Filling material and decking material—fabric beneath loose cushions on an upholstered sofa or chair—must meet a similar test, but with a char limit of 2 inches.

A fabric that fails can be used in upholstered furniture if a barrier material that passes this test method is used under the fabric. When a barrier is required, the barrier material must cover all sides and top of the seating cushions.

Non-reversible and non-detachable seating cushions do not require the use of the barrier material on the underside of the seat cushion.

TB 117-2013 also details the testing environment. The tests use unfiltered cigarettes that are conditioned for at least 24 hours at 70 ± 5 °F and less than 55% relative humidity. The cover fabric and sheeting material must be washed and dried before testing. The foam must be cut from the middle of the cushion to minimize variation.

Items exempted from the rule include cushions intended only for outdoor use and many juvenile products, such as car seats, playpen pads, nursing pillows, and strollers.

Manufacturers began using materials that passed the updated testing methods as of January 1, 2014, when the rule went into effect. By January 1, 2015, all upholstered furniture materials must meet the new standard.

Under TB 117-2013, manufacturers are no longer required to make their furniture resistant to open flames. Fabric that complied with the previous version of TB 117 does not have to be re-tested. Additionally, the Bureau has launched a study into fire barriers.

Rik Khanna - Panelist

Recent evolution of rulemaking at the Consumer Product Safety Commission (CPSC) was explained, beginning with an overview of the risk of upholstered furniture fires. From 2009 to 2011, about 5,000 residential fires each year involved upholstered furniture as the first item ignited. They resulted in 420 deaths, 730 injuries, and \$280 million in property loss.

Residential fires can spread very quickly after the upholstered furniture ignites and begins to burn.

The CPSC issued a Notice of Proposed Rulemaking in 2008 with the goal of reducing the risk of smoldering ignition fires, or those typically caused by a burning cigarette.

The proposed standard was based on bench-scale test methods—using small models—to test cover fabric. Because consumers sometimes want specific cover fabrics, the tests included fire barrier material, and revealed differences in fire intensity and growth. That's where there's promise for fire barrier materials.

The commission altered its regulatory approach. At a Fire Safety Technology meeting on April 25, 2013, the CPSC obtained input on fire barriers, including those currently used in the mattress industry.

The CPSC is developing a standard focusing on barrier material as the primary approach and research is being conducted. Six barrier materials will be tested on 118 chairs that resemble a club chair with a wood frame, spring decking and four-inch-high legs. Half will contain barrier material subjected to accelerated wear from pounding the material for 200,000 cycles with 160-pound weights.

The tests will encompass a range of parameters, including the effect of spilled liquids or cleaning products on the barrier. They will compare open flame and smoldering ignition and will measure CO, CO₂ and O₂ in the effluent, peak heat of the fire, and the time it takes to reach the peak heat, among other variables.

Chemicals released from the barrier materials in a fire will be analyzed. The commission is especially concerned about the performance of the barrier material in a smoldering ignition caused by a cigarette.

Full-scale tests will begin in the summer of 2014.

Gordon Damant - Panelist

It was acknowledged that Gordon Damant was chief of the bureau responsible for flammability research in California when the technical bulletins were developed. It was noted that fires and fire deaths with upholstered furniture as the first item to ignite declined sharply after 1980 but then reached a plateau.

From 1980 to 2011, there were 461,680 such incidents with more than 24,000 deaths and almost 52,000 injuries. That is not an insignificant number, and it is something that a society should be concerned about.

The fires often start from cigarettes or children playing with matches, candles, or lighters.

There are substantial differences between smoldering fires and flaming fires. Open flame fires progress very rapidly, with a flashover within two to five minutes. If a piece of furniture ignites in an open flame, you can have the entire home involved before the fire department gets on the scene. With or without flame-retardant materials, the resulting smoke will contain toxic chemicals.

The history of rulemaking related to the flammability of upholstered furniture was recapped, beginning with a possible finding of need by the U.S. Department of Commerce in 1970 and a California law requiring the development of a standard in 1972. The CPSC, established in 1973, took on the development of a federal flammability standard. California issued TB 117 in 1975 and Technical Bulletin 133 in 1984, requiring flammability testing of furniture used in public buildings, such as hotels.

One of the purposes of this Summit was to come up with a way forward. Certain flame-retardant chemicals have been found to be potentially hazardous to people's health. That raises a question—are all flame-retardant chemicals hazardous?

Assuming that all chemicals are hazardous is a very dangerous proposition. When considering whether flammability tests of upholstered furniture should include open flame ignition, it was noted that further work by the National Institute of Standards and Technology (NIST), the NFPA and the CPSC will shape the flammability standards.

General Discussion with Panel

Question: Has the correlation between TB 117 and TB 116, a voluntary smoldering standard for finished furniture been established?

Comment:

- While there has been no direct comparison of the two, material that passes TB 117-2013 would likely also perform well in a full-furniture test.

Question: What if manufacturers select a fabric that performs very differently from the fabrics tested by CPSC?

Comments:

- Analysis would only be compliant to those six specimens, and would say nothing about a seventh one that might be the cheapest, and the most popular with consumers.
- The tests would not cover every possible barrier material. But the tests would show the feasibility of relying on barrier materials to reduce fire hazard, especially related to smoldering ignition. The testing methods also would ensure performance even after wear, and CPSC would strive for permanence and durability.

Question: What about the commercial availability of the barrier materials and what type of thread is used in the construction of barriers?

Comments:

- The barrier materials currently are used in the mattress industry, and the thread is Kevlar-based and fire-resistant.
- The experience of the mattress industry using fire barriers has been good for both open flame and smoldering, and to the participant's knowledge, the industry has had no problems with smoldering ignition tests.

Question: What about the environmental health effects related to barrier materials? The CPSC should think carefully about the materials that will be used, and what happens if the cheapest way to meet the standard is through toxic chemicals.

- The CPSC would look at the environmental impact and effects on worker safety as it evaluates the life cycle of exposures to the barrier materials. The possibility that manufacturers will use the cheapest possible option is a challenge related to all consumer products and CPSC is aware of the concern about trying to circumvent standard requirements by the use of inferior materials.

Question: What about fires that start on the side of a chair, rather than on the seat cushion, such as from a burning wastebasket?

- The CPSC is limiting the scope of the rule making to upholstered furniture as the first item ignited. Regardless of the ignition scenario, there could be some benefits from barriers.

Question: What has led to the reduction in fire deaths?

Comments:

- A decline in smoking and an increase in the use of smoke detectors and fire alarms, among other factors.

- Laboratory tests showed that polyurethane foam produced in the last 10 to 15 years was more likely to contain flame retardants than previous samples.
- TB 117 applied only to California, but manufacturers began adopting it nationwide on a voluntary basis in the late 1990s.
- Some furniture designs comply with TB 117 without the use of chemicals.
- Wool can be an effective barrier.

Question: What about the impact of furniture imports?

Comments:

- Most imported furniture is wooden, and most of the imported upholstered furniture is leather.
- Manufacturers began reducing petroleum-based components in the mid-1990s.
- Cotton batting is more susceptible to smoldering but performs better in open flame tests. The materials that are good for smoldering are among the worst from an open flame point of view, and the opposite is also true.

Plenary: Safer Product Initiatives

Ann Blake, Ph.D., Environmental and Public Health Consulting

There are regulatory and market pressures to find safer chemical alternatives. The challenge is to provide the same functional result—flame retardancy—with design approaches or other chemicals while avoiding the regrettable substitution.

Maine and Washington require the reporting of chemicals of high concern in children's products. The California Safer Consumer Products Act of 2008 has a broader scope. It covers all consumer products. Three priority products were named in 2014, including chlorinated Tris compounds in children's products.

The goal was to find chemicals that had documented potential for harm and exposure. The basic question to ask about a chemical in a product is whether it's necessary.

The Center for Environmental Health tested 42 children's couches for flame retardants. While no PBDEs were detected, the tests found tris(1-chloro-2-propyl) phosphate (TCPP) and tris(1,3-dichloro-2-propyl) phosphate (TDCPP), which were banned in children's pyjamas in the 1970s.

Resources are available to help evaluate alternatives. The Interstate Chemicals Clearinghouse Guide to Alternatives Assessment in 2014 and BizNGO can aid in the assessment of the trade-offs among different chemicals. The Sustainable Technology & Policy Program at the University of California Los Angeles developed multi-criteria decision analysis software to compare such factors as human health impact and economic feasibility, using bar graphs that allow users to visualize the trade-offs.

In evaluating a chemical, one should first determine if it is really needed in the product. Then consider if there is another way to achieve the same functional performance with product redesign or with a complete system change, she said. For example, if fewer clothes have a dry-clean-only label, there is less use of those chemicals. Consumer demand also can drive a search for safe chemicals.

General Discussion

Question: What about data gaps in scorecards?

Comment:

- Some scorecards indicate when data is missing.

Question: What about the usefulness of the safe chemicals database of the U.S. Environmental Protection Agency (EPA)?

Comment:

- The database is absolutely usable, although there are some data gaps and limitations.

Question: What about evaluating not just the hazard of a chemical but also the potential for exposure?

Comment:

- The risk of exposure may be important in setting priorities: That's an ongoing discussion, and the EPA is still figuring out the appropriate balance.

Question: What about California's assessment of alternatives related to chlorinated Tris?

Comment:

- The state is holding workshops to receive input on the three priority products, which include children's foam products that contain chlorinated Tris. There will be a year-long rule-making process to designate those priority products and a three-year work plan for alternatives assessment. Relevant factors will guide the alternatives assessment, Blake said. The California Department of Toxic Substances Control will provide guidance on evaluating as many as 200 potential relevant factors.

Expert Panel: A Review of Flame Retardants and Human Exposure

MODERATOR

Judy Qualters, Ph.D., Centers for Disease Control and Prevention

PANELISTS

Heather Stapleton, Ph.D., Duke University

Christopher Weis, Ph.D., National Institutes of Health

Yawei Zhang, M.D., Ph.D., M.P.H., Yale University

Heather Stapleton – Panelist

Past studies of baby products and residential furniture identified flame-retardant chemical additives in the polyurethane foam, including PBDEs, TDCPP, TCPP, triphenyl phosphate (TPP), and Firemaster 550 (FM 550).

After being inundated with questions about chemicals in furniture, Duke University received funding to launch a testing program in January 2014. Most samples contained commonly found flame retardants, but three samples showed new chemicals: Exolit 560 and Thermolin 101.

Research is underway to study the toxicity and human exposure related to FM 550. In one study, three pregnant rats received a low dose of FM 550 and three received a high dose. They were compared to three control rats. FM 550 was associated with higher thyroid levels in the pregnant rats and obesity among the pups born to the high-dose rats. High-dose FM 550 in the female pups was associated with early-onset puberty and a longer time to metabolize glucose, which is an indication of possible insulin resistance.

Studies also focused on whether FM 550 and its components would bind to the nuclear receptor PPAR-gamma, which affects lipid metabolism and the development of fat cells. The organophosphates in FM 550, not the brominated compounds, were found to bind to the receptor. The study indicated that TPP, an organophosphate, may be the active component.

TPP comprises only 10–15% of FM 550, by weight. This suggests that the dose in vivo that is causing this is actually lower than reported in the study and points to the need for further research.

A study conducted with the NIEHS involved 53 adults from North Carolina. Each participant provided a urine sample, a hand wipe sample, and a dust sample from home.

Almost every sample contained 2-ethylhexyl-2,3,4,5-tetrabromobenzoate (TBB) and bis-(2-ethylhexyl)-tetrabromophthalate (TBPH), two components of FM 550, and there was a significant correlation between what was found in the hand wipes and dust. What was on the subjects' hands was predictive of the metabolites in their urine. About 80% of the urine samples contained TBBA, a metabolite of TBB.

The study also found TDCPP and TPP in all the dust samples and 90% of hand wipe samples, and it showed a correlation between hand wipes and metabolites in the urine: What's on our hands gets into our bodies.

The metabolite of TPP was twice as high in women as in men. The findings indicated exposure from personal care products. In a study with nail polish, a spike in TPP was found after the application of clear nail polish.

A study with the Environmental Working Group analyzed the urine of 23 pairs of mothers and toddlers. In all cases, the levels of the children were higher than those of the mothers, leading the researchers to wonder about exposure to flame retardants in baby products.

Polymeric flame retardants show promise as a safer alternative.

Christopher Weis - Panelist

Discussions centered on how environmental health sciences and toxicology have changed. Toxicologists once focused on acute symptoms caused by large exposures. Now they know that some compounds have hormone-like effects at extremely low concentrations. The National Chemical Genome Center in Rockville, Maryland, is a high-throughput screening facility where toxicologists use a robotic device and state-of-the-art biochemical laboratory to test hundreds of thousands of chemicals.

Exposures in the womb in gestation can have striking effects later in life. Some of those effects, as we're now learning, can be transferred to children and grandchildren.

About 85,000 chemicals are currently in use, and about 5,000 new chemicals emerge each year. An unknown subset of these are toxic. Some have endocrine-disrupting characteristics that can have persistent or latent effects. Exposure is ubiquitous. Chemicals also can trigger epigenetic changes, altering DNA.

Understanding the potential effects of chemicals is the challenge for Toxicology for the 21st Century (Tox21), a federal collaborative research project.

The project is trying to identify patterns of compound-induced biological response. Toxicologists could then set priorities for more intense investigation and develop models to predict the biological response in humans.

Bioinformatics helps toxicologists unravel the complex biological issues. The goal is to rapidly provide information about toxicology, so that public health and the chemical industry have a tool with which to choose safer alternatives.

In phase 2 of Tox21, the EPA's ToxCast program is running about 650 assays on about 1,000 chemical compounds. The National Chemical Genome Center is also running assays on thousands of chemicals. The work will proceed until researchers are successful or give up, but they're making great headway.

Yawei Zhang - Panelist

There has been a focus on the health effects of PBDEs. These brominated flame retardants are known endocrine disruptors and are neurotoxic and genotoxic. Researchers have found an increasing body burden from those chemicals, noting that PBDEs have been found in breast milk, blood, urine, and body fat.

The effects of PBDEs on children's health have been difficult to determine because studies used different samples, such as breast milk or blood, and different exposure time frames. They varied greatly in their sample size, the age of the children, and the outcomes tested.

A California neurodevelopment study measured PBDEs in maternal prenatal blood samples and followed the children from 1999–2000 to 2005–2008. The follow-up included 310 children at five years of age and 323 children at seven years of age. PBDE exposure was associated with impaired attention, poorer fine motor coordination, and decrements in verbal and full-scale IQ.

A 2004 North Carolina study measured PBDEs in breast milk three months post-partum and followed up with 222 children at three years of age. PBDE exposure was associated with increased externalizing behaviors, such as impulsivity.

Studies of PBDE exposure and birth weight also have been inconsistent and have had small sample sizes, but they all suggest some inverse association between PBDEs and birth weight. Fertility studies found reduced sperm concentration and testis size, reduced sperm mobility, and an increased time to pregnancy associated with PBDEs.

Thyroid hormone studies were inconsistent, as they used different measurement methods and often lacked information on iodine status, an important factor in thyroid hormone levels. PBDEs behave differently in breast milk and serum, and that thyroid hormone levels change during pregnancy. One study of 260 pregnant women in Canada that found an association between higher PBDE levels and lower thyroid hormone levels.

In terms of cancer risk, researchers speculate that thyroid cancer might be the most relevant to PBDEs. Thyroid cancer has been rising dramatically since the 1990s, and only about half of that increase can be explained by over-diagnosis, suggesting environmental exposures may play a role.

A study funded by NIEHS will examine the link between PBDEs and thyroid cancer through the U.S. Department of Defense serum repository and tumor registry. Researchers will test pre-diagnostic serum of 800 individuals with thyroid cancer for PBDEs and compare the results with 800 matched healthy controls.

Large and prospective epidemiologic studies are needed to determine the health effects of PBDE exposure.

General Discussion with Panel

Question: What about health effects?

Comments:

- Fish studies showed a link between TDCPP and thyroid hormone. A study with University of California Berkley will analyze TDCPP metabolism in pregnant mothers and children to see if they are associated with neurodevelopmental outcomes.

Question: What about the samples sent to Duke for testing?

Comments:

- The Duke program receives foam samples from around the country and keeps a database of information about them.

Question: What about possible sources for the TDCPP in indoor environments?

Comments:

- It could be from car dust.
- Chlorinated Tris compounds were higher in car dust than home dust.
- The source might be hard plastics, such as TVs and home electronics.
- TVs contain brominated fire retardants.
- The situation indicates of regrettable substitution, and encourages anyone manufacturing flame retardants to seek advice on whether their substances would cause problems down the road.
- Chlorinated Tris has been found in unusual items, including ski goggles and children's play tents.

Question: What about European chemical risk assessments?

Comments:

- NIEHS would like the raw data from those studies, but it is proprietary.

Question: What about dose response and endocrine disruption?

Comments:

- NIEHS is very interested in understanding the extent that dose response on the endocrine system.

DAY 2

Plenary: Fire Characteristics of Products and Emerging Needs

Vytenis Babrauskas, Ph.D., Fire Science and Technology, Inc.

The value of open flame testing of upholstered furniture was questioned. According to the data, open flame furniture fires have been decreasing for years. The question is to what this decrease may be attributed. The United Kingdom has the most stringent fire regulations in the world and has also seen a decline in the number of fire deaths. However, it is unclear whether the UK regulations actually save lives.

The decrease in cigarette smoking in the United Kingdom is largely responsible for the decrease in the number of fire deaths there. When comparing the number of cigarette sales and the number of cigarette fires, the decreasing trends correspond.

The NFPA has made recommendations based on its National Fire Incident Reporting System (NFIRS) questionnaire data, and it was questioned whether the NFIRS data is being entered correctly. Any use of the field for flame spread, in particular, should raise red flags, because the majority of the data in this field is left blank. There is concern about the NFIRS asking fire fighters to answer engineering questions.

The effectiveness of open flame regulations across the years was discussed. TB 117-1975 was costly, had little effect, and increased concerns about harms from chemicals in the flame retardants. The old regulations were a curious beast, with smolder requirements that were weaker than the industry standards and an open flame requirement that, while well intentioned, led to furniture that could still be ignited by an open flame. These regulations had consequences, including the addition of chemical flame retardants to foam, and these caused concerns for firefighters.

The 1988 NIST study often cited by the flame retardant industry to support the effectiveness of their products was examined. Information from this study was disseminated in a misleading way. There are multiple flaws with generalizing the results of this study to the average household. The materials tested are not readily available to consumers, are not used in common furniture, and were almost wholly very highly treated with flame retardants.

Flame-retardant-chemical-added products have created the worst of all possible worlds. They have enough chemicals in them to cause health hazards, but not enough to prevent fires. The alternatives to flame retardants may not be practical either. Chairs with most barrier technologies would fail existing open flame regulations. To meet barrier specifications, furniture manufacturers would have to double upholster each piece, and this is not practical from a cost perspective. Engineering does not support the idea that for furniture as a second ignition source, flame retardants help slow fire spread.

The implementation of TB 117-2013 nationwide is important because this standard focuses on smolder ignition and would address the vast majority of fire deaths. The continued study of new material technologies is suggested.

General Discussion

Comments:

- Items contributing to fire spread questions on the NFIRS will be often be left blank because of the rules for this question. While fire fighters are not engineers, they do know fire and fire spread patterns.
- Fire spread is a significant issue that needs to be addressed.
- Concern of the characterizations of the UK regulations and of the purpose of reduced ignition propensity cigarettes was made. Producers said from the beginning they will not eliminate cigarette fires but will reduce them.
- Literally thousands of pieces of furniture, all of which contained a fire blocker of some sort have been tested in other studies and the regulations could be met, and they worked well. It is important to test enough furniture.

Plenary: Flame-Retardant Chemicals—New Directions: Bound-in Halogen-Free Flame Retardants in Flexible Polyurethane Foams

Gordon Nelson, Ph.D., Florida Institute of Technology

We each have a one in three probability of experiencing a fire big enough to bring the fire department. Internationally, the most progress on fire deaths has occurred in the U.S. and the UK. The difference is the role of upholstered furniture in home fires. Both the United States and the United Kingdom have stringent flammability standards for furniture foam.

Experience in correcting fire issues with televisions in the 1970s was described. There were 200 deaths per year caused by fires ignited by television sets. The question was, is 200 deaths from 120 million TV sets in the U.S. too many? The answer was yes. Standards organizations and voluntary regulations took over the job of correcting this problem. Flame retardants were the answer, an example of successful implementation of well-researched regulations.

About 73% of home fires involving upholstered furnishings today do not involve smoking materials. In the 1980s the majority of such fires involved smoking materials. Materials do make a difference. Polyurethane (PU) foams are treated with flame-retardant chemicals in an attempt to protect consumers from fires. Nelson said some FR flexible foam items may have toxicity issues. To address this, he said we must consider how different factors affect polyurethane properties. Flame retardants may come from a host of different chemistries, and each has its own set of environmental, health, and chemical properties.

The various ways of testing flammability of polyurethane foams was explained and the reasons the current chemicals used in PU foam were initially chosen. All provide flame resistance and still allow for flexibility. The question is what to do now that the health risks are known.

One solution to flame retardant migration and toxicity is the use of reactive flame retardants. Bound-in flame retardants permit minimal exposure. Examples were given of tests on multiple versions of PU foam with bound-in phosphorus flame retardants. Such foams met CAL 117, CAL 133, and BS 5852, for furniture and 16CFR 1633 for mattresses without the need of added barriers. It was noted that barriers can fail from faults as simple as a pin hole. With a bound in flame retardant the issues of high flame retardancy and of toxicity are substantially addressed.

General Discussion

Question: Are any of the non-flammable flame-retardant foams tested available on the consumer market?

Comments:

- The flame retardants discussed are commercial including the reactive phosphorus flame retardant. Many of the specific foams discussed were for use in the Navy, not for standard commercial use.
- Confusion was expressed concerning how much flame retardants are actually in foam. The range is typically 1–25%. Low-density foam has 15–25%. The amount depends on the specific standard the foam has to pass.
- In one comment it was alleged that the use of flame retardants only gives about one second of fire protection. Such data suggests a limited flammability protection and an increased risk of toxic gases in a fire situation. In fact large scale tests such as CAL 133, BS5853, and 16 CFR 1633 show the dramatically different results with the presence or absence of the reactive phosphorus flame retardant in such significant fire exposure tests.
- In another comment, there are many products that might use this new methodology, but none are commercially viable. There is a big cost impact for products that just do not work very well for commercial use. Through the use of bound-in flame retardants one avoids the use of barriers and the risk of failure due to minor flaws. Commercial viability depends upon the specific application.
- Looking for a broad application for this product, the authors have produced 100-pound blocks and have the capability of 1,000-pound blocks.

Question: What about PBDEs found in the Great Lakes years later and the projection that up to 136 million pounds of PBDEs will enter the environment? Where are solutions and potentials for new products?

Comments:

- Bening chemicals and new technologies will lead to better products. With more experience the commercial viability increases, the applications expand. There are also other solutions, such as residential sprinklers. There are a variety of alternatives, so products are only a part of an overall solution.

Plenary: Green Chemistry and Selection of Safer Alternatives

Henry Slack, MS, US Environmental Protection Agency

The search for safer chemical alternatives was presented. In the 1970s, the question was whether a product was natural. Today, the question is whether it's green.

Green chemistry is the design of chemical products or processes to reduce or eliminate the use or generation of hazardous substances. Dangerous chemicals may be used for many reasons: we don't know the hazard; we think we can handle the hazard; they work well; they are necessary to perform a function; and most importantly, because that's the way we've always done it.

There are many reasons to use green chemistry, from cost savings to safety, but among the most important is to change perceptions. Our preconceptions affect how we respond, and green chemistry is a great way to manage those perceptions.

Green certifications are pushing consumers toward green chemistry options. Green chemistry works. As an example a green chemistry contest was sponsored by the EPA. In the process of conducting the contest, they were able to protect the environment. The nominees for the award were able to prevent the use or generation of one billion pounds of hazardous substances, end the release of 350 million pounds of CO₂, save 21 billion gallons of water, and save 9 billion BTUs of energy.

A desire for green chemistry leads to a search for safer alternatives. In response to the need for greener chemical alternatives, the EPA developed the Designing for the Environment (DfE) program. The goals of DfE include developing safer products, creating baseline safer chemical products, and protecting the environment. In 2012, the EPA announced a working plan to investigate 83 different chemicals.

In March 2013, the EPA announced a program to examine 20 flame-retardant chemicals. The chemicals will be divided into three groups of structurally similar chemicals, and at least one chemical from each group will be fully assessed.

Part of the DfE's mission is to help stakeholders trying to make green chemical choices. The process involves a diverse group of stakeholders: industrial customers, fire retardant makers, the military, government, nongovernmental organizations, academia, international groups, and many more.

DfE assesses 15 toxicity and fate endpoints for each chemical and gives them a color-coded letter ranking of H, M, or L for high, medium, or low hazard. The EPA provides a variety of data, and this year it launched ChemView, an attempt at one-stop shopping for consumers, manufacturers, and the industry. The EPA hopes people will see this database as an effective way to get information on chemical health and safety data received by the EPA.

General Discussion

Question: Could the assessments take into account additives. For example, many products from China contain a multitude of additives.

Comment:

- No – the EPA looks at the product in its pure state based on its pure chemical makeup.

Plenary: Considerations for Future Strategies

Marshall Moore, Director of Innovation and Sustainability for Chemtura's Industrial Engineered Products segment

Considerations were outlined for future furniture safety strategies, describing regulations as the convergence of fire safety and chemical safety.

There are two sides of convergence: fire safety and flammability testing. The future for flammability standards is in the composition of furniture. Upholstered furniture has three main components: foam, inner lining material, and upholstery fabric. One approach is to make all these components fire resistant, but the question is whether this is necessary.

Industry has been burn testing all three components looking at how different combinations of standards impact fire spread. The conclusions indicate that British Standard 5852 is better than TB 117 for foam, and flame-retardant fabric and flame-retardant foam are effective when flame retardant formulations are adjusted. Higher levels of flame retardants are more effective, as are the proper choice of flame retardants and adjuvants. In most of the studies of fire resistance, variables of improving foams were not examined.

Specific testing methods as used by various laboratories were described and the different testing standards that could be followed. Slides of various open flame testing of foam with and without flame retardants were shown. The slides showed how effective flame retardant can be in combating fires in polyurethane foam.

In a comparison of no-flame-retardant foam and flame-retardant foam, the flame-retardant foam doesn't prevent fires, but it significantly slows fire progression. Studies also examined the effect of fabric covers. There was a range of fire results depending on which fabrics were tested. Comparing the contributions of the inner lining, foam, and cover fabrics, the lining dominated the test results, with polyester batting as the biggest driver of flame spread.

From the flame retardant side of the safety convergence, the approach is to look at product safety through a Green Innovation strategy. They were striving for performance, stewardship, and sustainability.

Chemtura's Green Innovation such as Emerald Innovation 3000, a product that has low toxicity assessments across the board, and Firemaster 550, which was cleared by the EPA assessment in 2012 and is being evaluated again. Products can always improve, and the new ones will be inherently better than those used in the past. More dependable testing can be developed. Higher performance with flame-retardant foam, flame-retardant liners, and flame-retardant fabric covers can be achieved. Chemtura endorses higher testing standards and even greener solutions.

General Discussion

Question: What he meant by high loft polyurethane?

Comments:

- There is a technical definition, but in general it refers to a lower-density batting than foam. It is designed to be a replacement for cotton batting.

Question: What about the degradation of the Firemaster product? The EPA said Firemaster 550 is not persistent, but its degradation products are.

Comments:

- The product does biodegrade, but initial EPA assessments did not assess what it degrades into. The EPA is looking into this.

Plenary: Product Flammability Research

Rick Davis, Ph.D., National Institute of Standards and Technology

Shonali Nazare, Ph.D., National Institute of Standards and Technology

This presentation highlighted ways to reduce product flammability by focusing on the individual components of residential upholstered furniture. NIST developed the measurement science that could be used to evaluate the fire performance of materials used in upholstered furniture. They partnered with manufacturer organizations to develop the technology to mitigate furniture flammability and regulatory agencies to understand the potential performance requirements for upholstered furniture and its contents.

In examining the ignitability, both flaming and smoldering, of upholstered fabric, it's important to ask what attributes would prevent foam involvement in a fire, and what barriers might be effective. In answering these questions, NIST utilized a suite of tools ascertain the fire performance characteristics of barrier materials.

Their long-term goal is to predict full scale burning behaviour of upholstered furniture using the results from small scale testing of the furniture components and/or furniture mock-ups. If this approach is successful, one could simply build a chair without having to test it. One of the main limitations of the current tools is that they cannot accurately address fire spread.

Another goal of the NIST research is to provide the technical guidance that could result in a more reproducible smoldering ignition test for upholstered furniture. Based on guidance from regulatory agencies, NIST sought to identify flexible polyurethane foam that produced reproducible smoldering mass loss when used in a defined smoldering testing configuration. Through partnership with a foam manufacturer, NIST researchers identified the processing and chemistry parameters of the foam that dictated smoldering. The “target” specifications were difficult to consistently manufacture. During this study, NIST discovered that airflow to the smoldering front significantly influence the extent of smoldering in the foam. The current smoldering test configuration restricts airflow as the foam is placed upon wood slabs. NIST suggests that in real furniture the foam is against webbing or other supports that don’t inhibit airflow through the foam to the smoldering front. NIST showed that lifting the foam off the wood support pieces (a configuration they suggest more mimics real furniture) increases the extent of smoldering by fourfold. They are currently conducting tests to determine which bench scale configuration better predicts real scale smoldering experiments.

The largest fuel source in upholstered furniture is the flexible foam. NIST’s research on barrier fabrics and new fire resistant technologies gives hope for developing fire safe flexible foam, which could significantly reduce the fire threat of furniture. NIST researchers introduced a OnePot – OneStep coating that when applied to the foam makes the foam ignition resistant. In full scale and bench scale tests, the coated foam delayed ignition of furniture by 460 seconds. The peak amount of heat produced during these tests was also reduced by more than 60%.

Barrier fabrics are textiles placed between the foam and covering fabrics. They are often used in aircraft seating and in upholstered furniture found in institutional settings. They are usually high-end and very expensive. Very recently, many different types of barrier materials were developed to reduce flammability of residential mattresses, but high-loft barriers containing polyester and flame retarded rayon are most commonly used in residential mattresses. Various fiber blends were tested from glass to cotton, to see how these barriers work with open flame and determine what variables to measure to determine how these materials would perform as fire-blocking barriers. Researchers also wanted to see how barriers protect foam from flaming fabric, and they examined burn patterns to see how much degradation occurred. Of the several barrier fabrics tested, the woven glass fiber fabric performed the best with no burn, low heat transfer to the foam due to reduced gas and air permeability.

This new fire resistant coating technology combined with their work on barrier fabrics is expected to significantly help manufacturers with producing fire safe furniture.

*General Discussion***Comments:**

- After examining glass fire barriers when they first came out 30 years ago, there is concern of fiberglass barriers becoming pulverized into dust over time.

Plenary: Manufacturer Considerations for Safer Consumer Products

Cordon T. Baesel, Esq., McKenna Long and Aldridge, LLC

With the continued expansion of Safer Consumer Product (SCP) metrics by Federal and State governments, can fire safety and prevention peaceably coexist with health risks posed by certain flame retardants? Or will the SCP metric trump fire prevention?

Great ideas for fire prevention may cause adverse health consequences for children. In the end, environmentalists, scientists and regulators must increase collaboration and work together for both safe and effective fire protection. In the meantime, manufacturers are caught between potentially conflicting objectives for flame retardants. To effectively evaluate this dilemma and the SCP metric, manufacturers must go back to basics.

Manufacturers face three main duties for consumer products. They owe a duty to consumers to provide a useful and desirable product; they face various legal duties to comply with applicable laws, while simultaneously meeting business duties throughout the supply chain (*e.g.*, profitability, agreement terms, trade secrets, business partner needs, etc.).

There is a distinct need to independently determine “how safe is safe” under applicable SCP standards, because environmentalists, scientists and regulators don’t yet agree on a universal SCP metric. Manufacturers have to develop their own metric for identifying where are the strong, who are the trusted, and how to reach business harmony in a climate of moving targets and standards. Human health is always the touchstone for safety.

The SCP metric also demands assessment of ecological impacts throughout the environment as a major factor into any matrix for manufacturing. Regulations will be based on both human health protection and promotion of ecologically sound products. Thanks to U.S. EPA resources and California’s SCP program, manufacturers have access to specific criteria and methodologies for development of SCP compliant products – even in the fire safety industry.

Key things to look at include the transparent workings and deliberations of California’s SCP Program and its Green Ribbon Science Panel. This Panel is exploring an SCP product-development model to help make products safer, without reliance on “regrettable substitutions” and adverse consumer consequences. Much of the new approach and SCP metric are based on exposure modeling and require a leap of faith to determine which chemicals, in what particular products, will actually be safer without undermining the utility of the product. In the future, the Green Ribbon Science Panel in California will have a huge impact. The panel is looking for a wide range of views, and remote attendance is an option.

Nonetheless, there are many risks for manufacturers. Supply chains may be interrupted if necessary chemicals are found to be harmful. Trade secrets and confidentiality disputes can be hard to resolve, especially given presumed transparency of the Federal and State SCP process.

Many SCP programs lack meaningful, practical, and equitable dispute resolution systems to address and protect trade secrets.

There will be significant manufacturer impacts from Federal and State SCP programs, as the future focus and direction of SCP regulations may include entire product categories or segments. California's Green Ribbon Science Panel is currently evaluating conceptual models to assess human health and ecological impacts, to ensure priorities and relevant factors for SCP regulation of entire product categories. Manufacturers must be involved at every step of the process.

General Discussion

Question: If California is leading these initiatives, is there a blueprint for the federal government, and are there other physical elements of these products?

Comments:

- The ICC and the various stakeholders provide a blueprint model. The Federal SCP approach does not mesh perfectly with State programs, such as California. For some issues, the Federal requirements are pre-emptive, and everything is stalled at the national level right now. California has spent years developing its own initiatives rather than following the European approach (*i.e.*, REACH). A "blueprint" of sorts is to avoid the SCP alternate assessment process and correct human and ecological issues before going to the market.
- California will do what it wants and the Federal standards will not reach this level of detail. Each state will want to make its own regulations. Science does not change. While the modeling and exposures may change, the science will remain the same.

Question: Is fire safety and flammability included?

Comments:

- California is pulling it in at this point. The Green Ribbon panel is needed because entire categories of products will be considered for SCP regulation.

Expert Panel: Furniture Strategies and Considerations

MODERATOR

Liz Harriman, Toxics Use Reduction Institute

PANELISTS

Jillian Pritchard Cooke, Wellness Within Your Walls

Joe Ziolkowski, Upholstered Furniture Action Council

Hardy Poole, National Council of Textile Organizations

Kyle Bullock, Preferred Finishing

Bob Luedeka, Polyurethane Foam Association

Mike Goode, Ph.D., ICL Industrial Products

Jillian Pritchard Cooke - Panelist

This panel presented a picture of the supply chain behind the furniture industry's finished products, and stressed the need to address the root causes of problems, rather than symptoms at the end of the pipe. Furniture does not cause fires. The industry has been given the burden of trying to prevent or slow down those fires, and while the supply chain has taken on that challenge, there are other intervention points that could be even more effective in reducing fire risk.

It was stressed that professionals who specify and purchase home furnishings can be the missing link to drastically reducing toxins in interior living environments. If consumers are educated before a project reaches the design and execution stage, the building and home furnishings industries can realize greater profits by meeting consumer demand for healthier living environments. So better awareness is a plus, not a negative.

One presenter traced experiences working on the first LEED certified home in the southeast, an upscale sustainable home in Atlanta that features geothermal and solar power. During the project, the designer was diagnosed with cancer, so it became very personal to understand what had brought on the disease. The designer began focusing on paints, furnishings, and other potential sources of toxic exposure, and began travelling to building and home furnishing shows around 2006.

Questions were asked, and there was no answer. Instead, the designer found she encountered a deep division between LEED practitioners and the rest of the industry, and no one could come to any conclusions on what designers should or should not be specifying.

When manufacturers were asked what was in their products, at first, answers were hard to find. Manufacturers were urged to increase information sharing on furniture constituents.

The need to simplify available information on how to achieve a healthier interior environment was underscored. It was noted that there is a big difference in the response from younger and older designers: while the new generation is excited about healthy, natural products and

components, older designers are sticking with the brands they love. Stressing that not all chemicals are bad, three categories for furniture components were suggested. As defined by the Wellness Within Your Walls (WWYW) educational program:

- Natural—made from natural materials free of man-made chemicals
- Sustainable—made of sustainable materials that provide long-term well-being
- Responsible—controlling toxins responsibly through accountability

The categories were developed by WWYW to educate and help simplify overwhelming amounts of information on harmful interior toxins.

Joe Ziolkowski - Panelist

Technical challenges were described for achieving fire resistance for a product that is covered in fabric and filled with plastic and that incorporates other materials. The CPSC has been involved with this issue since 1973, and there still has not been any silver bullet that accounts for the characteristics of tens of thousands of upholstery fabrics and their synergies.

The manufacture of upholstered furniture encompasses fiber science, consumer preference, behavioral factors, the competitiveness of domestic industries and, increasingly, scrutiny over chemicals that may pose a risk to human health or the environment. Despite an endless array of furniture styles, shapes, sizes, materials, frames, accents, and functions, the industry is trying to come up with one flammability solution that is applicable across the board. The individual materials may pass a standard, but the question is whether the furniture as constructed will be as good. It was voted that the incidence of fire-related injuries, deaths, and property damage has declined over the last 30 years.

Flammability testing for upholstered products is a complex process because of the synergies among product components. Ultimately, product designers can reduce the risk of fire death, but they'll never eliminate it. Three criteria for new flammability solutions were suggested:

- Safety, so that the solution doesn't introduce new risks for consumers, workers, or the environment or undermine existing levels of resistance to cigarette ignition
- Effectiveness in reducing the number of residential fires that ultimately involve upholstered furniture, rather than creating a false sense of security by making furniture flame retardant
- Saleability, through the development of attractive, comfortable, durable, affordable products

Hardy Poole - Panelist

Visual appearance is the primary criterion when consumers buy textile products, with strength, pilling, colorfastness, and other performance factors adding to the list of expectations on an industry that employs 231,000 people and had \$23.7 billion in exports in 2013. The supply chain

within the textile industry includes manufacturers, importers, converters, and finishers. From the discussion during the symposium, it appeared that the cover fabric itself was becoming the primary barrier for flammability performance. While that's a worthy goal, it will be a balancing act to combine safety performance with aesthetics.

No one wants to walk into a house where all the colors and textures are the same, so fabrics are designed to be different. The result is an industry with a wide variety of fibers, weave patterns, colors, and finishes, more than 100,000 SKUs, and 800 to 1,000 new patterns per year.

California's TB 117-2013 regulation specifies smolder rather than open flame performance, and this is the right place for a standard to focus first. TB 117-2013 and ASTM E1352-08a were compared and contrasted, noting that manufacturers have options in their response to the California standard: They can certify product lots based on sample testing, or decline the test completely for product that is not destined for sale in California. If a product fails a test, it can be re-engineered, treated with a fire retardant, or eliminated from a fabric line as a last resort.

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Kyle Bullock - Panelist

The evolution of materials and standards was discussed for a backcoating business. The company was the very first fabric flame retardant coating and currently manufactures about 75% of the TB 133-compliant barrier fabrics used in the United States. (Note – compliant barrier fabrics are not a possibility, as TB 133 is a test of the composite product performance and not individual components)

Although the TB 133 standard originated in California, it has since been adopted in eight U.S. states and multiple cities—a volume of activity that is important for a firm that runs equipment the size of a football field that can apply multiple coatings in a single pass. Barrier fabrics for use in constructing TB 133-compliant furnishings are constructed of synergistic layers, either a separate coated barrier fabric under upholstery fabric, or a barrier laminated to the outer fabric.

Bob Luedeka - Panelist

The flexible polyurethane foam (FPF) manufacturers and suppliers are aware of the ignition combustion characteristics of their products, just like the producers of any other natural or synthetic material that can provide fuel and sufficient access to oxygen to support vigorous combustion once ignited.

But unlike other foam materials, FPF is a polymer product that performs relatively well against smolder and radiant heat. Its tendency to shrink and retreat, thereby removing fuel for combustion, is an important performance factor and the basis for using FPF (note: urea is a fertilizer) as top-layer cushions in spring mattresses to meet CFR 1632 smolder test performance requirements. FPF also offers durable resilience, compression recovery, and favorable economics. It can be modified to meet evolving flammability performance specifications, traditionally through the use of flame-retardant additives. It was noted that combustion-modified foam could be easily made. The discussion has turned to ways of making furniture with adequate resistance to ignition without using flame retardants. Industry's response is to support a performance-based, measurable flammability standard that is appropriate to the risk of ignition and leads to product that is saleable and safe for workers, consumers, and the environment. Since the industry sees smoldering cigarettes as by far the leading risk, it was happy to recommend science-based approaches to improving on the existing smolder ignition test method when California began updating TB 117. The recommendations included specification for smolder-prone foam that addressed issues like cell size, air permeability, and sample orientation requirements, as well as density. Smolder propensity has been shown to increase with density and with hardness. These specifications, reflected in the recent update to TB 117, were provided in the interest of delivering consistent smolder test results with a foam substrate that may represent a "worst-case" smolder-prone example in the real world, leading to more robust evaluation that may disqualify borderline products that may have passed the previous test.

Open flame is still an open question. CPSC's focus gradually shifted from smolder to reduced heat release rate and peak heat release, and then back to smolder performance. Now, the agency is looking at possible mitigation of larger-flame ignition sources through the use of barriers. The FPF industry recommends either ASTM 1353-08a or the new California test method as a national standard that addresses smolder resistance, thereby dealing with the most prevalent cause of fire.

Given a range of open flame risks—from lighters, to candles, to lanterns, to clumps of newspaper or household trash—there is no way to arrive at a single solution to possible open flame ignition or even to estimate the aggregate ignition risk. Before working on an open flame standard test method, it was recommended that CSPP quantify, qualify, and prioritize the magnitude of risk; understand the effectiveness of possible remedies; and consider the cost-benefit of the remedies, weighing the benefits of full or partial mitigation against the impacts on manufacturing costs, finished goods, employment, the environment, and social costs.

Mike Goode - Panelist

Responsible chemistry is about saving lives, and while fire and chemical safety are both important, they are separate issues. The industry is supposed to come up with new and better products, and the starting point for that work is that flame retardants do save lives, allowing people to lead modern lives in relative safety. Smoke and soot from fires are highly hazardous, with or without flame retardants, containing PAHs, benzene, and other hazardous substances. While it is unfortunate that firefighters aren't looked after properly, that has nothing to do with flame retardants.

Ultimately, the reduction in the number of fire deaths in the United States correlates to the number of fires, not to the incidence of smoking, he said. Fires aren't more survivable than they used to be. Combining available U.S. data with similar research in the United Kingdom, said it was noted that 85% of the new furniture sold in the United States will be less safe, while 15% might be less, equally, or more safe—in a country where more than 80% of existing furniture already meets a smolder and open flame test.

Combining available U.S. data with similar research in the United Kingdom, demonstrated conclusively a correlation with reduction in fire deaths to the implementation of open flame fire standards. According to feedback from industry, it was noted that after the move to TB 117-2013 then 85% of the new furniture sold in the United States will be less safe, while 15% might be less, equally, or more safe. It was pointed out that the results of the fire tests carried out by NBS in the 1980s actually demonstrated what others have subsequently proved, namely that a small loading of flame retardant in a foam will not resist a large ignition source, whereas a larger loading of flame retardant will resist such large ignition sources, and that an intermediate loading of flame retardant will successfully resist a small open flame challenge such as in the original TB 117.

*General Discussion with Panel***Comments:**

- Participants heard many different interpretations of data and science during the two-day meeting. Data can tell many different stories, and everyone interprets that information through a particular lens, using it to make a particular point.
- Everyone in the room shared a common objective of fire safety and health, and solutions require respectful dialogue and listening with an open mind.
- While a participant agreed that chemicals have saved lives in upholstered furniture, another questioned whether the data makes the firm conclusion that it's all about flame retardants.
- Another comment questioned whether the U.S. data could be teased apart to separate changes in smoking rates from other factors that had driven down fire losses. Gaps in

the U.S. data were acknowledged but it was discussed that the reduction in fire losses does not correlate to smoking trends or the introduction of smoke alarms. It is understood that the average room is bigger and contains more combustible material and ignition sources. All things being equal, you would expect it to go up, so something is bringing it down. One hypothesis presented is that higher-end furniture contains flame retardant, so the big remaining fire losses are linked to products in the lower price and quality range.

- One comment reflected that one U.S. manufacturer had undertaken efforts to eliminate flame-retardant coatings by mid-June 2014, but its foam contained Toluene diisocyanate (TDI), a known carcinogen—so the effort still just scratched the surface. In response, a panellist explained that TDI is a listed toxic substance which is the feedstock for FPF, but tests repeatedly show that it is fully reacted and not present in FPF.
- A discussion centered on the dichotomy between a chemical and non-chemical world, adding that a non-chemical world is not feasible. An indiscriminate commitment to natural fibers brings its own severe hazards. Natural wool crib bumpers place infants at higher risk of sudden infant death syndrome, while the added land use and methane emissions from raising sheep would be an environmental disaster if humanity relied more heavily on wool.
- One company's latest barrier combines three common elements in proportions that form a char barrier when they burn, thereby preventing oxygen from getting through.
- There needs to be a focus on consumer awareness, including the language and formats that will make technical information understandable to the public. A panellist responded that there is a voluntary CertiPUR foam analysis program, created by foam producers and in effect since 2004. The program involves independent laboratory examination of foam products. Evaluation criteria are based on consensus between 17 different national and international standards. Today, foam used in many upholstered products meets the program criteria, and the industry is working to raise public awareness.
- It's important for the public to understand that a product meets a flammability standard may still burn rapidly and emit toxic gases—so user caution is still essential.
- The United Nations has been looking at how to transfer information down through the supply chain, to make it available to both consumers and workers, and it was asked how the industry could participate.
- The UFAC association keeps its members up to date on the options available to them and leaves it to individual companies to decide their own approaches. The textile association (out in right name) had adopted the NSF 356 sustainability standard, primarily for the contactor market, but left participation up to individual firms.

- The PFF industry has not supported any specific sustainability standards, after concluding that the analysis was impractical. FPF is a complex individually-formulated product, involving many raw materials. Attempts have been made to gather sustainability information, but the raw materials are diverse and numerous, and it became almost a mathematical impossibility. Existing sustainability analyses also often fail to factor in the cost and impact of transporting competing materials to the United States for processing, or the human rights issues at different points along the production chain.
- Future labeling would have to balance chemical content with a product's contribution to climate change. The very serious issue here is the future of our planet, and that means moving beyond a false greenness that says if it's grown, it's good. Deforestation is responsible for one-quarter of global warming. Companies are already required to produce material safety data sheets, so information on chemical content is readily available.
- Discussion centered on the safe harbor provisions in California Proposition 65, with one participant pointing out that Prop 65 is a warning system, not a safety statute. The label can be seen as selling proof or as a communication tool, and is sometimes interpreted as a guarantee that TDCPP levels will fall below the safe threshold for serious health effects. One participant suggested a discrepancy between the threshold and the science: European regulators see no reason to phase out TDCPP, because exposures are already below the safe harbor level.

Question: Where can consumers get objective, third-party product information that they can read and understand without being toxicologists?

Comments:

- A federal government official said fact sheets from the EPA might be useful to public as well as specialist audiences.
- Another participant said retailers like Walmart have begun applying their own regulations to consumable products, adding that there might be a role for third party organizations in supplying the independent information the market needs.
- What about the health impacts of TDCPP? Earlier calls for accurate advice were echoed, produced in plain language, which reflects the intended use of a particular substance. The guidance must be written by an independent organization, use language which is always similar, and meet growing public demand for more information.
- A concern was expressed that furniture manufacturers already have a limited range of dye and fabric options for some products, and regulation could introduce further restrictions. Panelists and participants said consumers want choice, and retailers are looking for products that will sell. Some companies do 25–40% of their business with

customers who supply their own fabrics, raising concerns about the cost of compliance if those fabrics have to be tested.

Question: Would industry benefit from a labeling program like ENERGY STAR?

Comments:

- Retailers would not want it.
- A big, visible tag would be useful.
- There is a need for readable labels and consumer education, noting that even scientists found current labels unintelligible.

Question: The panelists were asked if they can recommend next steps.

Comments:

- Small steps in the right direction, noting that a fire test already exists and it might be problematic to develop a new one.
- CPSC should focus first on a smolder test, allow time for the various industries to learn more about open flame hazards, and engage a third-party expert with a national reputation to answer the questions that arise.
- Small steps really are small steps in light of the major progress that has been made over the last two decades.
- The importance of transparency was stressed, noting that the food industry has seen phenomenal change in the direction of consumer information and awareness.
- There will never be a single, perfect flammability test for the full range of furniture designs and geometries, and it will never be possible to make furniture that does not burn. The question is how much consumers will be willing to pay and how many lives will actually be saved.
- Cost-benefit analysis is a part of the CPSC's work, but it was noted there has been some pressure to remove it.