Every day, architects, builders, and other building professionals specify and use products that help them create appealing, durable, and functional homes, offices, schools, hospitals and other structures. Innovations in chemistry contribute greatly to developing building materials that help meet today’s evolving needs. For example, high performance spray foam insulation helps improve buildings’ energy efficiency; synthetic flooring in hospitals and operating rooms can be easily cleaned and disinfected; and plastic coatings added to metal roofing can protect the roof for years from corrosion and the physical impacts of storms and the elements.

While these innovations have tremendous benefits, there is increased interest around how building materials may affect the health of building occupants and the environment. Architects and other building professionals want to understand health and safety information about product ingredients and be able to make informed choices about the materials they select.

Balancing important factors like performance, durability, and aesthetics with health, safety, and environmental impacts can be a challenge. But an informed material selection process can help advance the health, safety and welfare of building occupants without sacrificing the quality and effectiveness of the building materials used.

This article will review basic concepts that could change how you look at materials and your materials specification processes. It begins with understanding the differences between hazard, exposure and risk—the importance of considering product use and exposure and the limitations of using a hazard-only decision making process when selecting building materials. This article also will describe some tools, guidance and resources available for evaluating products and materials to help...
achieve both a high quality construction project, and one that is safe for building occupants. Finally, this article will provide information to help you use building materials safely.

SECTION 1—CONSIDER HAZARD, EXPOSURE AND RISK WHEN SELECTING BUILDING MATERIALS

Material selection is a critical aspect of the building design and construction process. The materials that comprise a building not only affect how the building looks and performs, but also can have an impact on the health, safety, and welfare of the people in the building. Increasingly, architects and builders seek to specify and provide clients with innovative materials that not only perform well, but also reduce the amount of resources consumed and improve overall health and environmental impacts.

Selecting the appropriate building materials can be a straightforward task with the proper information. But what information should building professionals consider before making a selection decision?

Defining hazard, exposure, and risk

When selecting a material or product for a building project, the core issue comes down to understanding the difference between hazard and exposure, and the relationship of both when it comes to informing risk or danger. So what goes into the determination that a material or product might cause or result in a negative impact on human health or the environment?

An easy way to think of the relationship is that a hazard is anything that might cause harm to a person because of some characteristic it has. Exposure, or contact, relates to the amount of or frequency with which a person comes in contact with the hazard. Think of exposure as “hazard in context” with use or another form of contact. Risk is the possibility of harm that may come from exposure to a hazard. Danger is a commonly used term to indicate risk. Alone, a hazard does not present a risk/danger unless there is contact, a level of exposure.

To put it in terms of a simple equation: Hazard × Exposure = Risk

An example that illustrates this concept is exposure to sunshine, specifically the sun’s ultraviolet rays. In temperate climates, ten minutes of direct sun exposure without sunscreen will likely not harm a person, and can be beneficial by providing a natural dose of Vitamin D. However, longer time spent in the sun—30 minutes, an hour or longer, might result in painful sunburn, and the risk of the negative effect—the sunburn—increases as the exposure time increases. Risk can also increase if the exposure is more concentrated—ten minutes of exposure in a very hot climate at the peak of summer may result in sunburn, and longer exposure will increase the risk. To take this a step further, repeated or severe unprotected sun exposure may lead to skin cancer.

We can look at chemical ingredients in building materials in a similar fashion:

- **Hazard** refers to the inherent properties of a chemical substance that makes it capable of causing harm to a person or the environment.
- **Exposure** describes the amount, duration, and frequency with which a chemical substance comes into contact with a person, group of people, or the environment.

**Risk, or Danger**, then, is the possibility of harm arising from a particular exposure to a chemical substance, under specific conditions.

**Evaluating hazards**

In this article, we will consider two main types of hazards: human health and environmental. If direct human contact is anticipated, then questions related to human health hazards—also called the human health endpoints—are important. If direct human contact does not occur but the product or material is expected to be used or discarded in a way that impacts water, soil, outside air, or wildlife, then environmental hazards are key.

Table 1, below, provides a starting point for considering which hazards are relatively more important.

<table>
<thead>
<tr>
<th>Table 1: Considering Human Health and Environmental Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard Endpoints</td>
</tr>
<tr>
<td>Chronic Effects:</td>
</tr>
<tr>
<td>Cancer, Mutagenicity,</td>
</tr>
<tr>
<td>Reproductive Toxicity (CMR), Target Organ Systemic Toxicity</td>
</tr>
<tr>
<td>Acute Effects:</td>
</tr>
<tr>
<td>Skin, eye, or respiratory irritation, or sensitization</td>
</tr>
<tr>
<td>Chronic or acute aquatic toxicity</td>
</tr>
<tr>
<td>Persistence or Bioaccumulation</td>
</tr>
</tbody>
</table>

Scientists classify hazards based upon test results that address exposure to the chemical in its pure form. Some tests are designed to indicate chronic toxicity (longer term or recurring repeat exposure) or acute toxicity (a single or short term exposure). Generally, most chemical manufacturers are required to use the World Health Organization’s Globally Harmonized System of Classification and Labeling (GHS), which provides a global framework for hazard testing, classification, and labeling. In compliance with GHS, manufacturers provide a Safety Data Sheet that identifies chemicals having a hazard classification. Most other declarations use a format similar to GHS to identify the chemical
(either specifically by scientific or by trade name) and its hazard class.

Although hazard classifications are determined based on an evaluation of the pure chemical, building materials and products may contain smaller levels of multiple chemicals that together make up the final product used in the building. Thus, the hazard of the pure chemical as classified may not apply to either the form or the level of the chemical present in the building product or material.

As an example, titanium dioxide in dust form is classified as an inhalation hazard, but when titanium dioxide is in wet form, as in paint, there is no inhalation hazard. In another example, formaldehyde in the concentrated gaseous form is an inhalation hazard, but at lower concentration levels, like that found in human breath, it is not. For these reasons, determining the form and the exposure level of an ingredient are important factors when determining danger or risk.

**Limitations of hazard-only materials selection**

Chemical hazard-based lists, often known as “red lists,” are sometimes used to identify chemicals for reduction, phase out, or elimination.

When such lists are developed with scientific rigor and assignment of risk—based on a substance’s use in a specific application—they can be a useful part of a risk-based chemical management program. However, “red lists” are often developed based on an evaluation of a chemical or substance hazard, without consideration of exposure to the chemical ingredient or how and why the ingredient is used in the product.

Moreover, some hazard scoring tools include production chemicals that have been used at some point during a product’s manufacturing process but are not present in the final building product or material. For example, the chemical benzene, classified a human carcinogen, is used in the synthesis of styrene to make polystyrene, one of the most widely used plastics and deemed safe for a variety of food contact applications, such as coffee cups, plates and take-out containers. In this case, the chemicals used early in the production process are transformed into inert or benign molecules in the finished product.

To summarize, hazard assessment tools can provide useful information when used in conjunction with other information. But used alone, hazard may lead to poor product and materials selection decisions. Hazard needs to be put into the context of the product, how it is used and by whom.

**Building on hazard to incorporate exposure**

With the increased availability of materials disclosure information, decision makers have access to information about the ingredients and their hazard classification in building products and materials. Hazard information is important if it is likely that an ingredient in a building product or material could have exposure,
i.e., human contact. Unfortunately, current disclosure forms often do not contain critical exposure information. A useful framework might ask: What is the product? Where is it used in the building? Is human contact expected during expected use? If so, what degree of contact is expected? For example, if the product or material is within the building envelope and direct contact with the building occupant is not anticipated, one might evaluate the material differently than if building occupants are in contact with the material on a daily basis.

Additional questions to ask include: 1) Is the ingredient reacted into the building product or material, or can it migrate out of the material? 2) Does the material have a physical barrier to limit or prevent human contact? 3) Does the material degrade over the expected service life of the material, allowing eventual ingredient contact? By thinking about the physical properties of the product, professionals may be able to answer these questions. If human contact is likely, then a hazard analysis for those ingredients is appropriate and informative.

**Gauging appropriate exposure levels**

Even with a variety of hazard information and tools available to help assess potential risk and provide guidance for safe use, practitioners may still seek additional guidance on determining appropriate exposure levels to specific chemical substances.

Safety thresholds play an important role in helping determine acceptable exposure to an ingredient or substance, and thus help determine the actual risk. In its most basic sense, a safety threshold is the point after which some degree of harm may result. It is important to realize that safety thresholds are set based upon an evaluation of the hazard of the ingredient, independent of use, and may include a number of factors that could lead to an overly low threshold for risk.

Several established safety thresholds can help when screening chemical ingredients. Acceptable Daily Intake (ADI), Maximum Allowable Dose Level (MADL), Reference Dose (RfD) and Reference Concentration (RfC) all provide useful information to screen whether the threshold of a chemical ingredient is acceptable or not without the need to more advanced assessment.

<table>
<thead>
<tr>
<th>QUIZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Which formula accurately portrays the relationship between Hazard, Exposure and Risk?</td>
</tr>
<tr>
<td>a. Risk + Hazard = Exposure</td>
</tr>
<tr>
<td>c. Risk x Exposure = Hazard</td>
</tr>
<tr>
<td>2. What is risk in exposure to a substance?</td>
</tr>
<tr>
<td>a. The probability of harm</td>
</tr>
<tr>
<td>c. The possibility of harm</td>
</tr>
<tr>
<td>3. How is exposure measured in a substance that comes into contact with a person, group of people, or the environment?</td>
</tr>
<tr>
<td>a. Type and time</td>
</tr>
<tr>
<td>c. Detection and research</td>
</tr>
<tr>
<td>4. What products are classified as a hazard?</td>
</tr>
<tr>
<td>a. Ones that are capable of harm</td>
</tr>
<tr>
<td>c. Ones that should be avoided</td>
</tr>
<tr>
<td>5. What are chemical-based lists also known as?</td>
</tr>
<tr>
<td>a. Red lists</td>
</tr>
<tr>
<td>c. Orange lists</td>
</tr>
<tr>
<td>6. True or False: All chemicals listed on chemical hazard assessment tools are ones that are present in the end product.</td>
</tr>
<tr>
<td>7. True or False: Using single-attribute consideration, or lists, is an acceptable way to determine risk.</td>
</tr>
<tr>
<td>8. What does a LCA take into consideration?</td>
</tr>
<tr>
<td>a. Chemicals present in the initial build</td>
</tr>
<tr>
<td>c. The environmental impacts of a product through its entire lifespan</td>
</tr>
<tr>
<td>9. What are EPDs?</td>
</tr>
<tr>
<td>a. Experimental Process Directions</td>
</tr>
<tr>
<td>c. Electronic Performance Documents</td>
</tr>
<tr>
<td>10. What U.S. organization provides specific guidance around appropriate exposure levels to various substances?</td>
</tr>
<tr>
<td>a. FDA</td>
</tr>
<tr>
<td>c. EPA</td>
</tr>
</tbody>
</table>

This article continues on [http://go.hw.net/AR1216Course5](http://go.hw.net/AR1216Course5). Go online to read the rest of the article and complete the corresponding quiz for credit.

<table>
<thead>
<tr>
<th>SPONSOR INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The American Chemistry Council represents the leading companies engaged in the business of chemistry. ACC members apply the science of chemistry to make innovative products and services that make people’s lives better, healthier and safer. ACC is committed to improved environmental, health and safety performance through Responsible Care®, common sense advocacy designed to address major public policy issues, and health and environmental research and product testing.</td>
</tr>
</tbody>
</table>
CONTINUING EDUCATION

EVALUATING A VARIETY OF CHEMICAL ASSESSMENT TOOLS

A variety of chemical assessment tools are available in the marketplace, with the stated purpose of helping users determine whether specific chemical ingredients in products may be a concern, or to certify what some call “greener” chemical ingredients. A comparative analysis of leading chemical assessment tools recently published in the Integrated Environmental Assessment and Management journal sought to determine what sort of information these various tools provide, and found that that when evaluating the same chemical, individual tools can come to different conclusions about the hazard score of each chemical.

The results show a wide variety of hazard scores for the same chemical—ranging from little or no hazard/toxicity to very high hazard/toxicity. For example, one chemical substance evaluated in the study—caffeine—was ranked by two of the tools as a “low” hazard, as a “moderate hazard by one tool, as a “high” hazard by three tools, and as a “very high” hazard by two of the tools.

What does this mean? All of the tools analyzed may be useful in providing hazard-level information about chemicals. The challenge is that different tools can produce varied, and sometimes conflicting, results when assessing the same chemical.

The reason for many of the differences stems from the approach each tool uses to screening and methods to analyze information. For example, the tools differ in the sources of information (lists or data) and “endpoints” they use to judge hazards. The results affirm the importance for tools users to have a good understanding about what each tool is designed to measure, as well as the appropriate conditions for each tool’s use, so they can choose the best tool for their needs.

SECTION 2—MAKING INFORMED MATERIALS SELECTION DECISIONS

When making materials selection decisions, architects and other building professionals may start by reviewing specific ingredients in the materials and products. However, such an approach by itself does not provide all of the information needed to make appropriate materials selection choices.

There are a range of additional factors that building professionals should consider as they make project-appropriate choices. Some of the questions architects might ask include:

- What are the optional materials or products that can meet the client/customer needs?
- Are there any ingredients with high hazards? What is the likelihood that humans might come in contact with ingredients in the product or material after installation?
- What are the trade-offs among different ingredients and materials choices?
- What is the functional role of the ingredient; why is it being used in the product?
- Are there substitute products or materials available that will meet the project’s needs?

How, where and why

The previous section reviewed the distinction between hazard and exposure and the role of both in evaluating risk/danger. Another way of looking at the differences among various levels of exposure is to ask whether the substance is “in,” “on,” or “near” a person. Do people come into contact with the substance through eating, drinking, inhaling or touching the building product or material? How frequently is the substance used? Is the material containing the ingredient accessible, or is it hidden within or behind something (e.g., a wall)? Is it in a form that can migrate out of the product?

A couple of examples of various levels of exposure to ingredients in products include:

- **Spray foam insulation** located in the building envelope (NEAR the occupant, but behind structural elements so there is no direct contact post installation)
- **Formaldehyde emissions from composite wood products in cabinets** (IN the occupant when inhaled) Small levels of formaldehyde are emitted from any wood product.
- **Volatile organic compounds (VOCs) in carpets or paint** can be inhaled when these products are installed (IN the occupant when inhaled)

Spray polyurethane foam insulation in the building envelope

Spray polyurethane foam (SPF) is a spray-applied polymer that can form a continuous insulation and air sealing barrier on walls, roofs and contoured surfaces. It is made by mixing and reacting methylene diphenyl disocyanate (MDI) with a resin blend at the job site to create the foam, which insulates, seals gaps, and can form air and moisture barriers. SPF insulation is known to resist heat transfer extremely well, and it offers a highly effective solution in reducing unwanted air infiltration through cracks, seams, and joints.

SPF insulation used in homes, schools and other public buildings is considered cured when it reaches its end-use state. Foams cure at different rates, but generally are fully cured after 24 hours. According to the U.S. Environmental Protection Agency (EPA), “completely cured products are fully reacted and therefore are considered to be inert and non-toxic.”

Formaldehyde in composite wood products

Formaldehyde is a natural ingredient in wood, many foods and all living organisms. Industrially, formaldehyde-based resins are used to manufacture composite and engineered wood products used in cabinetry, countertops, moldings, furniture, shelving, stair systems, flooring, wall sheathing, support beams and trusses and many other household applications.
Few, if any, compounds can replace formaldehyde chemistry in creating high-quality resins without compromising quality and performance.

The use of formaldehyde-based resins in wood panel and board products also enables the sustainable use of forest resources and minimizes waste, as composite wood panels, such as particleboard, are typically made from recovered wood waste that would otherwise be burned or disposed of in a landfill. Composite panels allow for more than 95 percent of the tree to be used, compared to only 63 percent of a tree that can be used in solid lumber.

Products containing formaldehyde are strictly regulated to ensure that whatever emissions the products do emit are as low as possible. Studies show that formaldehyde does not accumulate in people or animals because it is quickly broken down by the body’s natural metabolic processes. In the environment, formaldehyde is quickly broken down in the air by moisture and sunlight, or by bacteria in soil or water. Numerous studies show that air levels of formaldehyde normally found in homes and offices are close to naturally occurring background levels, and are well below the World Health Organization’s acceptable inhalation level and do not pose a human health risk.

**VOCs in paint**

During the manufacture of paints, solvents are needed to carry the pigments and other ingredients during installation, but then evaporate after application to form a smooth surface film. Over the years, the paint industry has reformulated some paints to include low VOC options that meet stringent air quality regulations and still provide a smooth final surface film.

Low VOC paint is available to meet more air quality regulations.

**VOCs in carpets**

Building occupants also need to be informed about post-installation issues that may have health or safety effects. For example, when builders install new carpeting in a home or office building, chemical substances in the carpet, carpet cushioning or adhesives may off-gas or evaporate into the air, giving off an odor, for several days. This can affect the indoor air quality and potentially contribute to health effects such as headaches and dizziness, or trigger or exacerbate asthma symptoms. In such cases, building occupants may need to be prepared to limit the time spent in rooms with the new carpeting and ventilate the room to keep the air fresh until the VOC emissions have dissipated.

**Considering trade-offs among material and product choices**

A trade-off is generally defined as a compromise, or the balance between two desirable but mutually exclusive or incompatible features or characteristics. For example, decisions might require trade-offs between cost, performance, functionality, or safety.

When considering trade-offs in building situations, professionals need to be clear what their priorities and selection criteria are, particularly in terms of cost, performance, functionality, health and environment impacts, and safety. While project staff usually focus on achieving project goals, installation and delivery of the project, staff might consider factors in other stages of the building material or products, such as use and maintenance during service life and final disposal of the product or material all have their own issues, whether in the form of health risks or environmental damage.

In all decisions that require examining trade-offs, the decision-maker needs to consider what benefits and downsides they may potentially gain or lose by making a certain choice between mutually exclusive alternatives. These trade-offs can be visually analyzed simply using a four block matrix (see Table 2).

**Table 2: Trade-Off Matrix: Chlorine in Drinking Water**

<table>
<thead>
<tr>
<th>Adding Chlorine to Drinking Water</th>
<th>Not Adding Chlorine to Drinking Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit:</td>
<td>Benefit:</td>
</tr>
<tr>
<td>Removing harmful pathogens from drinking water</td>
<td>Eliminate exposure to chlorine and its by-products</td>
</tr>
<tr>
<td>Risk:</td>
<td>Risk:</td>
</tr>
<tr>
<td>Exposure to small levels of disinfectant by-products present in drinking water</td>
<td>Increased likelihood of exposure and effects from harmful pathogens, like cholera, in drinking water</td>
</tr>
</tbody>
</table>

When it comes to the chemical additives to building materials, building professionals may consider whether there are products where a potentially harmful, but well characterized, ingredient is replaced with something else that is less well characterized, and if so, what are the potential risks/dangers associated with using a product or material containing the alternative ingredient.

**Considerations when making product substitution decisions**

On the surface, it may seem like an easy thing to replace a potentially hazardous substance from a product’s ingredient list. In reality, it is not quite that simple. Most times, whenever one ingredient is removed, something else needs to replace its functional role to ensure that the product performs as required. However, the replacement ingredient may have unintended consequences—for example, it may present a higher risk than the original ingredient—thus leading to what is called a “regrettable substitution.”

Decision making can be enhanced by remembering the use and purpose of the product as the first step in framing any analysis. For example, insulation materials that contain flame retardants are installed within walls and unconditioned spaces. Flame or fire retardants are used to retard materials from burning, allowing the precious time for occupants to flee. Some flame retardant materials appear on various chemical hazard lists, so architects and builders may be concerned about the effects of exposure to materials containing these chemicals. In most cases, occupant exposure to the insulation and its ingredients is minimal,
because the insulation containing the flame retardants is located behind a wall, in the building envelope, and not in direct contact with building occupants.

**Limitations of single-attribute consideration**

As mentioned in the previous section, lists and declaration documents can be useful in helping identify whether certain chemical ingredients are present in a product or material, but lists require the consideration of exposure to provide an indication of danger or risk. Therefore, lists should not be used alone to determine whether a specific chemical ingredient poses a genuine risk/danger. In fact, by de-selecting a product or material based only on a single attribute, practitioners may substitute one material with another that has a different, possibly regrettable, tradeoff.

For example, a contractor might have to choose between a pipe made of metal or plastic. If the contractor’s decision is based solely on the desire to avoid using a specific plastic resin because it contains a chemical ingredient that appears on a red list, then they might specify a metal pipe. But that selection comes with tradeoffs—for example, a metal pipe might be more prone to corroding over time, leading to costly repairs and damage due to leaking in the building.

When a single attribute is used to make a materials selection decision, other elements are often ignored. In the case of underground piping for water or sewage, the local climate, soil conditions, and even water parameters/conditions may play a role in helping a building professional decide which type of piping is best for a specific application or building site. It is also important to factor in the cost of purchase, installation, and maintenance over the lifetime of the product—not just the initial costs.

Understanding and weighing product and materials trade-offs, and deciding which attributes are most important in each project, is crucial to making comprehensive, informed product selection decisions.

**SECTION 3—EVALUATING A VARIETY OF PRODUCTS AND MATERIALS**

Architects, designers, and construction specifiers consider a variety of attributes, including product durability, carbon footprint and sustainability, when choosing materials and products to use in building design and construction.

Decision makers in the building and construction marketplace may be interested in comparing the benefits and trade-offs among alternatives, using metrics such as cost, performance and aesthetics, among others. A product also needs to align with and provide a particular function, as well as the builder, architect or designer’s overall vision. In addition, a growing number of stakeholders are asking for more information about the safety and sustainability of consumer products, particularly related to their chemical ingredients.

Materials used in building and construction applications have unique strengths and weaknesses, and there are often trade-offs among these attributes. For example, a particularly durable product may also come with a hefty price tag. Or a particularly beautiful product may be difficult to maintain and need early replacement. To help architects, designers and builders navigate this complex territory, a number of tools, guides and considerations are available to help weigh the options and understand the impacts and trade-offs associated with decisions.

**A Life Cycle Assessment (LCA)** is a systematic evaluation that helps measure the environmental impact (or “footprint”) of products, materials, or services, and can be used to help assess the safety, resource efficiency, and environmental impacts of a product through its entire lifespan, including materials extraction and disposal. An LCA takes into account factors related to emissions and the related health and environmental impacts, the expected lifetime of the product, durability, product performance, cost, job site conditions, and transportation, among other project-specific factors.

 Lifecycle thinking is valuable in that it helps architects and building professionals identify and address “burden shifting” issues; that is, what happens when one impact point of a product is eliminated, and that change unintentionally results in an equal or greater impact at another point along the life cycle. For example, life cycle thinking can inform a straightforward household decision like whether to use cold or hot water to do laundry. By using cold water, no additional energy is used for heating processes, whereas a hot water wash requires energy that most likely came from burned fossil fuels.

**Environmental Product Declarations (EPDs)** are standardized documents that quantify the life cycle environmental impacts of a product or system. They communicate transparent and comparable information about the life-cycle environmental impact of a product. For example, a company may register an EPD to transparently communicate the environmental impacts of a project, such as their infrastructure works, electricity generation, or product sustainability.

EPDs can help decision makers objectively assess key environmental impacts of products throughout their life cycle, and in turn identify opportunities to improve environmental performance. Note that having an EPD does not mean that the product is superior to alternatives; it is a transparent declaration of the life cycle impact that allow for comparison between similar products.

**Materials Disclosure Tools** provide information to help users evaluate chemical ingredients in a product. Some common materials disclosure tools include: safety data sheets provided by the product manufacturer, as well as tools developed by private organizations or nonprofits, such as Declare, Health Product Declaration®, GreenScreen®, and others. Some of these tools include detailed information including hazard classification and concentrations levels. Some of the declarations, such as safety data sheets, were created to inform customers about safe handling requirements; other declarations were designed to only list ingredients and their hazards. Most disclosure tools do not provide an indication of health impacts throughout the product life cycle, nor do they assess exposure risk associated with a product or handling use.

**Risk Assessments** combine the hazard evaluations with an exposure analysis to provide an indication of the acceptable use of an ingredient. Different products with the same ingredient will require an exposure assessment using factors specific to the use. For example, insulation, which is installed behind a wall or ceiling and does not come in contact with building occupants, requires use of different exposure parameters than flooring, which is literally under-foot, and thus occupants come in contact with every day.

While there may be no “silver bullet” or “one-size-fits-all” answer to tell you the “best” product or material to use in a specific application, careful consideration of the intended use and performance of a product coupled with safety profile from health and
exposure information can provide information to inform the potential risk/danger from a product choice. Adding product life cycle impacts, economic factors, and performance across the service life of the product can help provide increased confidence in materials selection decisions.

SECTION 4—MANAGING RISK AND DETERMINING SAFETY

The question of whether a hazard poses a serious risk can be a tough one, since risk can depend on how much, how often, and how long the product is used. These conditions are generally referred to as amount or dosage, frequency, and duration, and as such can provide building professionals with useful information to better assess the seriousness of the risk. Products containing chemicals, for example, will include hazard warnings noting the severity of the risk. If that information isn't enough, products may have legislated requirements or standards, industry codes, or safety data sheets that provide more detailed information.

Volatile organic compounds (VOCs) serve as an example of how challenging it can be to properly determine risk. VOCs can vaporize at normal room temperature and usually pose a higher risk when first installed, with the risk lowering as they dry or cure. This example illustrates how amount, frequency, and duration affect risk. With some chemicals such as VOCs, the actual health effects of long-term exposure (i.e., years of living or working in a building) may not be known until later, when exposed people either become sick or remain unaffected. To address this, regulators have put in place regulations to address health concerns with evaporating VOCs from building products.

There are specific resources and guidance that architects, specifiers and builders can use to make sure that they are taking appropriate safety precautions to appropriately handle materials containing chemical ingredients.

Safe Handling: Following Guidelines

In the construction phase, product installers and construction workers need to be aware of and follow instructions, product installation guidelines, and all information on the manufacturer’s Safety Data Sheets (SDS), to mitigate unnecessary risk.

One of the best ways building professionals can help mitigate the risk of any product is to ask for help from the product suppliers. A well-informed supplier should be trained to provide whatever information is needed, and to address questions concerning the needs of each specific project. Suppliers can serve as experts for tricky installation situations, and may help building professionals consider alternatives they may not have thought of and help them avoid unnecessarily exposing their workers or the building occupants to any chemical hazards.

Many manufacturers also have developed and make available safety training resources online. For example, the Spray Polyurethane Foam Chemical Health and Safety Training module provides information about the use, handling and disposal of SPF, potential health hazards, and available control measures, including engineering controls and personal protective equipment (PPE). There are two training courses available on this topic, which have been approved by the Building Performance Institute for Continuing Education Units (CEUs) and by RCI, Inc. for Continuing Education Hours (CEHs). More information is available at SPF Health and Safety.

For information about safe and healthful working conditions, the U.S. Occupational Safety and Health Administration (OSHA) provides specific guidance around appropriate exposure levels to various substances. Companies are responsible for training and certifying that their workers are aware of and follow OSHA requirements.

Publicly available scientific research is another source of information—the U.S. Environmental Protection Agency (EPA) and other regulatory agencies have websites that provide information about products and ingredients, and can help professionals make informed decisions about product use, installation, and long-term effects.

Trade associations also can be a source of information about chemicals used in building materials. BuildingWithChemistry.org, developed by the American Chemistry Council, includes information about the applications and benefits, as well as safety information, about the range of chemical ingredients used in building products and materials. Product-specific trade associations also are a source of information on a variety of building components, from windows, flooring and roofing to insulation, paint, adhesives and coatings and more.

SECTION 5—CONCLUSION

In conclusion, there are several key takeaways when it comes to understanding hazard, exposure, and risk and evaluating materials ingredients. First, hazard information is important, but hazard is only one factor building professionals need to consider when making materials selection decisions. Product ingredient information is important, and this information should prompt questions concerning what purpose the ingredient has in the product, what concentration is considered “safe,” and who will be exposed and for how long.

The final decision about what products or materials to use for a specific building project should take into account not only the cost, performance and aesthetics of the product or material, but also the environmental, health and safety information about a product and its ingredients, how the product is used in a specific application, its exposure and risk profile during use and its impacts at end-of-life. ★

REFERENCES