CHEMISTRY IN MATERIAL SELECTION & SPECIFICATION:

Key Considerations

AMERICAN SOCIETY OF INTERIOR DESIGNERS

RESEARCH

American® Chemistry Council

INTRODUCTION

Interior designers seek creative design solutions to challenges in the project space using knowledge and research from multiple disciplines.

Designers may utilize psychology to understand human behaviors within a space, access experts in the field for specialized areas (e.g. acousticians designing noise control strategies), wear a business hat when completing financial projections and budgets for project, etc. When selecting and specifying materials, designers may also tap into chemistry and performance characteristics required for the specific application to help make informed product decisions.

Chemistry is the study of matter and energy and the interactions between them. But, how does this relate to interior design? The materials and products interior designers select and specify are formulated as a result of chemistry. **Chemistry determines the material properties that impact the function, performance, aesthetic, and lifecycle of the product design solution that may further impact the health, safety, and welfare of the end-users.** To achieve these goals, chemicals undergo a review process and comply with regulatory requirements (e.g. the Environmental Protection Agency's continual updates to the Toxic Substance Control Act, otherwise known as modernized TSCA[i]. Finished products include compliance with regulations to meet federal or state requirements in addition to following minimum performance testing standards set through consensus-based processes by standard development organizations. Interior designers do not have to be full-fledged chemists but benefit from understanding chemistry basics to think critically, discern information provided, ask important questions, and make informed decisions.

Goals and objectives for interior designers:

- Health, safety, and well-being
- Performance (function)
- Aesthetics
- Budget
- Social responsibility
- Sustainability

As designers, why is chemistry important?

- Chemistry is the foundation of all product and material formulations.
- Chemistry may impact the risk profile of a product/material.
- Chemistry may impact the safety benefits of a product/material.
- Chemistry impacts the durability of a product/material.
- Chemistry impacts the cost of a product/material.
- Chemistry may impact the energy efficiency of a building.
- Chemistry may impact the environmental performance of a product.

[i] For more information, visit the American Chemistry Council's Toxic Substance Control Act (TSCA) page: https://www.americanchemistry.com/TSCA/

The challenge in demystifying chemistry in materials and products is not for interior designers to tackle alone. Technical departments of product manufacturers and trade associations are excellent partners to assist interior designers in better understanding product chemistry, impacts of chemicals within formulations, and the role of chemicals to meet product performance characteristics. Interior designers also have access to valuable resources from organizations that provide third-party review and verification for more detailed information on material ingredients.

Furthermore, the American Society of Interior Designers (ASID) and the American Chemistry Council (ACC) sought to connect designers and chemists to better understand potential gaps and needs. Based on multiple roundtable discussions, both parties agreed that a simple and easy resource that helps interior designers understand the basic connection to chemistry in materials and trains them to ask key questions for making informed decisions appropriate to the project was a top priority. Interior designers desire clarification in terms, case studies to better understand applied settings, updates in products and findings, and overall transparency as they are challenged to make decisions with limited resources, knowledge, and time.

This document takes the first step in reviewing the basic connection between interior design and chemistry, considerations in the material selection and specification process, and guidelines for decision making by addressing questions such as:

1. Why do interior designers benefit from knowing **basic chemistry of material formulations**?
2. What are the potential impacts of chemistry on **human health** based on risk and exposure?
3. What **considerations/priorities** based on performance are important in making product selection decisions?
4. What **questions** should interior designers consider asking product manufacturers in the process?
5. How do we achieve **transparency and innovation**?

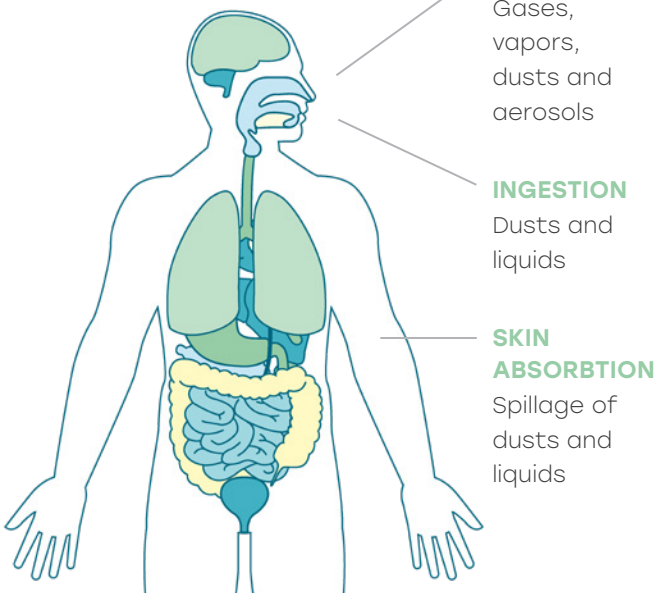
CHEMISTRY OF MATERIALS:
The Basics

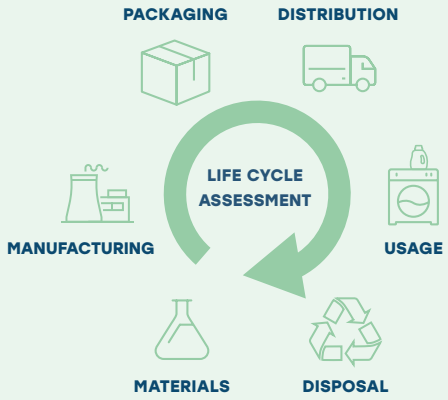
Chemistry is part of our everyday lives, whether we realize it or not – understanding chemistry can help us understand our surroundings and make better decisions. Chemistry can help materials form into various shapes, be resilient, withstand stress, be long lasting, easy to clean, resist moisture, keep from spreading fires, etc. We reap multiple benefits from chemistry, but some of these chemicals have risk profiles that may need to be assessed prior to application and use.

Chemicals can affect our health by exposure through various pathways (i.e., inhaled through our lungs, ingested through our mouths, absorbed through our skin, and entered through our umbilical cord) and vary depending on our metabolic rate and genetics. Health impacts from exposure to certain chemicals in specific amounts can vary, from eye and skin irritation, to respiratory sensitization, to larger effects on the organs. In addition, some chemicals are designated as having acute, chronic or systemic toxicity or carcinogenicity, so people may have concerns about potential interaction with these materials.

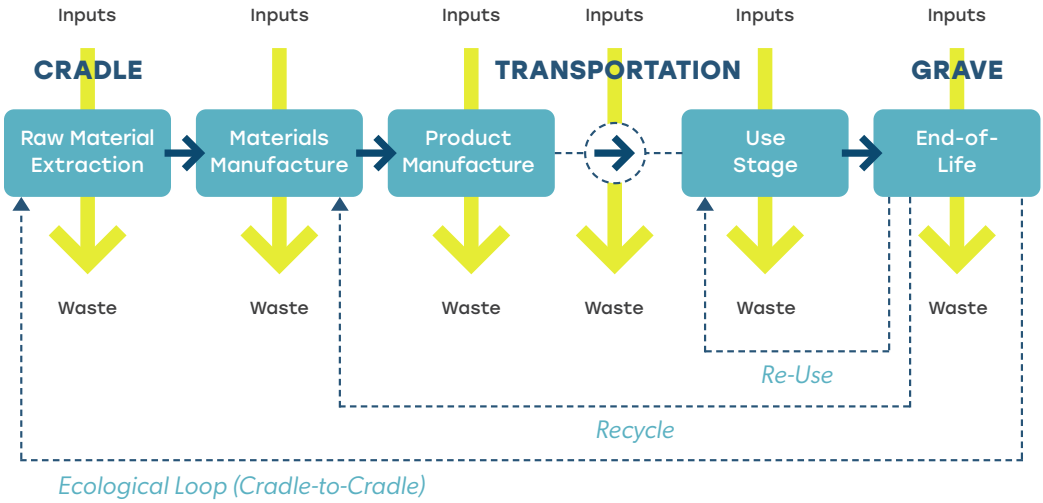
Risk, the likelihood that exposure to a chemical may lead to an adverse health effect, is measured by understanding the inherent properties of a chemical that make it capable of causing harm (hazard) and the amount and frequency of contact (exposure). Both hazard and exposure need to be considered together to fully understand the impact of a chemical. Further, when working to understand potential chemical risk and exposure, products should be considered in their final form, not as single material components, as chemicals can change properties as they react with each other in the manufacturing process.

POTENTIAL EXPOSURE PATHWAYS





Chemistry plays a part in the full lifecycle of materials, including material sourcing, manufacturing, installation, use, maintenance, and end of life (or reuse). Interior designers can benefit from considering how and where the material is being used, how people come in contact with the material, how long people are in contact with the material (including the duration, extent, timing, and frequency of exposure), and how the manufactured product is installed, used and disposed at end of life.



Learn more by watching, "Understanding Hazard, Exposure and Risk in the Built Environment."

Lifecycle assessment of materials during different stages:

CRADLE-TO-GATE:
Consideration during material sourcing and manufacturing/assembly of products

CRADLE-TO-GRAVE:
Consideration during construction/installation process, maintenance, and environmental impact at end of life or reuse phases

CRADLE-TO-CRADLE (OR CIRCULARITY):
Consideration of collecting and utilizing end of use products as ingredients, constituents, or components to create more of the same product family

Product selection and specification requires evaluating all attributes and performance characteristics in the context of the interior design application – 'de-selection' of a chemical is not a life cycle approach that considers the formulation, product risk and exposure, and the product service life, which are all needed to create successful solutions that protect both the environment and human health and safety.

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MATERIAL SELECTION & SPECIFICATION:
Considerations

Interior design projects typically move through a systemic design process (with iterations); however, each project is unique in its solutions due to the variation in application and client criteria, needs, and goals. During the design process, understanding key questions and considerations can further aid in making informed decisions during the material selection and specification process. Having conversations with clients early on and educating them on the possible impact of design on their health, safety and welfare can be powerful as well.

Application/Use

- What are the client's criteria/needs/goals?
- What are the aesthetic goals?
- What are some characteristics of the end-users? (e.g., primary occupants, visitors, children, elderly, office workers, etc.)
- What is the function of the space? (e.g., residence, education, office, medical, etc.)
- What are the usage properties? (e.g., circulation, occupancy, frequency, duration, etc.)

Performance

- What are the key health and safety needs in the project?
- What are key properties needed in the material? (e.g., durability, flame retardant, cleanability, disinfection, etc.)
- What is the priority of these key properties?

Maintenance

- How will the material be cleaned, sanitized, and/or disinfected (e.g., methods, frequency, personnel, etc.)?
- What are the expectations on the material life (e.g. anticipated product service life)?

Budget and Timeline

- What is the project budget including finishes?
- What is the project timeline and schedule milestones?
- Is the client open to additional premiums for health and safety considerations? (*Note: Innovation in materials have advanced and many common materials may not have premiums.)
- Is the client willing to extend construction time for necessary and/or beneficial procedures (e.g., material off-gassing)?

Contractors/Installers

- Are the contractors/installers aware of health and safety protocols for installation of different materials (i.e., do they provide protective equipment as recommended by manufacturer during installation)?
- Are the contractors open to learning how to install new materials that they may not be familiar with installing?
- Are the contractors/installers willing to complete pre-construction meetings with the design team?

Once it is time for material selection and specification, more detailed questions are key to understanding the **health, safety and environmental impacts**.

Health & Safety

- Are there health and/or safety concerns related to certain materials/products?
- What are the trade-offs among different ingredient and material choices in relation to performance, sustainability, and potential human health impacts?
- Are substitute materials/products available that meet the project's performance, aesthetic and budget criteria?

Exposure (Worker)

- Are there chemicals released during the manufacturing and/or installation process? If yes, what are the regulatory limits for chemical releases?
- What are the VOC content and emission limits of a specified material or product and/or its installation?
- What is the pathway of contact, if any, to chemicals in the material/product?

Exposure (Occupant)

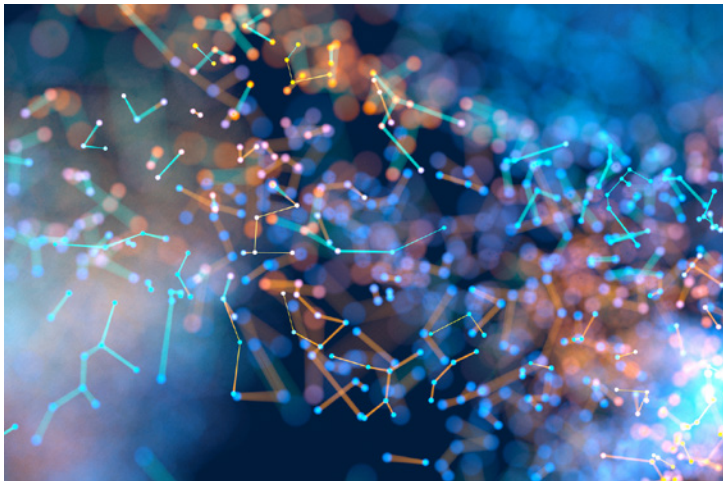
- What chemicals are released after installation and over time (i.e., do chemicals used during manufacture remain in the end-product and are they bound into the formulation)?
- What is the pathway of contact, if any, to the material/product (e.g., inhalation, absorption, etc.)?
- Do occupants come in contact with the material/product during use? (For example, insulation in a wall would have limited or no contact versus a manual light switch that has direct, regular contact.)

Function/Multi-functionality

- What is the purpose of the chemical included in the material/product?
- How is the chemical used in the formulation of the material/product?
- What additional performance characteristics does the material/product provide to the interior environment?

Human health information to consider requesting from manufacturer's technical department:

- Carcinogenicity
- Mutagenicity & Developmental Toxicity
- Acute Toxicity
- Chronic Toxicity
- Systemic Toxicity & Organ effects
- Eye & Skin Irritation
- Skin & Respiratory Sensitization
- Aspiration hazard
- Air purification/filtration, or positive impacts to indoor air quality



Maintenance

- What are the cleaning, sanitizing, and/or disinfecting guidelines for the material/product?
- Will any chemical interactions occur when using common cleaning, sanitizing, and/or disinfecting chemicals on a surface (i.e., what happens if cleaning protocol is breached)?
- What cleaning, sanitizing, and/or disinfecting chemicals can be used successfully on the material and/or product?
- What are the manufacturer recommendations for cleaning, sanitizing, and/or disinfecting surfaces, materials, and products?
- What training is required for the environmental services staff (in-house or contracted) on cleaning, sanitizing, and/or disinfecting protocols for materials, surfaces, and products?

Environmental and end-of-life characteristics

- How is the finished material/product typically disposed?
- What chemicals may be released during the disposal process?
- What environmental impact does the product/material have after end-of-life?
- What does the product lifecycle assessment demonstrate through all stages of the life cycle process? Is there an environmental product declaration available for the product or material?
- If reused or recycled, what different health and/or safety concerns should be considered?
- If reused or recycled, what material properties have changed, if any?
- If recycled, what changes are made to the chemical composition, if any?

DECISION MAKING:
Priorities, Challenges, & Opportunities

The material selection and specification processes are not simple when factoring in all the considerations. Projects will have different priorities and interior designers make decisions using the information at hand for their design solutions. Some priorities may be driven by clients, but some are determined by the interior designer. Your approach to the design problem—whether you consider thresholds at the beginning of the process (i.e., create a wide sampling of materials that fulfill the requirements at the beginning of the project) or at the end (i.e., verifying submittal requirements of specified materials and evaluate all alternatives using the same performance characteristics required)—could also change how challenges are met and sustainable solutions are built.

Material innovation has advanced, providing more options for interior designers to select as part of their design solution. However, accessing credible and pertinent information on a product's health, safety and performance properties requires due diligence and utilizing manufacturer technical expertise. Research, innovations, and trends are constantly changing and are part of the due diligence process. Manufacturer representatives should be trained and prepared to share the necessary information at the depth requested. When product manufacturers are not transparent in disclosing material ingredients, a level of distrust can form. Although efforts to share information and commitments to enhance transparency continue, product manufacturers are faced with obstacles in creating venues to provide the data in a credible and understandable way while navigating supply chain complexities and value chain information sharing.

Challenges continue throughout the design process that could impact the considerations made in developing design solutions, especially when competing priorities emerge. For example, conversations with contractors/installers are oftentimes difficult as their priorities may differ,

Additional questions to ask when challenges persist are:

- What are the equivalences and trade-offs of the material/product?
- Does product lifecycle information support the product performance requirements?
- Does the product service life reflect the client's criteria and needs for the application and the end-user?
- What business case can be made on the long-term health, safety and environmental benefits of a product or material? How can this be communicated to the client for enhanced change management?

and they may not have a shared understanding on why substitutions cannot or should not be made. Education is critical in the construction industry as well, and a significant learning curve exists. Conversations with end users and the maintenance staff typically do not happen unless change of management is in place. It is important to share appropriate maintenance procedures and train staff (in-house or contracted) for implementation to achieve optimal execution.

Interior designers should aim to have a frequent pulse on peer-reviewed research findings that come from reliable sources. Although several valuable resources and databases exist to help interior designers understand the list of ingredients in materials and further decipher chemistry more holistically, this does not exist in aggregate form with documentation/data on products and compliance to rating systems. We see opportunity in learning from other industries by breaking down silos and transferring "best practices" and materials by collaborating to create toolkits that work for multiple industries. For example, the LEED Integrative Analysis Pilot credit encourages collaboration between project teams and product manufacturers by sharing life cycle information on materials/products to evaluate environmental, health and safety impacts.

Innovation comes from demand, competition, motivation and collaboration. The current climate demands healthy, sustainable, and safe solutions that are supported by peer-reviewed research. Emerging generations demand sustainable solutions that also provide social equity (achieving a system of equitable access and fair treatment across communities and processes) in material sourcing. Interior designers should demand research and data on materials to further push innovations that will enhance their design solutions. It is important for conversations across industries to continue for meaningful collaborations to form and innovation to thrive.

So, let's take a step forward: What would you like to see in new materials and how can we (interior designers) work with the material science industry to communicate these industry perspectives/innovations?

Interior designers should consider having conversations with:

- **Clients** to determine requirements and priorities
- **Manufacturers** to communicate needs and better understand materials/products – utilizing technical expertise that is available from product manufacturers and trade associations
- **Contractors/Installers** to emphasize importance of specified materials/products (discourage substitutions and hold specification) including pre-construction meetings and discussions with both general and sub-contractors
- **End users** and **facility staff** to educate on product use, appropriate maintenance, and disposal options (re-use, recycle, return to manufacturer, etc.)

Learn more by watching, "LEED Pilot Credit #103: Integrative Analysis of Building Materials."

As designers in the pandemic era (and beyond), we are walking a line between ultra-cleanliness and actual wellness. As in all things, moderation and common sense need to play a role. Overall wellness - physical, emotional, and mental - is the ultimate goal for our projects, our clients, and ourselves.

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COMMON CHEMISTRY TERMS

A list of basic chemistry terms and definitions to start your journey in understanding material/product chemistry. For an extensive list, check out the **Healthy Materials Lab at Parsons School of Design** and the **A to Z Chemistry Dictionary from ThoughtCo**, among other resources.

+ **Aspiration hazard:** a substance that has the potential to enter the respiratory system through a single inhaled breath
+ **Binder:** a component of an adhesive composition that is primarily responsible for the adhesive forces that hold two bodies together
+ **Carcinogen:** substance that can cause or contribute to cancer
+ **Chemical:** any matter or substance that has mass
+ **Chemical property:** characteristic which may be observed when matter undergoes a chemical change
+ **Chemical reaction:** a chemical change in which reactants form one or more new products
+ **Cohesion:** measure of how well molecules stick to each other or group together
+ **Compound:** chemical species formed when two or more atoms form a chemical bond
+ **Formulation:** a material or mixture prepared according to a particular formula
+ **Mass:** amount of matter a substance contains or property of matter that resists acceleration
+ **Material:** a group of one or more chemicals that together comprise a component or input to a finished product
+ **Matter:** anything that has mass and occupies volume
+ **Monomer:** a molecule that is a subunit or building block of a polymer
+ **Molecule:** chemical species formed by two or more atoms that share chemical bonds such that they form one unit
+ **Mutagenicity:** the potential a substance can induce an alteration in the structure of DNA
+ **Oxidant:** a reactant that oxidizes or removes electrons from another reactant in a redox reaction
+ **Particulate:** small distinct solids suspended in a gas or liquid
+ **Physical property:** characteristic of matter that may be observed and measured without changing the identity of the sample
+ **Polymer:** large molecule made of rings or chains of repeated monomer subunits
+ **Pure substance:** sample of matter with constant composition and distinct chemical properties
+ **Reactant:** starting material for a chemical reaction
+ **Reaction:** a chemical change that forms new substances
+ **Residue:** matter remaining after evaporation or distillation or an undesirable reaction byproduct or a recognizable portion of a larger molecule
+ **Sensitization:** the process of becoming allergic to a substance to which a person has been exposed
+ **Solution:** homogeneous mixture of two or more substances
+ **Substance:** matter of constant composition best characterized by the entities (molecules, formula units, atoms) it is composed of and by its physical properties
+ **Substrate:** medium on which a reaction occurs or reagent that offers a surface for absorption
+ **Toxicity:** the degree to which a substance can cause harm; can result in acute, chronic, developmental or systemic harm
+ **Viscosity:** how readily a fluid flows, which is the ratio between an applied shear stress and the resulting velocity gradient
+ **Volatile:** a substance that readily vaporizes

About ACC

The American Chemistry Council (ACC) is America's oldest trade association of its kind, representing more than 170 companies engaged in the business of chemistry—an innovative, economic growth engine that is helping to solve some of the world's biggest challenges. ACC's members are the leading companies engaged in all aspects of the $553 billion business of chemistry, from the largest corporations to the smallest, and everything in between. They are the people and companies creating the groundbreaking products that are improving the world all around us by making it healthier, safer, and more sustainable. The business of chemistry creates the building blocks for 96 percent of all manufactured goods. From energy efficient insulation to solar cells, and from resilient flooring to piping for clean drinking water, chemistry is at the heart of our buildings and economy. Learn more at **BuildingWithChemistry.org**.

About ASID

The American Society of Interior Designers believes that design transforms lives. ASID serves the full range of the interior design profession and practice through the Society's programs, networks, and advocacy. We thrive on the strength of cross-functional and interdisciplinary relationships among designers of all specialties, including workplace, healthcare, retail and hospitality, education, institutional, and residential. We lead interior designers in shared conversations around topics that matter: from evidence-based and human-centric design to social responsibility, well-being, and sustainability. We showcase the impact of design on the human experience and the value interior designers provide.

ASID was founded over 40 years ago when two organizations became one, but its legacy dates back to the early 1930s. As we celebrate nearly 85 years of industry leadership, we are leading the future of interior design, continuing to integrate the advantages of local connections with national reach, of small firms with big, and of the places we live with the places we work, play, and heal. Learn more at **asid.org**.

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