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Chemistry in Building Materials Litigation

Building materials are increasingly high-tech products. Some of these products are wood based composites containing resins, or adhesives, and others such as spray foam insulation are products in which the chemical process for their formation occurs as part of their installation. The "engineered" aspect of advanced materials can make their use highly complex. For example, wood composite flooring has anisotropic (i.e. directionally dependent) expansion and shrinkage with changes in humidity. In the case of spray foam insulations, the chemical formation process is part of the installation and is placed in the hands of non-technical people such as those in the building trades. This paper looks at the key aspects of investigating advanced building materials relative to insurance and litigation claims.

Investigating Advanced Building Materials

Physical chemistry is central to investigating the performance and failures of advanced building materials. Physical chemistry principles are the basis for materials science, and thermodynamics, which is a branch of physical chemistry that provides the underpinnings of moisture transport in materials, and their expansion and contraction.

Moisture transport, and expansion and contraction are important properties of many building materials such as vapor barriers, insulation materials, and wood products of all sorts. The properties of these advanced building materials, especially their expansion and contraction with relative humidity changes, are often anisotropic. It is often impractical to measure the properties of these materials because they may have been removed, or it may be difficult to alter the conditions at will over a wide range in a building, especially one that is in use. Fortunately, physical chemistry provides the tools to accurately estimate these important properties, even for complex layered materials. There is also a large body of data available to use in estimating the properties of these materials under various conditions. This data is generated by manufacturers to support sales, by academic research for student dissertations, and by trade studies to compare different technologies and products.

For building materials where the chemical formulation process is part of the installation, such as spray foams, the chemicals from which these advanced building materials are made are often solutions of other chemicals that have been synthesized at an earlier stage, and the entire chain of reactions needs to be considered. It is also not uncommon to encounter proprietary formulations, and chemical analysis techniques are not always able to sufficiently unravel the complete nature of the proprietary formulation. Again, a good understanding of the underlying thermodynamics and physical chemistry enable this situation to be successfully addressed, and accurate estimates to be made. The chemical processing step of the installation process must also be considered, and this will depend on the installation procedures and equipment, and the prevailing temperature and humidity. Processing these types of resins may involve a sequence of reactions at higher temperatures that have to proceed by a tightly controlled trajectory over time to achieve changes in viscosity at the correct temperature so that the materials foams and chemicals that could leach out later over time are expelled prior to the material hardening.

Experience and Case Studies

Dr. Fildes' work was the basis for establishment of Northwestern University's federally funded Advanced Materials Processing Center. Part of Dr. Fildes wok was on composites used in infrastructure. Dr. Fildes also won a highly competitive Defense Advanced Research Projects Agency project in this area, and he served as panelist on composites in the infrastructure at a SAMPE workshop. Dr. Fildes has also conducted litigation-related investigations of spray foam insulation odors and fires, and of expansion and contraction issues with engineered wood products.

Relative to engineered wood products, Dr. Fildes has used manufacturers' literature and trade studies along with physical chemistry principles to accurately estimate the degree of expansion and contraction in different directions. This approach has allowed litigation clients to investigate engineered wood products that have been removed and were not available, and to investigate site conditions during installation that could not be recreated later on. This approach also allowed clients to settle cases early through arbitration with having to incur the cost and time of extensive testing.

Spray foam insulations are made by trades workers in uncontrolled conditions on the job site. Dr. Fildes' investigations of spray foams often are concerned with odors and fires, and involve assessing the impact of installation procedures, the prevailing temperature and humidity, and the resin system chemistry, including the synthesis of precursors one to several steps removed from the installation process.

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Dr. John Fildes is uniquely qualified through experience and training to provide insight on the role of science and engineering in litigation. In addition to conducting highly successful technical investigations for high-stakes litigation involving a wide spectrum of metals and materials, chemical processes, and sensors and controls. He also organized and conducted over $26 million in funded projects including research, development, and collaborations involving Government labs, large companies, and leading universities. John was instrumental in establishing and served as co-Director of Northwestern University's federally funded Advanced Materials Intelligent Processing Center, which was a was a highly successful collaboration involving University staff and professors, McDonnell Douglas (now part of Boeing), the Office of Naval Research, the Naval Air Warfare Center, and the Naval Sea Warfare Center and small companies. He is a doctoral-level scientist who has 50 published papers, reports and presentations, and has 3 patents. John's credits involve:

- *John's pioneering work was the basis for formation of Northwestern University's federally-funded Advanced Materials Intelligent Processing Center. John's R&D involved advancing the state of knowledge of the sequence of thermoset cure reactions and their relation to performance and again, and the development of models and model-based processing methods that were the basis for equipment tested by McDonnell Douglas, Northwestern, and a small composites company, Production Products – St. Louis.*
- *John has investigated the failure of composite aircraft prats, the relationship of process deviations to composite performance, the relationship of resin chemistry and installation procedures to spray foam odors and fires, the expansion and contraction of wood products, and chemical issues involved in roadway resurfacing processes.*

John's R&D experience with statistics in experimental design and data analysis has been used in construction litigation cases where estimates of water leakage and materials failures were made from a small sample of units.

Our approach provides:

- ✓ *The quickest and best possible outcome.*
- ✓ *A unique opportunity for early resolution based on knowing 60% to 80% of what might ultimately be uncovered.*
- ✓ *Superior technical insight for even complex and multidisciplinary issues.*
- ✓ *A reliable basis for expert testimony that meets rules for admissibility established by the Supreme Court.*
- ✓ *A strategic advantage with corporate clients since they already appreciate that this approach improves outcomes and lowers costs through use of all existing knowledge and elimination of duplication.*

Our approach uses information research and analytics early in technically related cases and *establishes the* key *MAKE OR BREAK technical issues and everything that is known about them.* This approach requires someone who has the extensive experience with both contemporary R&D methods and litigation-related expert witness investigations so as to adapt the corporate R&D technical investigation process to the unique aspects of litigation expert witness investigations. Our experience to do this is reflected in our process to bring litigators the R&D technical investigation techniques that have revolutionized industrial R&D, providing litigators with the better outcomes and lower costs that industry has achieved in overcoming similar investigation challenges.

1. Define the Technical Issues – Inspections, insight from litigation parties, and broad literature searching are conducted to gather information from prior related cases, trade association publications, patents, manufacturer's marketing materials and reports, and Internet forums to establish the key technical issues.

2. Use Analytics to Establish What is Known About the Technical Issues – The data gathered above is analyzed with data mining and modeling to adapt the data and fill the gaps that always exist in litigation investigations.

(3) Reliably Define Testing Needed – The data that has been collected and analysis that has been done ensures that existing knowledge is not recreated, the remaining work is properly focused, and all involved parties understand the challenges, methods, and progress.

(4) Coordinate, Oversee, and Effectively Communicate – This approach ensures that the overarching technical concepts are effectively framed and communicated, and eases report preparation. The results are well supported, clear, and compelling even to people not knowledgeable of science and engineering.