

Background

John Fildes, Ph.D. has investigated a variety of failures involving composites including fuselages, wings, and blades. He also has experience with investigation composites used in construction and the infrastructure such as laminates, wood, and composite bridges and walkways. Dr. Fildes' physical chemistry, materials science, and chemical engineering background is well suited for these types of investigations because they are multidisciplinary involving chemistry, adhesion, mechanics, and chemical processes.

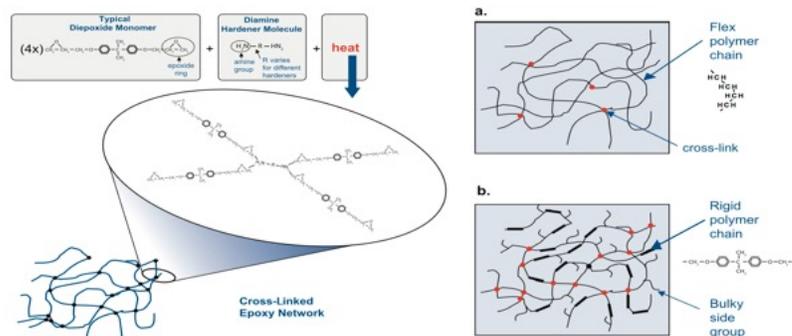
Dr. Fildes' research at Northwestern University was the basis for establishing Northwestern's federally-funded Advanced Composite Materials Intelligent Processing Center of which Dr. Fildes as the co-director. His composites research has also won funding highly competitive competitions such as DARPA's Technology Reinvestment Program. Dr. Fildes has also organized and led multimillion-dollar composites R&D collaborations involving major aerospace composites, leading Government labs, the Army, the Navy, the Defense Advanced Research Projects Agency, and leading suppliers of composite products and technology.

Dr. Fildes' composites research has addressed the cure chemistry and processing of resins, aging and water degradation of composites and resins, adhesion in composite sandwich structures, model-based control of resin transfer molding, resin flow monitoring, characterization of resins using impedance spectroscopy and infrared spectroscopy, and artificial intelligence model-based process control.

Composites Failure Analysis Is Multidisciplinary

Structural composites are made from a solid component enmeshed in a cured resin. The solid component is a high volume of continuous fibers for demanding structural uses, or lower volumes of chopped fibers or fillers for other uses. As such, the orientation of the fibers and chemical adhesion play fundamental roles in the performance (strength, stiffness, stability, and aging) of composites, which makes composites failure analysis a demanding multidisciplinary activity that involves assessing the chemical processing in a structure's fabrication, which is often documented, as well as the nature of the fracture in the failed structure.

The resins used in composites are multicomponent systems that cure through several competing reactions that cause the lengthening of molecular chains, (a) in the figure below, at the earlier stage of cure and the crossing linking, (b) in the figure below, of molecular chains at the later stage of cure. The relative rates of these two processes over time is controlled by chemicals called hardeners and possibly accelerators and by the temperature profile of the cure.



The length of molecular chains significantly influences the toughness (i.e. lack of brittleness) and the amount of crosslinking controls the strength and stiffness of a composite structure.



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Dr. John Fildes has a Ph.D. in physical chemistry, a B.S. in chemistry, and he was a post-doctoral research associate in a chemical engineering department. Physical chemistry provides the scientific basis for many engineering disciplines. Thermodynamics provides the basis for metallurgy, materials science, fire and explosion science, and others. Chemical bonding provides the basis for the strength of materials and electronic materials and devices. Electrochemistry provides the basis for corrosion science, and chemical kinetics provides the basis for chemical compatibility, reactivity, volatility, and chemical processes. Dr. Fildes has conducted over \$27.5 million of R&D and/or litigation-related investigations in these areas because he is well experienced in the fundamental scientific principles as well as in analytics and chemical safety. He led a large group of scientists and engineers at Northwestern University and two scientific/engineering firms licensed to practice professional and structural engineering that conducted thousands of litigation-related technical investigations, so he is also an expert in the conduct of these types of investigations.