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Investigating Friction, Wear, and Lubrication Issues

Dr. Fildes has extensive and unique experience with investigations friction, wear, and lubrication issues. Tribology is the science of friction, wear, and lubrication. Numerous areas of litigation are completely or mostly related to tribology, but most litigators probably do not know the term, or that there are experts who specialize in tribology. The easy way to understand the scope of application of tribology is to think of it as encompassing any situation where two surfaces are in relative motion and contacting each other either directly or through a lubricant. This includes brakes, clutches, hard disks, bearings, door latches, artificial joints, transmissions, locks, walking on all types of surfaces, cavitation, erosion due to fluid impingement, and some types of corrosion. The scope of technologies encompassed by tribology include materials (metals, plastics, composites, and ceramics), hard coatings, oils, greases, solid lubricants, and fuels. The disciplines that compose the science of tribology include mechanical engineering, metallurgy and materials science, physics, and chemistry, especially physical chemistry.

The Role of Materials and Physical Chemistry

Friction, wear, and lubrication, and failures related to them, are ultimately materials and chemistry issues. Adhesive wear is a chemical interaction between surfaces, abrasive wear is related to hardness and toughness, and understanding lubricant performance embodies a number of principles related to viscosity, wetting, fluidity, and structure that are central to physical chemistry. Friction, wear, and lubrication issues are often seen as mechanical engineering or metallurgy issues, but they are multi-disciplinary in nature, involving chemistry, materials performance, and the environment.

Dr. Fildes brings the multi-disciplinary perspective that comes from being grounded in the underlying principles that govern friction, wear, and lubrication. He is also highly experienced with conducting R&D in friction, wear, and lubrication, which enables him to select the proper balance of modeling, bench-scale testing, sub-scale-testing, and full-scale testing. Modeling provides an overall perspective and allows the estimation of performance early in an investigation, which guides the selection of testing that is needed and the assessment of the validity of testing as well as the testing of others. Bench-scale tests, utilizing industry standard test instruments and modified ASTM standards that accurately replicate the type of contact (point, line, conformal, etc.), the type of motion (sliding, rolling, unidirectional or oscillatory), the contact pressure, lubrication (if any), and the environmental conditions, offer important advantages over solely doing full scale testing. The test instruments are computer controlled and highly instrumented, providing a degree of control and a quality of measurement that is hard to achieve in full scale tests. The flexibility of the bench-scale tests allows a wider range of conditions to be measured, and enough replicates to obtain meaningful statistics, estimates, and projections. A limited number of full-scale tests may also be conducted to validate the accuracy of the bench-scale tests. The bench-scale tests are the same ones (or close variants) being used by manufacturers for regulatory and quality control testing of the products that we investigate for litigation purposes.

Experience and Case Study

Dr. Fildes was the President of the federally funded, not for profit Institute of Tribology and Coatings. Tribology is the science of friction, wear, and lubrications. Dr. Fildes worked in collaboration with the Army's Benet Weapons Laboratory and the Department of Defense's Small Arms Joint Program Office at Picatinny Arsenal, which handls small arms procurement and R&D for all services.

Dr. Fildes' work on small arms was instrumental in identifying a coating that was shown by testing at Picatinny Arsenal to significantly extend the life of the weapon and to extend the time between cleaning and make cleaning far easier. As part of this work, Dr. Fildes conceived or and developed a highly effective test for evaluation the abrasion resistance of coatings that is published in the leading tribology journal *Wear*. Dr. Fildes is also skilled with conducting other bench-scale tribology tests. Dr. Fildes' also conceived of the use acceleration monitoring to characterize the actions of small arms and monitor the friction and wear of their materials.

Dr. Fildes has a long experience with electrochemistry, which is the chemical basis of corrosion. Dr. Fildes has studied corrosion of metals and degradation of composite such as brakes in aircraft due to runway deicers, airports located near seawater, and chemicals used on aircraft. Dr. Fildes also has extensive experience with assessing the failures of protective coatings. Dr. Fildes uses sophisticated electrochemical methods to develop models that explain the corrosion mechanism and that predict its rate under various conditions.

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Dr. John Fildes

John Fildes, Ph.D. 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 Director of the 501(c)3 Institute of Tribology and Coating's federally funded Small Arms Tribology and Materials Characterization Project, which was a was a highly successful collaboration involving University staff and professors, the Army's Benet Weapons Laboratory, the Joint Services Small Arms Program Office at Picatinny Arsenal, and several small arms manufacturers. He is a doctoral-level scientist who has 50 published papers, reports and presentations, and has 3 patents. John's credits involve:

- *Conducts failure analysis and diagnostics of the underlying basis for materials related performance issues with machinery and weapons systems.*
- *Lead the failure analysis of a bearing failure in a power plant.*
- *Determined the reason adhesive wear testing was producing results contrary to expectations based on materials science and helped a process equipment supplier revise the test protocol and establish performance data to support a product introduction.*
- *Helped a client understand the reasons for galling of stainless steel components in a product fabrication machine and identified alternative materials and coatings to prevent the problem.*
- *Conducted R&D in plasma-assisted CVD and fabrication of diamond-like and organometallic coatings for tribological applications.*

Developed patented cutting tool wear monitors, led the automation and statistical analysis activities for a tribology lab, and conducted tribology evaluations for industrial customers and trade associations.

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.