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Background

Dr. John Fildes was the only defense expert in a case where the defendant supplied one of the materials used to make chip seal that was installed by a municipality's road crew who was the plaintiff. This case went to trial in the same municipality, which meant that in finding for the defendant, the municipality would incur the approximately $3 million of costs. The jury found for the defendant.

Chip seal is a road resurfacing method and material in which binder is sprayed and aggregate is spread on the binder and rolled into it to form a new road surface. Chip sealing is widely used throughout the 50 U.S. states and Canada and other foreign countries because it is much lower in cost than replacing the asphalt and it can provide a durable road surface that lasts many years.

Although chip sealing appears simple and is widely practiced by municipal road crews and commercial providers, it moves the asphalt plant to the roadway. The complexity of chip sealing is indicated by the U.S. Department of Transportation, many state departments of transportation, and foreign roadway authorities having sponsored numerous research studies over decades that have resulted in a large body of published studies on optimizing aggregate gradation, binder–aggregate compatibility, installation requirements, durability, and mathematical design models.

Chip seal is an example of a seemingly simple material in which the fabrication process has been integrated into its installation. Chip seal moves the asphalt plant to the roadway and places a chemical reaction in the hands of the road crew. Investigating this type of failure goes well beyond engineering considerations of codes and standards, and although these issues are important, establishing the cause and origin of this type of failure also requires considering materials science and chemistry.

The Case Details

A municipality in a U.S. state had installed its own chip seal for many years, but one year it experienced the complete failure, within a few months of installation, of tens of miles of chip seal on several different roadways. The failure, which corresponded with the onset of cold temperatures, involved the aggregate coming loose, which caused damage to hundreds of vehicles and resulted in the almost total loss of the roadway surface. An engineering professor from a major research university was used as an expert by municipality.

Engineering Codes or Science?

Municipalities commonly use their state's department of transportation's (DOT) codes. Aggregates for chip seal are often specified by their gradation, which is the percentages of aggregate of different sizes. The professor's investigation proposed a mechanism for the failure and implicated the supplier of the aggregate used to make the chip seal because the aggregate supplied in this case differed from the specification in the State's code.

In addition to practicing science, Dr. Fildes has led two science and engineering firms licensed to practice professional and structural engineering. These firms had over a hundred professionals who conducted thousands of litigation-related investigations annually totaling tens of millions of dollars, which makes Dr. Fildes an expert on the conduct of litigation-related investigations. Dr. Fildes pointed out that the municipality's expert did not explain how the mechanism of failure he proposed worked and he did not test his hypothesis, plus Dr. Fildes found other authoritative studies that contradicted the proposed hypothesis. This does not meet the Daubert decision requirement for the admissibility of scientific evidence, which emphasized that science is a process rather than a static body of knowledge, and that to qualify as scientific knowledge an inference or assertion must be derived by the scientific method that is described as a validation technique, involving the formulation of hypotheses and either experiments or observations to test the validity of them. (Imwinkelried, Edward J. (1993) "The Daubert Decision on the Admissibility of Scientific Evidence: The Supreme Court Chooses the Right Piece for All the Evidentiary Puzzles," Journal of Civil Rights and Economic Development: Vol. 9: Iss. 1, Article 2)

Although he does not practice engineering, Dr. Fildes has substantial experience with engineering and codes and standards. Dr. Fildes pointed out that codes for construction materials reflect what materials are locally available because of the cost of transporting remotely located materials, so these codes do not necessarily establish limits that would cause failures. Dr. Fildes also has substantial experience with how civil construction technology is established by the federal government and state DOTs, so he used this experience

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to establish that the aggregate that was supplied in this case met the codes of many other states including ones that were leaders in developing and advancing chip seal technology.

The Contributions of Chemistry and Materials Science

Chip seal is a composite material and Dr. Fildes has deep experience with composite materials having founded and co-directed Northwestern University's federally funded Advanced Composites Materials Intelligent Processing Center, and having received almost $20 million of funding in composite materials R&D from the Army, the Navy, the Defense Advanced Research Projects Agency, the Great Lakes Composites Consortium, and others. An advantage of chip seal is that the fabrication of the asphalt mix is done as part of the installation process and this reduces costs since it circumvents the need for the asphalt plant, but this also moves the asphalt plant to the roadway and puts it operation in the hands of an untrained (in asphalt plant operation) road crew. Scientific professionals at the asphalt plant selected the aggregate and binder, but the road crew now does this for chip seal and not all binders and aggregates are compatible. The asphalt plant contains equipment to thoroughly dry the aggregate, which in fact accounts for the largest energy usage in an asphalt plant, and completely mix the aggregate and binder, but this becomes the responsibility of the road crew when they use chip seal. Does the road crew even recognize these responsibilities?

The comprehensive information search Dr. Fildes performed not only produced the aggregates used by various states but also several mathematical models that are used by some states to quantitatively design chip seal for specific road conditions. Dr. Fildes used these models to further establish that the aggregate used in this case would produce a good chip seal, but he also used the models to establish the factors that are essential to achieving good chip seals. His search uncovered that over 90% of states use binders that are water emulsions, but the municipality in this case used a purely organic binder. Dr. Fildes used the models and data he uncovered to establish how much water could be tolerated and it is miniscule for the binder used in this case. From this he formulated a hypothesis that the aggregate contained too much water in this specific case and that the roadway crew did not appreciate how little water this particular binder could tolerate. Miniscule amounts of water block adhesion between the aggregate and binder, explaining why the aggregate came loose when cold temperature arrived. Dr. Fildes also validated his hypothesis with observations made by the road crew.

The cause and origin of accidents and failures involving multidisciplinary issues usually cut across the underlying disciplines and thus require a multidisciplinary perspective. Technical investigations of multidisciplinary issues by experts with broad knowledge and experience will produce results that are much easier to understand because the results will be related to the full spectrum of issues involved in the accident or failure and can be understood in the context of the accident or failure. Understanding narrow, isolated aspects of an accident or failure can be far more difficult because the context of the accident or failure is lost. This can be especially difficult for people who do not have technical training. This is why Dr. Fildes was able to provide trial testimony that the jury understood, and the jury contained an engineer from another municipality. Dr. Fildes was the only expert for the defense and their major witness. The jury found for the defense.

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.