

The production of corporate research to manufacture doubt about the health hazards of products: an overview of the Exponent Bakelite™ simulation study

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Although corporate sponsorship of research does not necessarily lead to biased results, in some industries it has resulted in the publication of inaccurate and misleading information. Some companies have hired scientific consulting firms to retrospectively calculate exposures to products that are no longer manufactured or sold. As an example, this paper reviews one such study – a litigation-engendered study of Union Carbide Corporation's asbestos-containing product, Bakelite™. This analysis is based on previously secret documents produced as a result of litigation. The study published asbestos fiber exposure measurements that underestimated actual exposures to create doubt about the hazards associated with the manufacture and manipulation of Bakelite™.

Keywords: Bakelite, Corruption, Asbestos, Dose reconstruction, Fraud

Introduction

Corporate sponsorship of research does not necessarily lead to inaccurate findings. On the other hand, corporate sponsorship may result in the publication of false or misleading evidence that supports corporate economic interests. A body of corporate research has been generated in an effort to reduce liability in toxic tort litigation.¹ Historic dose reconstructions have been used to estimate exposures to occupational and other groups to estimate a range of potential exposures in an effort to determine dose–response relationships. In defending themselves in tort suits due to asbestos exposure, some companies have attempted to apply dose reconstructions to estimate individual plaintiff's historic exposures. Asbestos companies – or their lawyers – have hired experts to reconstruct historic exposures to asbestos-containing products that are no longer manufactured or sold to claim that these exposures were either in compliance with contemporaneous standards and/or too low to cause cancer.

Exponent, an engineering and scientific consulting firm, published a study that purported to reformulate Union Carbide Corporation's Bakelite™, and characterized exposures to this asbestos-containing plastic molding compound.² After manufacturing Bakelite™ powder “based on historical formulation information,” Exponent molded and manipulated small “plaques” of this material (4 inches by 6 inches by .23 inches).¹ Exponent claimed

that the exposures produced by these plaques in laboratory simulations were representative of worker exposures to asbestos during manipulation of finished products made from Bakelite™.² The studies were conducted to assist UCC's lawyers in defending against legal cases where workers who had contracted mesothelioma after exposure to dust from Bakelite™-molding compounds or finished Bakelite™ products had sued the company for compensation. In their published paper, Exponent authors Mowat, Bono, Lee, Tamburello, and Paustenbach failed to cite more detailed results that they had provided the lawyer funders.^{2–4}

This paper critically reviews the litigation-generated study of Bakelite™. The arbitrary methodology Exponent used incorrectly minimized asbestos exposures from Bakelite™ and created doubt about the hazards associated with this product. Specifically, this paper reviews measures that Exponent took that gives the false impression that asbestos exposures to Bakelite™ “would not, under any reasonably plausible scenario, be expected to produce airborne concentrations of asbestos above historical or current 8-h TWA occupational exposure limits.” (.1 f/cc) In fact, UCC's actual contemporaneous exposure estimates were much higher than these levels.

Part I: Dose reconstruction studies Legal background

In 1993, the United States Supreme Court provided guidance regarding the admissibility of scientific evidence.⁵

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The Court defined “scientific methodology” and provided a framework for trial judge decision-making to determine “validity” of scientific testimony. The Court suggested, and many trial judges have adopted, five factors in evaluating whether or not a jury should decide whether a particular exposure caused or contributed to a particular disease:

- (1) Whether the theory or technique is falsifiable, refutable, and/or testable – a construct taken from Popper.
- (2) Whether it has been peer reviewed and published. The Appellate Court in *Daubert* itself relied heavily on a non-peer-reviewed polemic written by a lawyer who worked for the Manhattan Foundation.⁶
- (3) Whether the method has a known or potential error rate. This is not relevant for epidemiologic or animal studies since there is no way to evaluate the positive predictive value of a single or even many such studies.⁷
- (4) Whether the study had controls.
- (5) Whether, and the degree to which, a theory or technique is generally accepted by a relevant scientific community.

The courts have since determined that trial judges were required to act as gatekeepers to prevent “junk science” from entering the courtroom. As a result, judges have dismissed many cases by determining that juries should not even consider the scientific or other evidence. Prior to the *Daubert* and subsequent decisions, juries would have decided what weight to give this scientific evidence and would have made factual determinations of its reliability.

To capitalize on this decision, companies have funded research designed to undermine adverse scientific evidence and/or create a body of literature that supports their position that their product does not cause whatever disease plaintiffs or public health advocates allege.⁸ Dose reconstruction is a major tool companies use to retrospectively argue that exposures to their product were too low to be considered a cause of the disease or injury for which the plaintiff or her family is seeking compensation.

The role of scientific consulting firms

Scientific consulting firms have developed dose reconstruction studies and policy arguments as part of a legal defense strategy and not as a scientific endeavor. Exponent once described its business as follows:

Exponent serves clients in automotive, aviation, chemical, construction, energy, government, health, insurance, manufacturing, technology and other sectors of the economy. Many of our engagements are initiated by lawyers or insurance companies, whose clients anticipate, or are engaged in, litigation over an alleged failure of their products, equipment or services.⁷

The current Exponent website is less explicit:

Exponent is a leading engineering and scientific consulting firm providing solutions to complex technical problems. Our multidisciplinary team of scientists, physicians, engineers, and regulatory consultants will perform either in-depth scientific research and analysis, or very rapid-response evaluations, to provide our clients with the critical information that both day-to-day

and strategic decisions can require.ⁱⁱⁱ Our multidisciplinary organization of scientists, physicians, engineers, and regulatory consultants performs in-depth investigations in more than 90 technical disciplines. We analyze failures and accidents to determine their causes and to understand how to prevent them. We evaluate complex human health and environmental issues to find cost-effective solutions. / Our integrated approach offers a multifaceted perspective that leads to insight, revelation, and innovative solutions that produce bottom-line results. By introducing a new way of thinking about an existing situation, we assist clients to overcome seemingly insurmountable obstacles.^{iv}

ChemRisk, a similar type firm, has past advertised that its “scientists and engineers have served as technical advisors to lawyers in all aspects of environmental, occupational, toxic tort, and product liability litigation, including ‘Technical strategy development, providing scientific advice, expert testimony, selection and preparation of expert witnesses, assistance in cross-examining opponent’s expert witnesses.’” At the time, they claimed that:

A distinguishing characteristic of our legal support work is our emphasis on conducting original, field research which fills data gaps. This work is usually an essential component in resolving disputes involving chemical, or radiological agents. We have provided support to litigants in some of the most publicized and complex major toxic tort law suits including silicone breast implants, developmental toxicants, beryllium, hexavalent chromium, benzene, asbestos, brake dust, dioxin, various pesticides, and many others.⁷

Now known as Cardno ChemRisk (since 2012), the company’s website states:

[...] The Cardno ChemRisk team has a long-standing reputation for thorough scientific analysis and project excellence, and many are sought-after advisors to the public and private sector. They drive new methodologies and stay at the forefront of current and emerging issues, enabling clients to make informed strategic decisions. Cardno ChemRisk professionals are deeply committed to collaboration as well, participating in many industry associations and panels, and publishing hundreds of papers that are frequently cited in both regulatory and litigation decision-making. Many Cardno ChemRisk professionals have participated on some of the most complex projects in the world, and have built international acclaim in specific areas of expertise, including more than 50 chemicals. [...]^v

Paustenbach, the President of ChemRisk, explained in a 2006 presentation promoting the company’s work why the Bakelite™ and other dose reconstruction studies are performed.^{vi} The presentation took place at a conference held by the Canadian Chrysotile Institute (formerly the Asbestos Institute)^{vii} to combat the European Union ban on asbestos-containing products and to assist companies in defending asbestos law suits filed by injured workers and their family members. Paustenbach used the opportunity to market his company’s “simulation studies” as a

method that companies could employ to defend lawsuits and block regulation:

I'm going to talk today about simulation studies. I believe that they are a very important component of litigation and regulatory affairs, as well as in dealing with epidemiology studies. I happen to believe that epidemiology studies can be done better than categorizing exposure as low, medium, or high. There's not a single product that I can think of in the last hundred years that can't be reproduced in exposures simulated in the past.

Paustenbach went on to describe the likely results:

To the best of my knowledge in litigation that was traditionally lost in the United States, I'm not aware of a single case that has been lost when a high-quality simulation study was done, and of course the exposures were considered de minimis. And in those cases where they're not, then you can expect not to do very well. But when you go into these studies, quite usually you will know roughly what the degree of exposure's going to be; it's intuitive. Sometimes you're surprised, but quite often you're not.

Of course, since the studies are performed for lawyers who represent corporations, unfavorable results do not have to be published or reported if non-testifying consultants performed them for the purpose of defending lawsuits.

He used the Bakelite™ simulation study as an example of how dose reconstruction could be used to cast doubt about the toxicity of an asbestos product. Paustenbach noted that the companies had failed to measure exposures before or during the time the products were actually in the stream of commerce: "If you didn't collect the data contemporaneously, I think it can be done today."

In the same lecture, Paustenbach explained the monetary value of simulation studies in defending lawsuits:

This is intuitive. It's says – it would – it's a shame to have to have spent, let's say, \$250,000 to do this study when it's really intuitive that there wouldn't be much exposure. But when there's – when it costs \$4 million in the United States to work up and take a case to trial, that's just the expenses. That's not the outcome. A 250,000 or 500,000 study is – is a drop in the bucket. So when you heard the term yesterday – remember, we turned down a settlement of a \$150 billion – that's with a B – \$150 billion to settle the – the litigation crisis yesterday that was mentioned in the United States – these kinds of \$250,000, \$500,000 investments go a long way. If you've got a hundred cases and it takes \$4 million for the lawyers and consultants to get ready for the case and to take it to trial, you can see this is a drop in the bucket. So when I hear people say, "we can't afford it," I don't understand.

He later went on, specifically in relation to Bakelite™:

It is not easily done. The study cost over a million dollars, to find the product, to remanufacture it, to press it, and then cut it and drill and take all the samples. It – it was a massive project. But, again, I – the – the – in spite of the fact it cost upwards – I don't know if it was over a million, but it was very expensive, and it may well

have approached a million. It – in potential benefit, it probably is going to save tens of millions of dollars in litigation costs, not settlements. So we reformulated it. We collected 150 personal and area samples by sawing, sanding, drilling, and cleaning up. Those are the three things that were alleged. That's the only three things, I think – or four things you can do with Bakelite™, and these are the results.

You'll see even when you band-saw it, which is the highest possible concentration, it's still much below the .1 value. We look at one hour of work, two hours of work, half an hour of work, and then we can – we can scale up to eight hours if we want to. So I usually like to do it over a span of time; and, of course, you hope that those relationships are nearly linear, and they often are. So you see quite clearly the difference between cleanup, sanding, drilling, et cetera. So the studies on Bakelite™ clearly show that the concentrations were very, very low. This does not even qualify – this doesn't even discuss the fact that the asbestos may not even pose a hazard when it's been soaked with a – with a resin and made into really a – a little piece of plastic fiber, rather, it may not have its asbestos characteristics anymore biologically. But that's another matter. We're just talking just about exposure...

... In short, then, I believe that you can reproduce any of these exposure scenarios of the past 50 years. It is expensive, but I think it's well worth it, and I think they should be published for the scientific community to understand your views. We've looked at these five – or four that I've talked about today – or seven, depending on how you count them. We found that the exposures are very low. You need to consider the frequency, of course, and duration. And they're a wonderful add-on to the FE studies.

Paustenbach presents himself as part of the company defense team. He took credit for "victories," explaining in his lecture how "we" took the results of a dose reconstruction to trial and explains how "we won": "We took the first two results, I think, to trial, and we won hands down, again, based on this study." [Emphasis added]

While Paustenbach unequivocally states that the sole purpose of these studies is the defense of lawsuits, none of his papers explicitly explain this aim. And yet: "... we publish all of our work in peer-reviewed journals. That's kind of the – the – a distinguishing characteristic of our firm."⁸ Many of Exponent's studies are published in *Regulatory Toxicology and Pharmacology*, a journal edited by Gio Batta Gori, a former tobacco company consultant,⁹⁻³⁵ and published by The International Society of Regulatory Toxicology and Pharmacology. Jacobson has noted the problems with that journal:

Its sponsors include Dow Agro-Sciences, Eastman Kodak, Gillette, Merck, Procter and Gamble, R. J. Reynolds Tobacco, and other corporations that have an interest in weakening government regulations of toxic chemicals. The Journal's editorial board is dominated by industry lawyers and scientists who consult for industry. In one egregious episode, the journal's editor was paid \$30,000 by the tobacco industry to

write a paper – which was published in the journal – downplaying the risks of second-hand smoke.³⁶

Several journals have established ethical rules that bar publication of papers funded by tobacco companies, and many (e.g. European Journal of Respiratory Disease, British Medical Journal (BMJ), BMJ Open, PLoS Medicine, PLoS One, PLoS Biology, Tobacco Control, Thorax, Heart, journals published by the American Thoracic Society, and the Journal of Health Psychology) refuse to publish papers authored by researchers who received tobacco industry funding. Some ban authors who previously accepted tobacco funding, even if the researcher's work is unrelated to tobacco.³⁷

In his 2006 presentation to the Chrysotile Institute, Paustenbach noted that institutional review boards (IRBs) should review this type of research:

The second [expectation] that is new [when conducting simulation studies today] is the use of an Institutional Review Board. Even though the exposures are often incredibly low and sometimes you're wearing respiratory protection, in the United States, at least, the bar has been raised that you may need to use institutional review board approval. [...] I think the courts are going to be very sensitive to, at least, the institutional review board.

Despite this acknowledgment, Paustenbach did not seek IRB approval for the Bakelite study.

The protocol for Exponent's study called for the workers to wear Tyvek™ suits and use respirators. However, Exponent did not implement these worker protections in the Bakelite™ study.⁴

Part II: The Bakelite™ simulation study

In the following section, I deconstruct various components of the Bakelite™ simulation study that are of scientific and ethical concern.

Ignoring contemporaneous exposures

Mowat et al. claimed they performed this dose reconstruction to determine the historical exposures to asbestos from working with finished Bakelite™. Mowat et al. state that:

The test results from this study are useful in providing a sense of the possible exposures that historical workers may have experienced when they were engaged in sawing, sanding, or drilling of BMMA-5353 and other materials in this class of phenolic resins.

However, Mowat et al. completely ignored published and unpublished historical exposure data that UCC collected in their factories. In 1975, UCC's marketing manager, John Myers, published a paper and reported that users of Bakelite™ compounds had asbestos exposures that exceeded the 1972 OSHA asbestos TLV.³⁹ Peak exposures were 14 fibers/cc. Myers noted that the TWA exposure levels to various UCC products were "... in most cases ...

well below OSHA standards." (The 1972 OSHA asbestos standard was a TWA of 5 f/cc and a peak of 10 f/cc.)³⁹

Myers recommended that UCC place the OSHA warning on the bags of Bakelite™-molding material:

Caution labels are required on products containing asbestos except where the fibers have been modified by a bonding agent or other material to prevent dusting during any normal subsequent use or handling. [...] Products containing asbestos and not requiring a label could include: reinforced plastics (phenolic, nylon, polypropylene, polyester, etc.), roofing compounds, floor tile, reinforced rubber, ready-mix joint cements, flooring, coating and adhesives (polyester, epoxy, urethane, casein, etc.), paint (PVC, alkyd, acrylic latex), mineral board, lubricants and greases. 92% of total US asbestos is "locked" in.

At the same time, UCC told their sales men that:

[...] Measurements made at Bound Brook on molding compound have indicated that it is unlikely any free fibers in excess of the OSHA limit will be released during reasonable handling which might occur in a molding plant.^{viii} However we cannot assume that this will always be so. Accordingly it has been decided to place the required caution label or marking on all packages used for compounds containing asbestos. The label will read:

CAUTION

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

BREATHING ASBESTOS DUST MAY

CAUSE SERIOUS BODILY HARM⁴⁰

Furthermore, UCC had conducted studies of asbestos exposures in their Bound Brook, New Jersey plant where Bakelite™ was manufactured from 1968 to 1974.^{ix} All measurements were under 5 f/cc except for 14.1 f/cc when an operator was dumping five bags of phenolic-molding compound.^{41–45} In 1969, UCC discovered that the band sawing of Bakelite™ resulted in asbestos exposures that exceeded the TLV and "contaminated the room."³⁸ UCC's physician instructed local managers to require that workers who cut Bakelite™ with a band saw use respirators.³⁸ UCC found that emptying bags of asbestos phenolic molding produced exposures of 14.1 f/cc, which exceeded the former permissible exposure limit of 12 f/cc and the "newly adopted federal standard" of 5 f/cc.^{45,46} Given these contemporaneous data, there was little reason to produce a dose reconstruction of Bakelite™.

Although UCC never published these data, Paustenbach, a co-author of the Mowat et al. paper who oversaw the Exponent study, testified that he was given access to and reviewed the historical UCC documents related to phenolic-molding compound in the repository at the offices of Mayer Brown (UCC's legal counsel) in Chicago.⁴⁶ He referenced, relative to that visit, UCC documents related to the company's 1969 air sampling as well as exposures while emptying bags of asbestos phenolic molding.⁴⁶

Inaccurate description of the product

In describing Bakelite™, Mowat et al. went to great lengths to attempt to show that the product contained “encapsulated asbestos” [Quotation marks in original]:

The term “encapsulated asbestos” applies to fibers that are coated with a material or wetted with a binder, resin, or other medium, thereby containing the asbestos fibers within a solid matrix and limiting their potential to become airborne (e.g. asbestos in automotive brake pads, vinyl composite floor tiles, floor mastics, roofing tars). These fibers are considered to pose a negligible health hazard because of the inability of appreciable concentrations to become airborne and because the presence of the encapsulating medium inside and outside of the fiber may significantly reduce (or eliminate) its adverse effects.

Although the authors repeatedly placed the words, “encapsulated asbestos” within quotations suggesting that OSHA gave these words a particular meaning that excluded such products from asbestos rulings, neither of the regulations that Exponent cites includes the word “encapsulated,” nor do they make reference to any of the products that the authors mention. In fact, all references to “encapsulation” in the two cited regulations refer to products that can be *used* to reduce exposures to asbestos products when they are removed. For example, the 1994 OSHA standard’s reference to encapsulation describes the use of an “encapsulant” during removal – not a product that is comprised of “encapsulated asbestos”.⁴⁷

Further, the cited OSHA regulations fail to support the authors’ assertion that the listed products “pose a negligible health hazard.” The cited regulations specifically name and regulate these products, and include detailed mandatory workplace controls to avoid asbestos exposures while these products are used or removed:

Class II asbestos work is defined as activities involving the removal of ACM or PACM which is not TSI or surfacing ACM. According to the definition, this includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, gaskets, joint compounds, roofing felts, roofing and siding shingles, and construction mastics.⁴⁸

Two examples, asbestos-flooring and asbestos-roofing materials, of mandated workplace controls in the regulations are detailed in Appendix 1. In addition, OSHA specifically included automotive repair workers (brake mechanics) as a subject of the asbestos regulation:

“Automotive repair.” The general automotive repair and service sector includes establishments involved in brake and clutch repair work and maintenance. The major source of asbestos exposure in this sector occurs when compressed air is used for blowing the residual dust from the brake lining assembly. In addition, minor exposures in brake repair can occur during spray applications and when handling cloths and other supplies contaminated with asbestos fibers. Replacement of clutch assemblies can also lead to fiber release. CONSAD estimates that approximately

329,000 automobile repair shops and garages, brake and clutch repair establishments, and motor vehicle dealers, employing 676,000 workers, will be affected by the revision to the asbestos standard. OSHA is mandating specific engineering controls and work practices that will affect this sector.⁴⁸

The authors’ description of this merchandise as products that “pose a negligible hazard” cannot be explained as “bias” or “error” when the cited basis for the characterization affirms the converse. While Exponent repeatedly represented Bakelite™ as an “encapsulated product” they knew – or should have known – that this was inaccurate; their corporate sponsors, (UCC’s and lawyers) who approved of their publication, certainly should have known it. These failures raise the specter of corrupt science.

Misstatement of the law

Mowat et al. cited part of a sentence from the OSHA 1972 Asbestos Standard in support of their proposition that the Bakelite™ products are safe:

The low potential for release of fibers from these kinds of products is acknowledged in the federal regulations, wherein OSHA, in 1972, did not require asbestos caution labeling requirements for fibers that have been ‘modified by a bonding agent, coating, binder or other material.’^{xi}

The authors misstated the 1972 OSHA Standard by writing that the quotation ended with the word “material” and omitting an ellipsis, which would have indicated to the reader that the sentence was incomplete. In this case, the author’s premature termination of the sentence completely misstated OSHA’s intent:

Caution labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, or to their containers, except that no label is required where asbestos fibers have been modified by a bonding agent, coating, binder, or other material **so that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section will be released.** [Mowat et al. omitted part of sentence in bold].

The omission of the latter part of OSHA’s language (which limits the definition of asbestos-containing “modified” products to products that do not release asbestos fibers during foreseeable use) in an effort to characterize Bakelite™ as “safe” merchandise is particularly egregious given prior UCC research. As noted in the introduction, John Myers’ 1975 published paper indicated that users of Bakelite™ were exposed to asbestos at levels that exceed the TLV.

Inaccurate presentation of the “Bakelite™ formula”

Mowat et al. claimed they were reproducing BMMA-5353; however, the actual product formula code on which

they focused was BMMA-5353 25 DC.³ The code “DC” designated “dust controlled” – “Products which are specially processed to remove extremely fine particles or ‘smoke.’”⁴⁹ UCC had begun to develop low dust formulations after the ACGIH proposed that the asbestos TLV be lowered in 1968. Earlier versions would not have been “dust controlled.”

Exponent’s report to the Bakelite™ study funders (UCC’s legal counsel) provided a more complete description of the reconstruction methodology than those described in the methods section in the published paper, and included two different BMMA-5353 formulas.³ One of these used a two-step resin; Exponent employed a one-step resin, which was used in another BMMA-5353 formulation. In the published paper, Mowat et al. did not disclose that there were many iterations of the formula for Bakelite™.

Failure to disclose the use of different raw materials than those called for in the original formula

Exponent substituted two key components in their Bakelite™ formulation. UCC produced the original resin; however, Exponent never reviewed the recipe for this resin, and they did not use it. Instead, they purchased a one-part DURITE® FD-2170 Friction – phenolic powder resin (a Borden Corporation product) which “was specifically developed as a general-purpose bond for **friction** elements.” [Emphasis added]. UCC’s corporate representative testified that UCC never sold phenolic resins for friction products.⁵⁰ More importantly, Exponent used Johns-Manville chrysotile fiber from the Jeffery Mine in Asbestos, Quebec. Exponent thus used the third longest fiber size – 7RF-3 – while the original formulation called for RF-9 asbestos, from the Carey Mine in East Broughton, which was the shortest fiber type ever sold, and was tremolite-free.^{51,52}

Use of a different manufacturing process

The original process involved three sets of two rollers each. The Exponent process involved a single set of rollers followed by manual manipulation of the material. After the dry mix was charged on the two-roll mill, it was worked manually with hot gloves and spatulas. Additionally, Exponent set the rollers to temperatures that did not match the original specifications. UCC’s specifications called for temperatures of 60 °F (front roller) and 100 °F (second roller). Exponent kept the temperature of the front roller at approximately 200 °F, and the second varied from approximately 60–100 °F.

Additionally, Exponent discarded fibers smaller than 60 mesh. The original process did not discard any fiber size. This added process would have reduced the percentage of asbestos in the final Bakelite™ product. Exponent also used a different mesh cut-off which reduced the number of small fibers.

Exponent’s reformulated Bakelite™ product specified the following mesh tests:

The sieve set consisted of No. 6 (0.132 in.), No. 10 (0.0787 in.), No. 12 (0.0661 in.), and No. 60 (0.0098 in.) sieves. Granules that did not pass through the No. 6 sieve (over-sized) were either re-ground or discarded.

Exponent discarded undersized particles.³ This removal of small particles, which would have included small fibers, was not in the original UCC protocol.

Manipulation of the time of the work simulation in order to reduce the time-weighted average (TWA) exposure

The TWA is a simple formula, which divides the total exposure by the amount of time that a work process takes to perform. In a video taken as part of the Bakelite™ study, Exponent increased the time denominator by starting the clock minutes before any activity commenced, and by performing the work process at a farcically slow pace.⁵³ For example, in the band sawing test, Paustenbach stood next to the band saw for 2 min and 45 s before he picked up the reformulated Bakelite™ plaque to begin cutting, and stopped cutting 2 min and 35 s prior to the end of the taping. Thus, Paustenbach did not work for 5 min and 20 s of the 14 min 29 s “work simulation.” To further reduce exposures and increase the denominator time, Paustenbach worked at an unrealistically slow pace while cutting; he took 14 min and 29 s to make five 4”-long cuts in the reformulated Bakelite™ pieces that were 6” wide. No worker could work this slowly and not get fired. Paustenbach also only cut seven pieces; however, the protocol called for seven cuts resulting in 8 pieces.⁵³

Discussion: The etiology of the problem of corporate corruption of science

In the case of Paustenbach’s research, “filling data gaps” can mean producing science to specification. Instead of beginning with a question and seeking the most accurate possible answer, this research starts with the desired conclusions. For example, in 1990 Paustenbach developed a proposal for the American Petroleum Institute (API) and described it as follows:

McLaren/ChemRisk is pleased to provide this proposal to develop an alternative cancer potency estimate for benzene. It is our understanding that API would like us to develop a succinct, yet scientifically compelling, integrated position statement to be used in comments to the state of North Carolina and as a possible springboard for future analyses that could be presented to US EPA and the State of California.⁷

Paustenbach explains some of their methods, and assures the API that he will incorporate their comments into final published papers.⁷

... EPA and OSHA considered benzene to cause all types of leukemia in their development of cancer

potency estimates for benzene. ... The objective of this task is to develop a succinct, compelling position that presents evidence that AML is the only type of leukemia induced by benzene exposure (task 4.1). A meeting with Dr. Richard Irons will be needed in order to discuss the molecular basis for benzene-induced AML (task 4.2).

Deliverable to the API benzene task force: Draft manuscript, suitable for publication in *Fundamental and Applied Toxicology*. Comments from the Task Force and Dr. Irons will be incorporated into a final document.

Paustenbach published this work but failed to disclose that the research findings had been pre-determined with a foregone conclusion and had been subject to editing by industry representatives.⁷

Exponent's production and simulation study of Bakelite™ is typical of the type of service they provide industry in the form of fabricated historical reconstruction of product characteristics (i.e. "encapsulated") and exposure (i.e. "none," or "not enough to cause harm.") The breadth of similar results which Paustenbach has produced in his work is far reaching.⁵⁴⁻⁵⁹

Exponent's and ChemRisk's work for corporations involved in litigation is legal consulting and not science.^{xii} A 2002 letter from Exponent's Patrick Sheehan to Ford, GM, and Chrysler lawyers sheds light on the nature of the relationship that existed between Exponent and ChemRisk and their staff and the company's corporate clients. (Appendix 1 attached) This letter was designated as confidential attorney work product as follows:

Document type: Confidential draft memoranda from expert consultant to legal staff attorneys memorializing scope of litigation strategy tasks, ongoing work and budgets related to defending ongoing, pending and potential litigation matters.

Purpose: To set forth litigation strategy tasks to assist in ongoing, pending and prospective litigation.

Sheehan sent the letter to the legal representatives of the three automakers, and he stamped them "Attorney Work Product; Privileged & Confidential by Joint Defense Agreement."⁶⁰ Sheehan confirms that the company lawyers, rather than the companies, hired Exponent, and later ChemRisk, under a "Joint Defense Agreement" for litigation research. In his deposition, Sheehan stated that he labeled the documents that he prepared as "attorney work product" per instructions from the company lawyers. The letter confirms that he was part of the legal defense team and that Exponent's work was part of the legal defense – not independent research. Sheehan confirms Exponent's strategy understanding that the lawyers determined the nature of the research:

... for litigation support work performed by Exponent **at the request of you and/or your designated representatives** from 1 February 2002 forward to the completion of this project or the severing of this agreement

by these parties, each company will assume responsibility for payment of a one-third share of the cost of all tasks performed.^{xiii} [Emphasis added]

When research is conducted pursuant to litigation the company lawyers can block publication even though the disclosure would prevent disease and death. In fact, in most states the work of (or even the existence of) non-testifying consulting experts is not disclosed to the opposing party or to the court.⁶¹

Readers of corporate funded studies must determine whether they are legitimate studies or camouflaged data manipulation masquerading as science.

Notes

- i Exponent called the samples "plaques" in its reports to UCC's lawyers. They referred to the plaques as "test panels" in the published paper, apparently in an effort to imply that they reflected commercial sizes.
- ii For several reasons plaintiff lawyers almost never make Daubert motions to exclude defense evidence: Plaintiffs have the burden of proof, and must have pre-existing evidence of some sort to bring a case in the first place. In addition, while plaintiff lawyers usually represent a single – or a few – clients, companies are often sued by many alleged victims (in the case of asbestos, tens of thousands) and thus can distribute research costs over many cases.
- iii <http://www.exponent.com/history/>.
- iv <http://www.exponent.com/capabilities/>.
- v http://www.cardnochemrisk.com/index.php?option=com_content&view=article&id=569&Itemid=10.
- vi Paustenbach's presentation can be viewed here: http://www.chrysotile.com/en/conferences/speakers/Dennis_Paustenbach.aspx.
- vii The name change was part of the strategy to convince juries and regulatory agencies that chrysotile asbestos was less harmful (or even nontoxic) compared to other asbestos forms. <http://www.chrysotile.com/en/conferences/default.aspx>.
- viii UCC misrepresented the fiber test results to its own sales force. The testing showed that the exposures exceeded the OSHA level and UCC conclude and even published that this was the case.³⁹
- ix UCC has failed to produce any bag that actually had this caution on it.
- x Additionally, in the Army Corps of Engineers' study, three mechanical Certified Asbestos Consultants asbestos removal methods and a manual method were evaluated by monitoring removal of the siding. The three methods were: (1) super wet: the siding was thoroughly wetted with water on the outfacing and back side; (2) mist: a measured amount of water was applied to the outfacing side of the siding only; and, (3) encapsulation: an EPA-approved commercially available encapsulant was applied at or above the recommended application rate. These removals took place inside enclosures and the hand method was also evaluated.
- xi The authors cite the 1994 OSHA standard; however, in the text they correctly reference the 1972 OSHA standard, which is where this language appears.
- xii This section relies on materials that relate to Exponent and ChemRisk work for companies involved in asbestos friction product litigation – not to that involving UCC.
- xiii In fact, GM's outside counsel issued the checks on behalf of GM. Deposition testimony of Patrick James Sheehan in *Allen vs. 3M et al.*, third Judicial Circuit Court, Madison County Illinois Case No. 14 L 131, 28 August 2014.

Disclosure statement

David Egilman serves as an expert witness at the request of persons injured by asbestos and asbestos product manufacturing companies who have been sued in asbestos personal injury tort litigation. He also served as a consultant to UCC in the Bhopal MIC chemical explosion of 1984.

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Appendix 1. Asbestos flooring:

- (i) For removing vinyl- and asphalt-flooring materials which contain ACM or for which in buildings constructed no later than 1980, the employer has not verified the absence of ACM pursuant to paragraph (g) (8) (i) (I) of this section. The employer shall ensure that employees comply with the following

work practices and that employees are trained in these practices pursuant to paragraph (k) (8):

- (A) Flooring or its backing shall not be sanded.
 - (B) Vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) shall be used to clean floors.
 - (C) Resilient sheeting shall be removed by cutting with wetting of the snip point and wetting during delamination. Rip-up of resilient sheet floor material is prohibited.
 - (D) All scraping of residual adhesive and/or backing shall be performed using wet methods.
 - (E) Dry sweeping is prohibited.
 - (F) Mechanical chipping is prohibited unless performed in a negative pressure enclosure which meets the requirements of paragraph (g) (5) (iv) of this section.
 - (G) Tiles shall be removed intact, unless the employer demonstrates that intact removal is not possible.
 - (H) When tiles are heated and can be removed intact, wetting may be omitted.
 - (I) Resilient flooring material including associated mastic and backing shall be assumed to be asbestos-containing unless an industrial hygienist determines that it is asbestos-free using recognized analytical techniques.
- Asbestos-containing roofing materials:
- (ii) For removing roofing material which contains ACM the employer shall ensure that the following work practices are followed:
 - (A) Roofing material shall be removed in an intact state to the extent feasible.
 - (B) Wet methods shall be used where feasible.
 - (C) Cutting machines shall be continuously misted during use, unless a competent person determines that misting substantially decreases worker safety.
 - (D) All loose dust left by the sawing operation must be HEPA vacuumed immediately.
 - (E) Unwrapped or unbagged roofing material shall be immediately lowered to the ground via covered, dust-tight chute, crane or hoist, or placed in an impermeable waste bag or wrapped in plastic sheeting and lowered to ground no later than the end of the work shift.
 - (F) Upon being lowered, unwrapped material shall be transferred to a closed receptacle in such manner so as to preclude the dispersion of dust.
 - (G) Roof-level heating and ventilation air intake sources shall be isolated or the ventilation system shall be shut down.