Building the Case for Dose Reconstruction In Toxic-Tort Litigation

By Kim E. Anderson, Ph.D.,
GZA GeoEnvironmental

Dose reconstruction — in short, the scientific process of estimating a worker’s past exposure to chemical, physical or biological agent while working at a specific facility or when performing a specific task or tasks — can be a key element in toxic-tort litigation involving most, if not all, materials.

Often used when concurrent exposure measurements are undefined, dose reconstruction can ultimately lead to an aggregate of these exposures and estimate total exposures through the calculation of the approximated dose over a defined period of time.

Most dose reconstructions, particularly those used by expert witnesses in toxic-tort cases, are long-term processes that look at cumulative lifetime, working lifetime or other exposure time period exposure estimations based on pertinent available data and scientific literature.

This information may include published values for the material; in most instances a comprehensive review of case materials is also required to determine the duration of exposure to the product containing the specific material causing or contributing to the adverse physical effect.

In general, the dose of a material to which a human is exposed is proportional to the duration or time of the exposure and the exposure concentration. Estimations of exposure/dose can range from simple assumptions of “total migration” of additives from food packaging to sophisticated statistical modeling based on epidemiological studies.

The following example illustrates the determination of a routine exposure assessment for the naturally occurring mineral substance asbestos, extensively used in textiles, insulation products and other materials.

This example is based on an individual exposed to asbestos from the historic use of drywall joint compound, which was used extensively within the state-of-the-art construction industry during the post-World War II era through the early to mid-1970s.
In this example, the testimony of the plaintiff/worker indicated that he occasionally used premixed joint compound in the early 1970s for three years to finish the interior wallboard-covered walls of various construction projects. The exposure to asbestos was primarily considered during the application, sanding and cleanup work activities.

Let’s say that the worker performed two hours of sanding and cleanup work per day, five days per week over the course of 26 weeks during the three-year time period.

Based on these factors, the following dose reconstruction can be conducted:

The total hours exposed are next converted into the equivalent work year by dividing the work hours exposed by the hours in a standard work year (2,000 hours) — provided the worker only performed this work during a standard work year of five days per week, eight hours per day for 50 weeks per year. Inasmuch, the duration can be calculated as follows:

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\text{Duration} = 2 \text{ hours/day} \times 5 \text{days/week} \times 26 \text{ weeks} = 260 \text{ hours} = 260 \text{ hours} \times 1 \text{ standard work year of 2000 hours} = 0.13 \text{ year.}
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The dose is therefore calculated as follows:

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\text{Dose} = \text{duration of exposure} \times \text{exposure concentration} = 0.13 \text{ year} \times 2.1 \text{ fibers/cc} = 0.273\text{f-yr/cc}
\]

In order to calculate the dose, the exposure concentration is required. Not to get too technical, but scientific literature provides quantitative exposure information for drywall work. Using an eight-hour airborne asbestos concentration for a 40-hour work week for drywall/taping workers using premix joint compound and hand sanding techniques, as indicated above, 2.1 fibers of asbestos per cubic centimeter of air f/cc is utilized.¹

**ASBESTOS LITIGATION**

Dose reconstruction can be a crucial element in asbestos litigation, distinguished as the longest-running mass-tort litigation in the history of the United States, with an estimated 730,000 who have purportedly been exposed to the material bringing claims against 8,400 businesses.

It is highly likely that an equal number of such claims will be brought in the future, considering the potential number of people affected during the 30 or more years asbestos was routinely used in the construction industry.

Asbestos-related litigation is and will likely persist while the link between asbestos exposure and mesothelioma or lung cancer continues to be studied.

An estimated 3,000 new cases of malignant mesothelioma are diagnosed annually in this country, with a high percentage of that number often related to occupational exposures to materials containing asbestos.

**BENZENE EXPOSURE**

Another example of how dose reconstruction can be pivotal to toxic-tort litigation is illustrated by the scenario of a gasoline station manager alleging exposure to benzene during his two-year employment at the station.
The Agency for Toxic Substances and Disease Registry reports that studies have measured concentrations of benzene in the air at gasoline pumping stations, with the average air concentration reported as 0.91 parts per million or 0.384 mg/m$^3$.

One such study of a gas station attendant, similar to this example, found airborne concentrations of 0.12 ppm$^3$.

The Environmental Protection Agency has estimated that gasoline station employees in general, who are engaged in moderate levels of physical activity, experience a breathing rate of 20 cubic meters of air per an eight-hour work day based on common inhalation rates.

If the airborne concentration of 0.384 mg/m$^3$ of benzene reported for gas station attendants by ATSDR is used, the resulting benzene exposure during employment as a gas station manager for two years is 7.68 milligrams of benzene per day.

Assuming a standard work year of 250 work days per year for two years and the body weight of this specific worker, the benzene exposure dose from inhalation can be calculated, which would prove most valuable in this case.

A third example of the importance of dose reconstruction as a key element in toxic-tort litigation is demonstrated by the estimated daily intake, or EDI, evaluations used by toxicologists to determine exposure to food additives or food contact substances (materials, equipment or other articles that have contact with food).

These determinations are typically used for regulatory notification or as a method of consumer advocacy.

A prime illustration is the potential migration of residual bisphenol A from polycarbonate baby bottles to infant formula, juice or water.

In order to perform a maximal exposure evaluation, knowledge of the level or a realistic estimate of residual BPA in the polycarbonate polymers used to manufacture the baby bottle would be required, as would the amount of time a specific infant drank from the bottle per day. Also important is the longer-term duration of exposure.

Given that information, the assumption can be made — as a worst-case evaluation — that 100 percent of the residual BPA would migrate to the food/drink and therefore the EDI of the BPA could be calculated.

Total migration estimates of 100 percent are used as exposure to BPA from the bottle used to distribute the food/drink cannot exceed 100 percent of the free BPA concentration.

This total migration assumption is treated as if the exposure would be a single dose; however, it is more likely that the exposure would be accumulated over the serviceable life of the bottle.

This technique is routinely used for various food contact materials, to determine whether the food contact article complies with relevant regulations. The EDI could then be compared with the acceptable or tolerable daily intake, which is established based on toxicological data and standard uncertainty factors used by authoritative bodies such as the Food and Drug Administration.

Dose reconstruction can be a crucial element in asbestos litigation.
Dose reconstruction is indeed a valid process to determine retrograde exposure assessments; these calculations may then be used to establish and evaluate maximal risk, safety assessment and related factors pertaining to toxic-tort litigation.

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2. Agency for Toxic Substances and Disease Registry, Toxicological Profile for Benzene (December 2007).