Chemicals

Prop. 65

California's Prop. 65 has a broad scope that can impact a number of consumer products. An expert team from Intertox explores Bisphenol A's addition to paper.

A Proposition 65 Violation May Be Lurking in Your Cash Register or ATM Receipt

BY MEREDITH JONES-MCKEOWN AND CHRIS MACKAY

Businesses operating in California have long been aware of the perils of utilizing any of the almost 1,000 chemicals identified by the state of California as potentially causing cancer or reproductive harm under California's ''Proposition 65.'' Consumer-facing businesses have learned to identify high-risk Prop 65 targets: soft, flexible plastics; faux and colored leathers; and any kind of brass or metal that may contain lead or other heavy metals. If they don't, scores of Prop 65 ''bounty-hunters'' are waiting in the wings to seek penalties and attorney's fees from businesses when they are caught including these chemicals in their products without a compliant warning label.

But since California typically leads the way on consumer regulations, even businesses that don't operate in California should be aware of a recent addition to the Prop 65 list: bisphenol A, or ''BPA.'' Consumer advocates have long voiced concerns about the use of BPA in baby bottles, as a liner for canned goods, and in other plastics and products. And as of May 11, 2016, BPA has been added to the Prop 65 list, so many businesses are scrambling to eradicate its use from these known sources. But one source may come as a surprise: BPA may be lurking in your cash register receipts and other thermal papers.

The Addition of BPA to the Proposition 65 Chemical List. Effective May 11, 2016, the California Office of Environmental Health Hazard Assessment (OEHHA) added BPA to the list of Proposition 65 chemicals known to the state of California to cause reproductive harm. BPA commonly exists in certain plastics and as a liner for canned foods. But many do not realize that thermal paper (commonly used in printing machines such as cash registers, credit card machines, ATMs and automated ticket printers due to the fact that it does not require ink stock) is also likely to contain BPA—and businesses that fail to phase out the use of BPA-containing thermal paper before May 11th will eventually run the risk of receiving a Proposition 65 Notice of Violation from the plaintiffs' bar. Under Prop 65, businesses have a one-year grace period after the chemical is listed to achieve compliance.

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Thermal Paper Technology. The technology of thermal-sensitive paper is straightforward. Normal paper is coated with an ink in a form that has little color at neutral or high pH, but becomes vivid at low pHs. These inks are commonly made with leuco dyes that demonstrate this pH-dependent color change. The paper is then sequentially coated with a thin layer of a temperature-sensitive polymer and a solid-state acid, which acts as a developer. When the paper is heated by the printer head, the polymer melts and the dye and acid combine, the pH of the ink drops, and inks shifts to the colored form. When the paper cools back to room temperature, the thermal polymer condenses over the visible ink, thereby preserving the writing.

Why BPA is Commonly Used in Thermal Paper. In order to function correctly, the acid component of the thermal dye must be solid with moderate water solubility, chemically stable within a large range of temperatures, and possess a low vapor pressure. BPA is one of the few chemicals that meet these criteria, and it provides the additional benefit of being low cost.

Rationale for Adding BPA to the Proposition 65 Chemical List. The toxicology of BPA is complex and its effects on humans are unknown although a substantial number of animal studies have examined it. BPA has been classified as a weak estrogenic mimic, meaning that it produces effects similar to the female sex hormone estrogen. Binding studies with BPA and the classical estrogen receptors suggest its activity is 1,000 to 10,000 times less than estrogen. However, some animal studies show impacts at lower concentrations. Some researchers have opined that BPA may act as a selective estrogen receptor modulator (SERM), while other researchers have advanced alternative theories.

MADL for Reproductive Impacts.OEHHA has promulgated a dermal MADL of BPA of 3 ug/day effective October 1, 2016. This is extremely conservative and may not be supported by data. Studies reported by the National Toxicology Program suggest that a more appropriate MADL would be on the order of 150-250 μg/day.

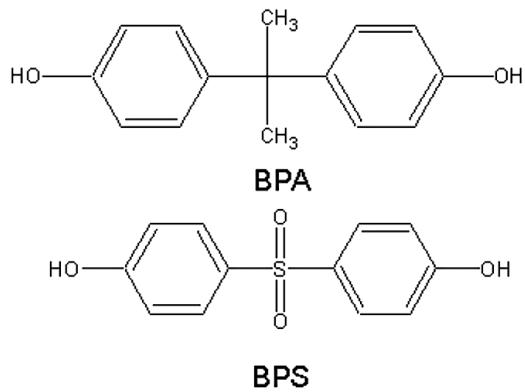
Concern about Dermal Uptake from Thermal Paper. Because BPA in thermal paper is present in its monomer form, some studies have suggested that it is more available for transfer to people than BPA trapped in a polymer; one academic study published in 2010 reports that a single 5 second contact by two fingers resulted in the average transfer of 1.2 μg (~0.22 μg/cm) of BPA during testing. The study also reported that the transfer amount increased by about 10 times when the fingers were moistened. Interestingly, multiple exposures did not increase the BPA concentration on the skin nor did longer holding periods (60 seconds compared to 5 seconds). This breaks down to an exposure of 3 μg/day (0.05 μg/kg-day) for the incidental user (i.e. consumer) and about 15.8 μg/day (0.24 μg/kg-day) for the occupational user (e.g. sales clerk).

Problems Coming into Compliance. With the finalization of the 3 μg/day dermal MADL, there is an urgent need to remove all BPA-containing thermal paper from the market. Proposition 65 prohibits exposing an individual to a listed chemical without first giving a clear and reasonable warning. The warning must be reasonably calculated, considering the alternative methods available under the circumstances, to make the warning message available *prior* to exposure. Since exposure to the receipt is automatic for every customer who receives a receipt, traditional Proposition 65 warning systems may not be sufficient to avoid liability for alleged exposures.

Alternative Materials for Use in Thermal Papers. BPA is not the only possible acid that can be used in thermal paper. The Environmental Protection Agency (EPA) evaluated the hazard levels of 19 different alternatives to BPA that can be used in thermal paper, although ''no clearly safer alternatives'' were identified in the report. Substitute materials include sulfonyl ureas or substituted salicylic acids, such as zinc di-tert-butylsalicylate. Another alternative commonly used in thermal paper is bisphenol S (BPS); however, because BPS itself has been implicated as a potential endocrine disruptor, it too may face limitations in the near future.

Cost Considerations of Alternative Materials in Thermal Paper. Economically viable chemical substitutes for BPA in thermal paper would include those that are easy to process and cost-effective to integrate into existing products. The Danish Environmental Protection Agency published a report confirming that five of the 19 chemical alternatives identified by the EPA were on the European market as developers in thermal paper. These alternatives have a financial benefit to companies because they can be used in existing thermal printers without adjustments. However, all five of these alternatives are still more expensive than BPA; BPS-based thermal paper is the most common and cheapest alternative at 5 percent to 10 percent more expensive, and Pergafast-based thermal paper is the priciest alternative at 10 percent to 25 percent more expensive. In addition to the higher costs of these alternative chemicals, substituting the developer requires significant adjustments to the manufacturing process and chemistry of the paper. Like the EPA study, this study also could not confirm that these alternatives were healthier than BPA. Where compatibility is not available, companies may need to modify their processes, and potentially purchase new equipment. Other considerations include the handling, disposal, and treatment costs of these substitute materials. Substitution decisions should be seen as long-term investments, and companies should anticipate using any chemical replacement for many years to come, with consideration of future regulatory actions as well as market trends.

Alternatives to Thermal Paper. Alternatives to thermal paper may be considered for substitution, including alternative printing systems to thermal paper, and the use of electronic or digital receipts (e-receipts). The EPA report cautioned that alternative printing systems should be evaluated for performance, cost, and hazard, and the Danish EPA report called these systems ''outdated.'' These products may also be more expensive because they require ribbons, inks, or toner cartridges, and typically have higher maintenance costs. E-receipts, in addition to being environmentally friendly, generate financial benefits by reducing manufacturer, transport, storage, and disposal costs, but also require additional data storage devices, electronic products, and peripherals that make their implementation and use more expensive. Today, more than one-third of retail businesses in the U.S. offer e-receipt options, and the practice is a growing trend. Should companies offer the option of either an e-receipt or a paper receipt at the counter, it may be possible to warn consumers who elect a paper option about the risks of BPA in those receipts, prior to their exposure.



Chemical structure of bisphenol A (top) and the related bisphenol S (bottom). BPA is a common chemical used in the adhesives and plastic industries. It is the common monomer in epoxy adhesives (the resin component) and is also used as a monomer high impact polycarbonates used to make reusable bottles, safety glasses, and CD/DVDs. Other advanced plastics such as polyether- and polyether ether ketones as well as polysulfonates may contain BPA. BPA may also be found in PVC and vinyl (softened PVC), where it is sometimes included in the product as both a polymerization terminator and as an antioxidant.

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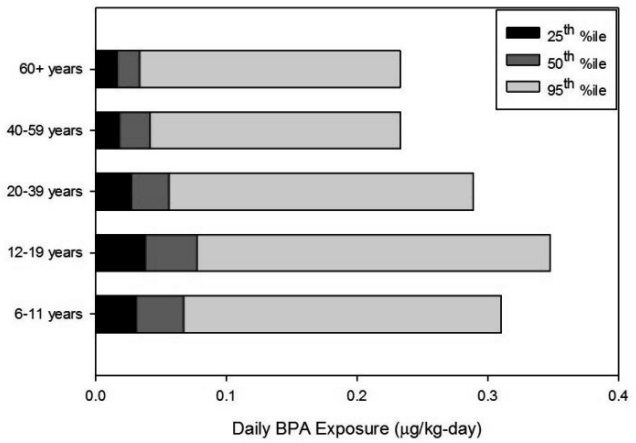

Daily BPA exposure based on urinary metabolite. The 2003-2004 National Health and Nutrition Survey (NHANES), performed annually by the Centers for Disease Control, measured BPA metabolites in participants and back-calculated exposures by age group. Bars represent the 25th (black), 50th (red), and 95th (green) percentile estimates from the 2003-2004 NHANES survey. The current draft MADL BPA falls in the 25-50th percentile.