Preventing Mercury Vapor Release from Broken Fluorescent Lamps during Shipping

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Abstract

Fluorescent lamps are estimated to annually release 1 t of mercury into the air in the United States; transport of used lamps may play an important role in these emissions. In 1999, the U.S. Environmental Protection Agency added lamps to the universal waste rule to encourage recycling by allowing shipment to recycling facilities by common carrier. The rules required that lamp packaging must be structurally sound and adequate to prevent breakage but did not address vapor release. In 2005, a requirement was added that packaging must be designed to prevent the escape of mercury into the environment, but this change does not apply to fluorescent lamps. The goal of this research was to compare mercury vapor containment among different packaging configurations. In 10 replicate experiments of 5 different packages containing 40 broken, used, low-mercury lamps, two 6-hr samples of airborne mercury vapor concentrations were taken in a well-mixed sealed chamber held at 83 + / - 2 °F. Average chamber concentrations ranged from 0.977 mg/m3 for a single cardboard box to 0.004 mg/m3 for a double cardboard box with a plastic-foil laminate bag sandwiched between the boxes. In comparison to the single cardboard box, a single box with an unsealed thin plastic liner lowered mercury concentrations in the chamber by 52%, single or double boxes with a thicker tape-sealed plastic bag lowered concentrations by 90–92%, and a double box with a ziplock plastic-foil laminate bag lowered concentrations by 99.7%. The latter was the only configuration capable of maintaining airborne concentrations below all occupational exposure levels. Standards more specific to mercury containment are needed for packages used to ship fluorescent lamps to recyclers. Results from this study suggest that an effective packaging design should minimize the effect of cuts from broken glass while also preventing the release of mercury vapor from broken lamps.

Implications

The results of this study suggest that most containers marketed for the shipment of used fluorescent lamps to recycling centers will not contain or limit exposure to mercury vapor from lamps broken during handling. The only package effective at keeping exposures below occupational limits used a vapor-resistant bag and two cardboard boxes. Employee and community exposures will continue to occur, especially with ongoing growth in the use and application of fluorescent lighting. Improvements in the current packaging standards, such as requiring the use of vapor-resistant materials, would ensure the containment of mercury vapor from broken lamps.

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