



Studies Suggest That Consumer Products Made With Polyurethanes Do Not Emit Measurable Levels of Harmful Chemicals Into the Air in Our Homes

A REVIEW OF: GIL Report number 2000/C, *Diisocyanates and indoor air*

Several scientific studies suggest that consumer products made of polyurethane do not emit measurable levels of harmful chemicals into the home environment. Polyurethanes are used to make a wide variety of household items, including furniture cushions, mattresses, insulation, wood panels, adhesives and sealants. Since the polyurethane manufacturing process involves chemically combining a diisocyanate and a polyol, some consumers have wondered whether traces of the diisocyanate might be present in household air. To answer this question, Gilbert International Limited (GIL) reviewed a number of studies that have been conducted, and provided summaries of their findings, as set forth below.

Summary Descriptions of the Laboratory Tests

- Flexible polyurethane foam products were placed in a room-sized chamber and the air was monitored for TDI, the diisocyanate used to make the product. The measuring techniques used can detect TDI at levels as low as 2 ppb; none was detected in these tests.
- Some polyurethane products were placed in a glass vessel at 50°C (122°F) held without any air exchange for four hours, after which the air was tested for TDI. None was detected.
- Freshly produced foam (3 days old) was tested in two ways:
 - Air was passed through the foam, then trapped and analyzed for TDI. No TDI was detected.

– Air containing TDI vapor was passed through foam; the foam was placed in a container for three days, then removed and let sit for three more days before measurements were taken. Less than 0.03% of the TDI that had been loaded into the foam could be extracted.

- Particleboard made from MDI, another diisocyanate, was tested in a procedure similar to the TDI foam testing; no detectable MDI was found in the air, even when the boards were new (less than 2 weeks old).
- Freshly manufactured particleboards manufactured with MDI binders were also tested. In this test MDI was detected in the air, but at an extremely low level—approximately 1 part per trillion.
- Resin-bonded particleboards that had been coated with an MDI-based polyurethane furniture coating system were also tested. Samples were taken for 8 hours; again, no MDI was detected in the air.

Data on Room Air Confirms Laboratory Studies

According to the report, MDI and TDI emissions have been studied in non-domestic room air tests, such as schools and offices. In one study of a refurbished office, air was tested for both MDI and TDI, and these compounds were not detected. The paints, carpets, and adhesives used in the refurbishing were all potential sources of these compounds.

Tests on Foams Suggest Minimal Residual Level of Diisocyanates

The report notes that over the last two decades, researchers have performed several experiments to determine whether or not diisocyanates remain in products, such as foams and sealants, made from these chemicals. A study using freshly prepared foam measured TDI content when the foam was one hour old and again at 24 hours old. TDI monomer was detected at about 300 parts per million (ppm wt/wt) in the newly prepared foam, but was not detectable after curing at room conditions for 24 hours.

In another experiment, the amount of free TDI in flexible polyurethane foam was measured in fresh foam samples. Researchers learned that TDI content ranged from 1.2 to 2.4 parts per million when the foam was one hour old. However, at 24 hours, TDI was undetectable.

Additional studies using commercial and outdoor products are consistent with these findings.

- In one such study, researchers detected hexamethylene diisocyanate (HDI) in sampled air immediately after applying HDI lacquer to a board. However, the concentration of HDI rapidly decreased over the next three days to below the detection limit.
- Another experiment tested for TDI emissions immediately following the application of a commercial concrete sealer. Although TDI was detected initially, only minimal emissions could be detected after one hour had passed.

Summary Findings and Rationale

The GIL Report concludes that these studies suggest that the levels of TDI in fully cured foams are below the limits of detection (less than 2 ppb). While some freshly manufactured foams contain trace amounts of TDI, these levels appear to quickly fall to levels below the limits of detection of the test methods when the foam is fully cured—within several hours of production. Similarly, MDI levels in rigid polyurethane foams and in particleboard made with MDI were below detection limits within several hours of manufacture. Because of the delay from the time a polyurethane product is manufactured and its introduction into the residential environment, these studies suggest that polyurethane products do not contribute appreciable levels of diisocyanates into the air in a home environment.

Several scientists have noted that these findings are not surprising, given the fact that diisocyanates have relatively low volatility, and they react nearly completely to form stable, inert products such as polyurethanes.

Reference: M. A. Collins, *Diisocyanates and indoor air*, GIL Report Number 2000/C, (Manchester, UK: Gilbert International Limited, November 2000)



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