

# IN\*TOUCH

## PROGRESS REPORT

## FLEXIBLE POLYURETHANE FOAM AND THE ENVIRONMENT

IN\*TOUCH is a regular publication of the Polyurethane Foam Association (PFA). It covers topics of interest to users of flexible polyurethane foam and is designed as a quick reference for background information on key issues. To get more detailed information about a particular topic, consult a PFA member.

### Flexible Polyurethane Foam Industry is Proactive on Sustainability

#### Environmental Neutrality

Over the past two decades, the flexible polyurethane foam (FPF) industry has successfully met the challenge of bringing sustainable values to its products and manufacturing processes. Today, FPF is one of the most environmentally neutral and versatile materials ever created. Awareness of the product's environmental qualities among consumers, end-product manufacturers and designers is increasing. FPF manufacturers, represented by the Polyurethane Foam Association (PFA) since 1980, have worked closely and responsibly with regulatory agencies and environmental groups to promote public health and safety. The FPF industry is proactive in environmental issues, recyclability, fire prevention education and consumer safety.

#### New Research Supports Facts about FPF and TDI

The manufacture of FPF involves the use of various chemical raw materials. One of these raw materials, toluene diisocyanate (TDI), has been the object of extensive environmental and industrial hygiene study. TDI is an essential, irreplaceable raw material that is required for the manufacture of FPF. In its raw material state, TDI presents a potential respiratory health hazard, but during the manufacture of FPF, TDI is reacted out, and in the end-product does not present a hazard or risk. In fact, a significant body of recent, peer-reviewed and government studies of the respiratory health of consumers, FPF workers and persons living near manufacturing sites where TDI is used, confirms there is no need for concern. Studies show that TDI is consumed in the manufacturing process and therefore not "free" in consumer products or emitted into the air from factories or end-products.

#### FPF and Studies on Product Emissions

A peer-reviewed study performed by Global Isocyanates Limited (GIL) concluded that TDI was not emitted from FPF samples, nor was any migration of TDI found.<sup>i</sup> The GIL study was performed using two types of high index TDI-based FPF samples, extraction was performed using several different

solvents, derivising agents and conditions. The samples selected were chosen because they were the most likely to contain residual, unreacted TDI. Yet, no emissions of TDI were found. Previous similar tests support the conclusion that TDI is not emitted from end-product consumer goods made with FPF, such as certain mattresses and furniture products. For instance, a 1995 study conducted on potential health risks due to emissions from new bedding sets found that "...TDI isomers posed no significant health risk for normal or convalescing individuals."<sup>ii</sup>

Two 1997 TDI emission studies performed by Dow Chemical scientists reached a similar conclusion. Using standard methodologies for determining the emission of TDI from end-product FPF, it was determined that "no detectable TDI could be extracted into air passing through polyurethane foam samples which had been loaded with TDI to a level of approximately 1 part per million. These conclusions align with the research findings of testing conducted by the State of California.

In 1996, the California Environmental Protection Agency (CEPA) commissioned a study entitled, "Determination of Formaldehyde and Toluene Diisocyanate Emissions from Indoor Residential Sources."<sup>iii</sup> That study consisted of screening products that were manufactured using TDI under elevated temperature and chamber loading conditions.<sup>iv</sup> Tests were conducted to determine if any TDI emissions could be detected along with an assessment of lifetime cancer risks. Test results indicated that none of the products normally found in homes showed any detectable TDI emissions.<sup>v</sup> In total, approximately 40 samples were tested. The lack of TDI emissions led the CEPA to conclude, "the primary result of the TDI screening in this study was the absence of detectable TDI emissions."<sup>vi</sup> (Please note that formaldehyde has never been used in the manufacturing of FPF.)

#### FPF and Studies on Manufacturing Emissions

In May of 2010, the North Carolina Department of Health and Human Services (NC DHHS) released the results of a long-term study concerning the respiratory health of people living near foam manufacturing plants that use TDI.<sup>vii</sup> The NC DHHS study, which was conducted over seven years with funding from the Agency for Toxic Substances and Disease Registry (ATSDR), was comprehensive in nature. The study included air monitoring and sampling, collection and examination of blood samples and respiratory health interviews. After taking 80 different air quality samples, NC DHHS

determined that no TDI was found, except for one reading of 1 part per trillion<sup>viii</sup>, a value significantly below levels of health concern.

Blood analysis of 350 different samples found only one positive indication of possible TDI exposure and the individual who tested positive reported a non-work-related use of a sealant that may have contained a TDI component.<sup>ix</sup> Respiratory health interviews similarly did not indicate any unusual patterns in community health. Independent third-party air monitoring around foam manufacturing plants in North Carolina found no detectable emissions.<sup>x, xi</sup>

The U.S. Environmental Protection Agency (EPA) conducted air sampling in 2009 specifically looking for TDI near seven schools located near factories (not foam manufacturers) that reported large amounts of TDI emissions.<sup>xii</sup> The EPA did not detect any TDI concentrations.<sup>xiii</sup>

## FPF and Studies on Worker Safety

Available scientific data indicate that TDI is used by foam manufacturers in a manner that protects worker health and environmental safety. Data concerning occupational asthma substantiate the safe use of TDI. FPF manufacturers have conducted business for more than half a century, and over the past 20 years, among 20 production plants represented in a survey conducted by PFA of U.S. FPF manufacturers concerning the incidence of medically diagnosed occupational asthma at their facilities, only one company reported any medically diagnosed occupational asthma that could result from possible exposure to TDI. The two medical diagnoses reported by that company were the only incidences out of thousands of worker respiratory health screenings conducted by the reporting companies.

The lack of occupational asthma diagnosed in FPF manufacturing workers is likely due to worker safety procedures and control-and-abatement technology employed by the FPF industry. In fact, the occupational asthma rate for FPF personnel is substantially lower than the self-reported asthma rate for the general population, which the National Health Interview Survey (NHIS) states was 10% among non-institutionalized adults in 2004. The benign health effects of working with TDI in the FPF industry are due in part to the significant safety and technological investments made by FPF manufacturers. TDI used in foam making is principally consumed during the foam manufacturing process. Manufacturing, handling and storage modifications employed by the FPF industry over the past 20 years—including enclosing pour lines and saw areas that incorporate high flow-rate ventilation and specially designed ducting and exhaust stacks, storage tank emission controls, raw material handling, management training and advances in personal protective equipment—are indicative of the safe circumstances under which FPF personnel manufacture products using TDI. Similarly, annual medical monitoring of manufacturing personnel is part of the standard operating procedures for most PFA members. These combined practices have reduced the opportunity for worker exposure to TDI.

## FPF Environmental Safety and Regulatory Compliance

The manufacture of FPF is closely regulated for environmental, health and safety at local, state and federal levels. In all processes and operations, manufacturers meet demanding emissions and workplace safety requirements.

The FPF manufacturing process is designed to be environmentally safe. The numerous raw materials are carefully handled by trained workers, using standard industrial procedures and containment. These procedures limit risk to the surroundings and communities. Trace emissions from the FPF manufacturing process are either collected in carbon scrubbing equipment or exhausted from specially constructed stacks.

The members of PFA make compliance with government and industry standards a priority—promoting effective environmental, health and safety practices for the benefit of industry workers and surrounding communities.

## A Track Record of Success

The FPF industry has an exemplary history of regulatory compliance. In the past 15 years the FPF industry:

- Phased out all use of ozone-depleting CFCs well before the international deadline;
- Developed several solutions to meet the EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP), issued in 1998;
- Ceased using the fire retardant pentaBDE in all FPF manufacturing in 2005, and successfully developed alternatives;
- Conducted research in 2008 that documented the safety of existing TDI workplace exposure limits;
- Received a 'clean bill of health' from the North Carolina Department of Health and Human Services and the Agency for Toxic Substance and Disease Registry following an exhaustive seven-year study of respiratory health in communities near foam plants;
- Continues to address the need for more sustainable products and new formulations that may help reduce the nation's dependence on petroleum.

## PFA Members Support FPF Industry Platform on Sustainability

In support of PFA members' efforts to be responsible stewards of the environment, PFA has identified eight principles of sustainability for FPF manufacturing and products, and published them in summary in the *Polyurethane Foam Association Platform on Sustainability*. The principles, applied by PFA members who are committed to producing better performing products that emphasize health and safety and improving the flexible polyurethane foam environmental 'footprint' through recycling and sustainability, include:

1. Reduce solid waste.
2. Host technical sessions to share scientific research about environmentally friendly materials and renewable feedstocks.
3. Support energy saving technologies.
4. Support efforts to improve product safety.
5. Encourage sustainability through product performance
6. Educate to support sustainability
7. Evaluate environmental and sustainability benefits in relation to human rights issues
8. Maintain continuous dialogue with leaders in sustainability.

The complete *PFA Platform on Sustainability* can be downloaded at [www.pfa.org](http://www.pfa.org).

## FPF and Recycling

Recycled content and recyclability are two factors consistently identified with sustainable products. FPF scrap collection and reuse has developed into one of the most successful examples of recycling in the world. As pioneers in recycling programs, FPF manufacturers first attacked the problem of FPF waste by using more efficient manufacturing processes to minimize the amount of process scrap, then developed a program to commercialize systems for recovering and recycling scrap generated in downstream product applications, and finally addressed post consumer waste at end-of-life. Today, FPF scrap provides needed raw materials and also generates additional revenue sources. With the development of practical end-uses for scrap flexible polyurethane foam, almost every piece of process scrap is potentially recyclable.

### *Bonded Polyurethane Carpet Cushion*

Instead of being dumped into landfills, FPF scrap and recovered materials are easily recycled into useful consumer products such as bonded carpet cushion, which accounts for approximately 80% of all carpet cushion products sold in the U.S. Bonded polyurethane carpet cushion boasts both recycle content and recyclability. Scrap collectors and processors can be found in most major metropolitan areas.

With a typical recycled content of around 90%, bonded polyurethane carpet cushion primarily uses scrap foam generated from various manufacturing processes and recovered post consumer waste from the “take up” of old product. This recovered material is incorporated into a valuable, high-performance cushion and serves to divert hundreds of millions of pounds of material from landfill or other disposal routes.

In addition to its recycling advantages, bonded polyurethane carpet cushion contributes to the sustainability equation by extending the lifecycle of carpet. Carpet cushion offers better appearance retention and longer carpet life. Less frequent replacement reduces raw material demand for replacement carpet as well as reducing the amount of used carpet requiring disposal by landfill or other routes.

According to an estimate by the Carpet Cushion Council, post consumer take-up carpet cushion recovery diverted between 300 and 325 MM pounds from landfills to the manufacture of carpet cushion.

## Misinformation and Environmental Facts about FPF

PFA and its members are continually on the alert to monitor misleading stories in the media that raise false alarms about concerns related to FPF products or manufacturing processes. The industry strives to provide important corrections in a timely way, backed by reliable scientific information about FPF's excellent environmental record, to counteract the scare tactics that can do genuine harm to the FPF industry in the United States.

## FPF Environmental Innovations

Exciting innovations in the FPF industry focus on the development of bio-content products. Partially made with raw material derived from renewable plants such as soy and castor beans, foams with bio-content can offer some promising property improvements, including better resistance to yellowing and slightly better mechanical properties such as support factor and dynamic flex fatigue. Although the technology does not exist to create flexible polyurethane foam with entirely renewable content, promising research continues.

## Decades of Progress

The tremendous environmental progress made by the FPF industry has included recycling initiatives; collaboration with the Consumer Product Safety Commission (CPSC) to help establish safer flammability standards for mattresses; coordinated effort with the American Home Furnishings Alliance to assist in the development of a national CPSC furniture flammability standard; compliance with all federal and state emission standards and the Clean Air Act; and continuous research to develop new systems and processes designed to ensure safety and environmental responsibility. Achievements include:

- CFCs: In the 1990s, the FPF industry eliminated the use of chlorofluorocarbons (CFCs), which had been shown to deplete the earth's vitally important ozone layer, from FPF manufacturing processes. By 1992, well ahead of the legally mandated schedule, the majority of the FPF industry had achieved a 98% reduction of CFCs.

- NESHAP: The FPF industry pioneered solutions for reducing emissions of the raw material methylene chloride to meet the EPA's new National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations. By the time of NESHAP's implementation in October 1998, PFA member manufacturers had already eliminated and replaced more than 90% of the methylene chloride used in FPF manufacturing.
- PBDEs: In January 2005, PFA manufacturer members voluntarily phased out the use of pentaBDE flame retardants in the manufacture of FPF for use in home furnishings cushioning applications. Working together with raw materials suppliers, FPF manufacturers reformulated their products using substitute FR materials. The process required almost two years of conversion work.

For information on these important milestones, see *Adapting to Environmental Progress: The Flexible Polyurethane Foam Industry's Record of Innovation and Success* at [www.pfa.org](http://www.pfa.org).

## Summary Points

- ▶ **FPF Environmental Safety and Regulatory Compliance:** The manufacture of FPF is closely regulated for environmental health and safety issues at local, state and federal levels. In all processes and operations, manufacturers meet demanding emissions and workplace safety requirements.
- ▶ **PFA Platform on Sustainability:** PFA has identified eight principles of sustainability for FPF manufacturing and products, which can be downloaded at [www.pfa.org](http://www.pfa.org).
- ▶ **FPF and Recycling:** Recycled content and recyclability are two factors consistently identified with sustainable products. FPF scrap collection and reuse has developed into one of the most successful examples of recycling in the world.
- ▶ **Product, Neighborhood and Worker Safety and Emissions:** TDI is used and consumed in the FPF manufacturing process. Numerous peer-reviewed and government studies confirm that TDI emissions are not a concern in FPF products, communities near FPF manufacturing plants, or for workers who follow industry safety procedures.
- ▶ **Media Misinformation and Environmental Facts about FPF:** PFA and its members provide corrections to reporters who have written misleading stories in the media or raised alarms about false hazards related to FPF products. The FPF industry distributes reliable scientific information about FPF's excellent environmental record.
- ▶ **FPF Environmental Innovations:** Exciting innovations in the FPF industry include the development of foams with varying amounts of bio-content.

## Notes

- i. "Free Monomer in PU Products," *Global Isocyanates Limited*. Presented by Michael Collins at Second International Polyurethane Forum, Busan, Korea, May 31, 2010. Collins is the director of the International Isocyanate Institute, Inc. The summary of this study was also presented at the PFA Annual Meeting in May 2010.
- ii. "Assessment of Potential Health Risks Resulting From Chemical Emissions from New Bedding Sets," *Analytical and Chemical Services and Versar, Inc.* (December 1995) (sponsored by The Sleep Products Safety Council).
- iii. "Determination of Formaldehyde and Toluene Diisocyanate Emissions from Indoor Residential Sources," *California Environmental Protection Agency, Air Resources Board Research Division* (November 1996).
- iv. *Id.* at v
- v. *Id.*
- vi. *Id.* at 111.
- vii. "North Carolina Community TDI Report," *North Carolina Department of Health and Human Services* (June 18, 2010).
- viii. *Id.* at 2.
- ix. *Id.*
- x. "Ambient Toluene Diisocyanate Concentrations from Flexible Polyurethane Foam Manufacturing in North Carolina," Gary Yoder and Sarah Slagle-Garrett, O'Brien & Gere, *Polyurethane Foam Association Technical Program Proceedings* (May 2008).
- xi. *Id.*
- xii. "School Air Toxics Ambient Monitoring Plan," *Environmental Protection Agency* (July 8, 2009).
- xiii. *Id.* at 37.

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