Asthma-Related Chemicals in Massachusetts: Toxics Use Reduction & Disease Prevention

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What is Asthma?

Asthma is a *chronic lung disease* that results from both environmental and genetic risk factors. Symptoms (frequently occurring at night) include:

- Wheezing
- Coughing
- Chest Pain or Tightness
- Difficulty Breathing
- Breathlessness

Once asthma develops, the airways of the lungs become more responsive to a variety of stimuli.

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Initial Onset of Asthma Asthma initially develops through a complex process with multiple contributing factors, including:

- dose
- duration of exposure
- characteristics of the causal agent
- a person's sensitivity
- physiologic status at the time of exposure
- previous exposure to other risk factors for the disease
- genetic factors

Asthma may develop within a few hours or days, weeks or even years after the initial exposure to a respiratory sensitizer. *Chemicals are among the exposures that can contribute to the initial onset of asthma.*

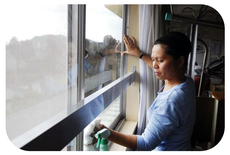
Exacerbation of Asthma Symptoms Chemical exposure also can cause exacerbations of asthma symptoms -- asthma attacks or episodes -- in people who already have the disease. Asthma exacerbations can be triggered by exposure to the same agent(s) that originally caused the initial symptoms of the disease, or by exposure to a range of additional agents. Frequent asthma exacerbations result in worsening lung function.

How Common is Asthma in Massachusetts?

Massachusetts Communities have among the Highest Rates of Asthma in the Nation – one in ten adults report having asthma [1] and nearly 11 percent of K-8 school children have the condition[2].

Total hospitalization costs due to asthma in Massachusetts increased 78% – from $50 million to $89 million – between 20000 and 2006, according to the Massachusetts Department of Public Health[3].

Work-Related Asthma—Asthma Caused or Exacerbated by Exposures at Work—is Common. In a recent survey of Massachusetts residents, 40% of adults with current asthma reported their disease was caused or made worse by exposures at either a current or previous job.[3] Over 5% reported changing or quitting jobs because of their work-related asthma.[3]



References

1. Centers for Disease Control and Prevention. Asthma. Behavioral Risk Factor Surveillance System (BRFSS) Prevalence Data. *2010 data; Adult Asthma*.
2. Massachusetts Department of Public Health, Bureau of Environmental Health. Pediatric Asthma in Massachusetts, 2007-2008. July 2010.
3. Massachusetts Department of Public Health, Asthma Prevention and Control Program. *Burden of Asthma in Massachusetts*. April 2007.
4. Quint J, et al. Primary prevention of occupational asthma: identifying and controlling exposures to asthma-causing agents, American Journal of Industrial Medicine. 2008;51:477-491.

What Asthma-Related Chemicals are Used in Massachusetts?

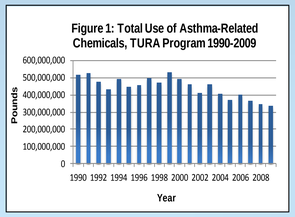
Of the over 70 asthma-related chemicals that are reportable under TURA, approximately 42 have been reported at some point during the 20+ years of the TURA program.

Top-Five Asthma-Related Chemicals, TURA Program, 1990-2009

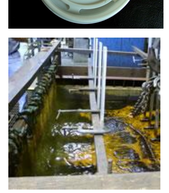
Rank 1990-2009	Chemical Name	% Change since first reporting year*	Total Use in 2009	Primary Industry Sectors	# of Facilities Reporting (2009)
1	Styrene Monomer	-8%	262,932,518	Chemical manufacturing, chemical distributors	12
2	Sulfuric Acid	-45%	23,784,147	Electric generation, fabricated metal, chemical distributors	95
3	Ammonia	+66%	14,063,675	Electric generation, electronic equipment, fabricated metal	38
4	Diisocyanates	-38%*	11,860,966	Chemical manufacturing, rubber and plastic products, primary metals	23
5	Nickel and Nickel compounds	-92%**	1,114,737	Primary metals, fabricated metals	10

* With the exception of diisocyanates, the percent change for all chemicals listed here covers the period 1990-2009. Reductions for diisocyanates were from 1995 to 2009, as several diisocyanates were not reportable until 1995. ** Note that nickel as part of an alloy was delisted in 1995.

Figure 1: Total Use of Asthma-Related Chemicals, TURA Program 1990-2009



Use: Top-Five Asthma-Related Chemicals, TURA Program, 1990-2009



Photos: Wikimedia commons

Styrene. In Massachusetts, the primary use of styrene is for the production of polystyrene. Multiple case reports link styrene with asthma.

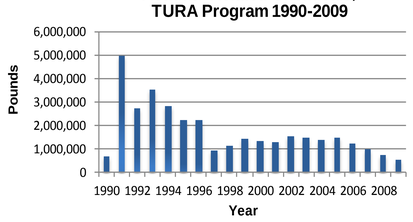
Sulfuric acid. In Massachusetts, sulfuric acid is used across many industry sectors, including electricity generators, metal industries (during electroplating and anodizing processes), and chemical distributors. Case reports reveal that high exposure to sulfuric acid, often as a result of accidents has caused irritant-induced asthma among workers. In addition, exposures to much lower doses of aerosols of sulfuric acid can exacerbate asthma in workers and the public.

Ammonia. In Massachusetts, the primary users of ammonia are wholesale chemical distributers and power plants (for NOx pollution control.) Several studies have documented increased asthma symptoms among exposed workers in a number of industries. Because of its properties as a lung irritant, ammonia inhalation puts both adults and children with asthma at risk of exacerbations.

Diisocyanates. The principal sectors reporting diisocyanate use in Massachusetts are the chemical distribution industry and the rubber and plastic industries. Diisocyanates are used to make a wide variety of products, including foams, adhesives, binders, surface coatings, elastomers, resins, and sealers. *Toluene diisocyanate (TDI) and methylene diphenyl isocyanate (MDI) are the most commonly reported diisocyanates under TURA and two of the most widely studied chemicals in the workplace that can induce the onset of asthma.*

Nickel and Nickel Compounds. In Massachusetts, the principal users of nickel and nickel compounds include primary metals, metal fabricating and metal finishing industries. Evidence linking nickel compounds with asthma is primarily from several workplace studies that have demonstrated exposure to nickel aerosols, for example in plating operations.

Figure 2: Total Point Air Releases of Asthma- Related Chemicals, TURA Program 1990-2009



*The Top 5 Asthma-Related Chemicals **Released** by TURA Filers 1990-2009*

- Sulfuric acid
- Ammonia
- Formaldehyde
- Acetic acid
- Styrene monomer

What Can be Done to Reduce Exposure to Asthma-Related Chemicals?

Where asthma-related chemicals continue to be used—at home, in community settings, and at work—it is important to minimize exposure.

Compliance with exposure limits set by the Occupational Safety and Health Administration (OSHA) or recommended by the American Conference of Governmental Industrial Hygienist's (ACGIH) or the National Institute for Occupational Safety and Health (NIOSH) are one approach to protect workers from chemicals that can cause or exacerbate asthma. However, many current exposure limits do not offer adequate protection from chemicals capable of causing exacerbations at very low levels[4].

The most effective approach for preventing exacerbations and additional new cases of asthma is product and/or process substitution.

What are some Alternatives to Chemicals of Concern?

Polystyrene production. There are no alternatives to styrene when used in the production of polystyrene. *However, there are suitable alternatives to polystyrene products, including polyethylene terephthalate (PET) as well as bioplastics such as polylactic acid (PLA).*

Styrene in fiberglass product fabrication. Alternative methods to reduce or replace the use of styrene in the fabrication of fiberglass products are available. Reductions in styrene monomer use and associated emissions both as solid waste from overspray as well as evaporation can be achieved when changing from an open molding process to a closed molding process. Other process changes that can reduce the use and emissions of styrene include using resin with a lower styrene content as well as using heat to reduce viscosity. Where open mold processes are required, using nonatomized application equipment will reduce emissions. However, alternatives to fiberglass are important to pursue as exposure to fiberglass can exacerbate asthma.

Formaldehyde in manufacture of phenolic resins. Alternative methods to replace formaldehyde for manufacturing a variety of phenolic resins include enzymatic water-based polymerization processes and pyrolysis of biomass. Soy peroxidase enzyme can result in decreased processing time and increased yield. Pyrolysis of agricultural and forestry wastes to produce phenolic resins is predicted to cost half as much as the current formaldehyde-based process.

Formaldehyde in printed wiring boards. Formaldehyde is used in electroless copper processes in the manufacture of printed wiring boards. Alternative reducing agents for this process include: carbon, graphite, organic-palladium, tin-palladium, or electroless copper using sodium hypophosphite as the reducing agent. Conductive polymer technologies are also viable alternatives.

Diisocyanates for polyurethane foams and adhesives. According to a 2011 EPA review, a new class of non-isocyanate polyurethanes are emerging. Though some have suggested that these polymers pose minimal health and environmental risks, adequate toxicity testing data are lacking. A soy-based adhesive substitute for formaldehyde-urea adhesives received a Presidential Green Chemistry Award in 2009, yet more research is needed to determine if soy-based adhesives are safer substitutes for polyurethane adhesives.

For complete references and more detailed information, consult the Massachusetts Toxics Use Reduction & Disease Prevention Fact Sheet: Asthma, at http://www.turi.org