The Massachusetts Toxics Use Reduction Act (TURA):

Services for Businesses and Communities

Overview

- The Basics: How TURA works
- Services provided by TURI, OTA and MassDEP
- Out of State Company Resources
  - Laboratory Testing
  - Online Tools and Databases
  - Library
  - TUR Planner Course
- Your questions
- Ice Breaker Activity

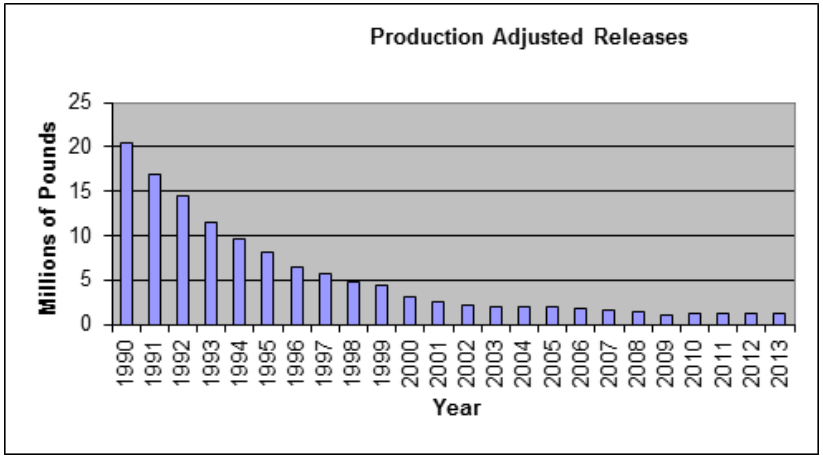
Massachusetts
Toxics Use Reduction Act (TURA)

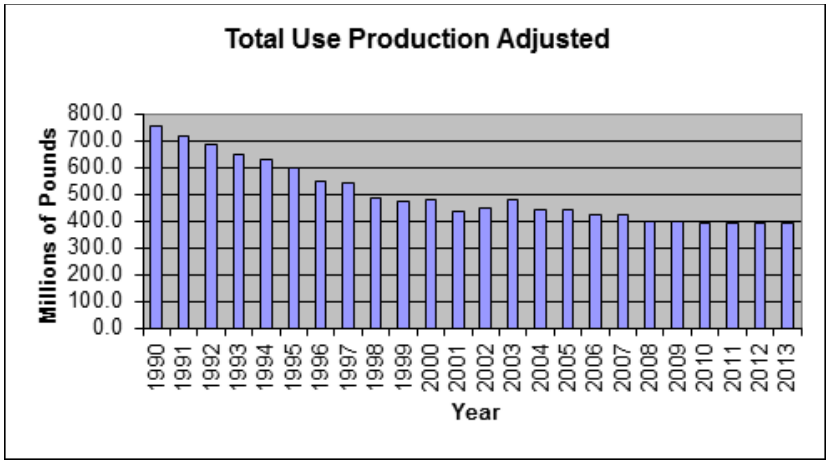
- Helps Massachusetts companies and communities:
  - ***Reduce the use of toxic chemicals*** while promoting competitive advantage of Massachusetts businesses.

How TURA Works

Users of large amounts of toxic chemicals must:

- *Report* toxics use
- *Pay* fees
  - Funds support services to industry & communities
- *Plan* toxics reduction





TUR Reporting

- Annual reports on amounts used, wasted, shipped in product, released onsite, or shipped offsite as pollution
- Affects ≈ 500 companies employing 10 or more FTEs that also use above threshold amounts of one or more of ≈ 1000 TURA listed chemicals
- Makes companies aware of quantities they use and waste

TURA Structure: Implementing Agencies

Massachusetts Department of Environmental Protection (MassDEP): planner certification, filings, enforcement, data analysis

Massachusetts Office of Technical Assistance and Technology (OTA): On-site, confidential technical assistance

Massachusetts Toxics Use Reduction Institute (TURI): Training, Grants, Research, Alternatives Assessment, Policy Analysis, Technical Support, Laboratory, Library

Referrals from OTA

- Works primarily with industrial facilities
- Free & confidential technical assistance includes
  - Recommendations to enhance compliance
  - Implement pollution prevention options
- Pollution prevention recommendations from OTA can include:
  - Suggestions for toxics use minimization to increase efficiency
  - Solvent recycling or reuse options
  - Specific chemical or process alternatives recommended based on what has worked for other companies, similar applications
  - Suggestion to contact the TURI Cleaning Lab for further investigation to assess an alternative
- Following a referral to the Lab, OTA technical assistance providers can help companies implement the Lab's recommendation

Toxics Use Reduction Institute Laboratory

- UMass Lowell (est. 1994)
- The laboratory works on such sectors as:
  - Industry
  - Janitorial
  - Households
  - Disinfection
- Learning Laboratory
  - 20-25 undergraduate students
  - 2-3 graduate students

How We Help Companies

- Performance Testing (Low Cost or through Grants)
  - Site Visit
  - EHS Assessment
  - Hansen Solubility Testing (HSPIP)
  - Flexible Performance Testing
    - Customized evaluations
- EHS Assessment of Potential Alternatives
  - Pollution Prevention Options Analysis System (P2OASys)

Ice Breaker (5-10 Minutes)

- Break into small groups (3-5 people)
  - Discussion:
    - Introductions
    - What do you hope to get out of this training?
    - Why do we clean?

Cleaning Solvents: Why We Clean

Surface Cleaning

- What “clean” means
  - Free from dirt, stain, or impurities
  - More simply, unsoiled
- Soils can be defined as
  - Extraneous or unwanted material deposited and/or attached to a surface
- Cleaning is the process of getting rid of these impurities

Who Cleans

- I guess a shorter question would be, who doesn't?

Company Types Using TCE

Companies	Total 47
Capacitor Manufacturer	2
Plating & Metalworking	22
Aircraft	1
Semiconductor/Electronics	2
General Mfr	14
Jewelry	4
Tools	1
Wire & Cable	1

What Has Been Cleaned

Contaminants	Tests Run	Specific Types
Buffing/Polishing Compounds	226	12
Oil	423	33
Paints/Inks/Coatings	62	9
Waxes	15	9
Other	14	4

Why Clean

- May be required to prepare the surfaces of parts prior to other manufacturing processes
  - Welding, plating or painting
- May be performed for aesthetic reasons as an aid for marketing and sales
- Or it may be necessary to ensure that the finished product will perform without failure caused by contamination

How to Clean

- Cleaning systems depend on three actions
  - Mechanical
  - Thermal
  - Chemical
- Balancing act
  - With a good chemical cleaner, the mechanical and thermal requirements can be lowered
- Time

With What Shall I Clean It…

- Solvency can be defined as the ability to dissolve.
  - Water is considered to be the ‘universal solvent’
    - Capable of dissolving many inorganic and some organic contaminants or soils
  - But not all soils readily dissolve in water alone,
    - Which is why additives were included to make the first soaps

Trouble with Cleaning

- Like dissolves like
  - Demonstrated by visual observation
- Natural soaps and detergents simply did not dissolve greases and oils on their own
- Synthetic Soaps
  - Halocarbon chemistry played an important role in development of more successful synthetic cleaners

Halogenated Solvents

- Most of the synthesized compounds exhibited characteristics suitable for cleaning
  - Chlorofluorocarbons - CFCs
    - Had an unfortunate environmental hazard, ozone depletion
  - Hydrochlorofluorocarbons – HCFCs
    - Were marketed as less toxic replacements for current ozone depleting substances
    - Did not eliminate ozone-layer damaging effects

Evolution of Solvents

- Hydrofluoro Carbons - HFC
  - Although they contain no chlorine,
  - High vapor pressure and low solubility make them poor cleaners
- Hydrofluoroether – HFE
  - Showed potential as a replacement solvent in metal, electronic, and precision cleaning applications
    - Still have Global Warming Potential (GWP)
      - 150-480

Evolution of Solvents

- Perfluorocarbons - PFCs
  - Contain only carbon and fluorine atoms
  - Exhibit good cleaning properties and are extremely inert
    - Not viewed as a danger to the ozone layer
    - Atmospheric lifetimes are thought to be thousands of years
      - Most likely have a very strong potential for enhancing global warming

Current Work Horse of Cleaning

- Trichloroethylene - TCE
  - Still used in metal cleaning
- Normal Propyl Bromide – nPB
  - Was thought to be TCE's replacement
- Perchlorethylene – PCE
  - Used because of its non-flammability, high solvency, vapor pressure, and stability
- Trans-1,2-Dichloroethylene
  - Moderately effective
  - Flammability issues

Downside

- Negative Environmental and health effects
  - Atmospheric ozone depletion
  - Global warming
  - Acid rain formation
  - Carcinogenicity
  - Neurotoxicity
  - Reproductive toxicity
  - Cardiovascular system damage
  - Central nervous system damage

Newer to the Market & Revisited

- Mixtures, Blends and Azeotropes
  - HFE
  - Trans-dichloroethylene (DCE)
  - Furoates
  - Methanol
  - Ethanol
  - Isopropyl alcohol
  - Acetone
  - Cyclopentane

Regrettable Popular Substitutions

- HydroFluoroEther (HFE)
  - Solstice PF
  - Solstice PF-2A
- Trans-dichloroethylene (DCE)
  - Fluosolv™ CX
  - Tergo Metal Cleaner
  - Vertrel™ SDG
  - Opteon™ Sion

Why Are HFEs Regrettable Substitutions?

- HFE
  - Contributes to global warming
  - Breaks down into very persistent and toxic PFAS (per- and poly-fluoroalkyl substances) chemicals
    - EPA initiated regulatory development process for listing PFOA and PFOS as CERCLA hazardous substances and hold parties responsible for PFAS releases into the environment (2018)
  - Low boiling point
    - Risk of losing chemistry with equipment issues

Physical Properties

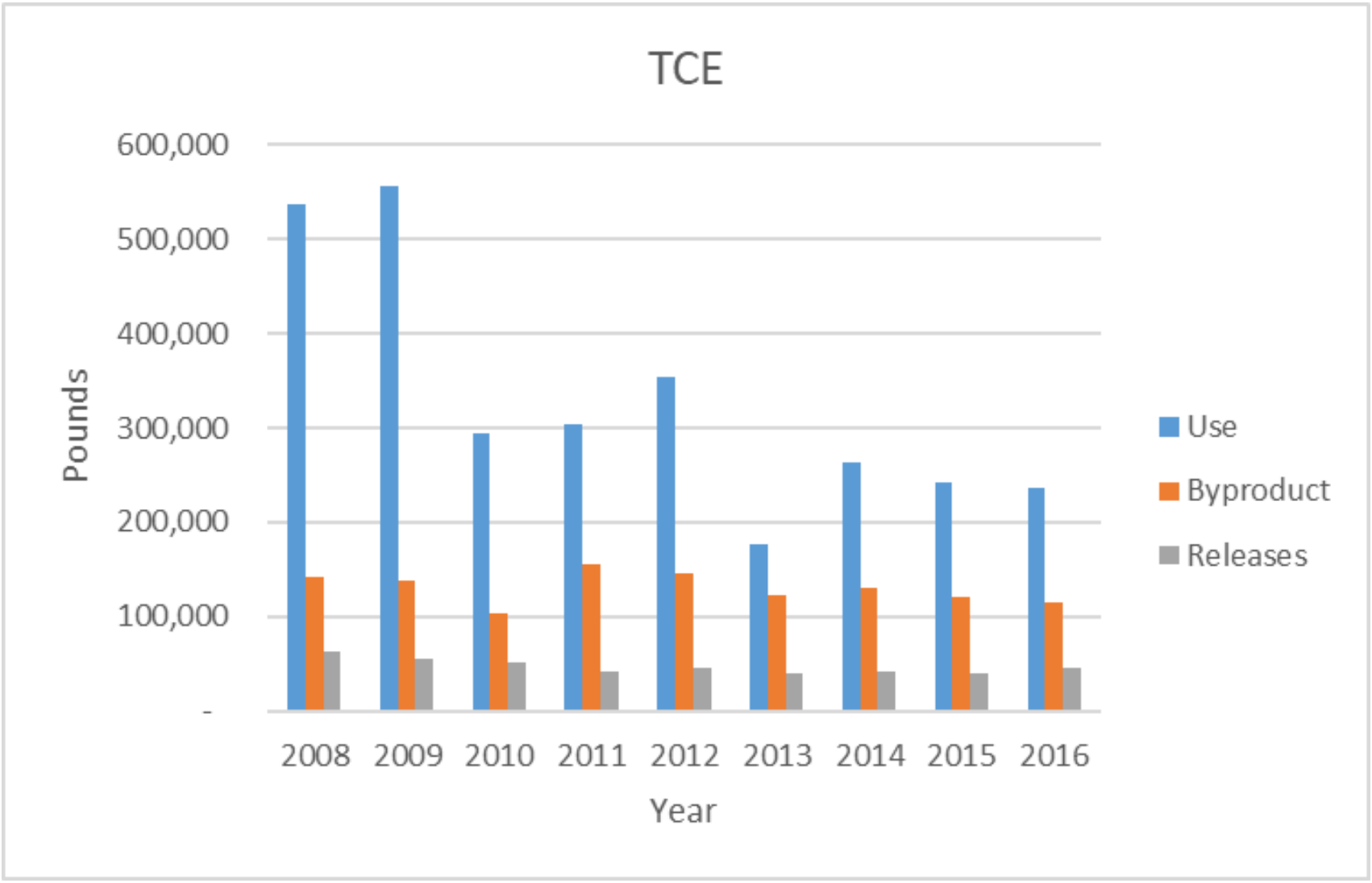
Physical Property	Vapor Pressure	Latent Heat	Surface tension	Boiling Point	Flash Point	ODP	GWP	VOC	KB value	Exposure Level
Units	mm Hg	cal/g	dynes/cm	C	C			g/l		ppm
TCE	69	57	29	87.2	none	0.007	<9	1456	125	50
FLUOSOLV_CX	340	65.3	19.1	41	none	No	<30	1035	95	200
FLUOSOLV_CX 500	525	50.3	17.8	36	none	No	<560	325	30	200
FLUOSOLV_FR110	525	41.3	17.5	46	none	No	<20	0	28	1000
FLUOSOLV_NC 786	525	47.5	18.5	39	none	No	150	255	45	750
Honeywell PF	1185	45.6	12.7	18	none	No	1	0	25	800
Honeywell PF - 2A	1185	45.6	12.7	18	none	No	1	0	25	800
Vertrel SION	335	59.8	21	47	none	No	<1	1278	100	200
Ethyl 2-furoate	0.40	73.8	34	196	70	TBD	TBD	TBD	TBD	TBD
Methyl 2-furoate	0.858	79.1	34	181	73	TBD	TBD	TBD	TBD	TBD

How TCE Still Being Used in US

Type of Degreasing Machine	Number Units	Total Annual Air Emissions (lbs/yr)
Open-top Vapor Degreasing (batch vapor)	116	890,000
Cold Solvent Cleaning (cold)	13	140,000
Conveyorized Vapor Degreasing (in-line)	11	120,000
General Degreasing Units (unknown)	40	330,000

Breakdown of Degreasing Machine Type based on NEI Data for Point Source, 2008

TCE Usage in Massachusetts

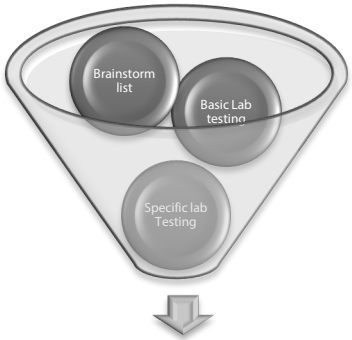


TURI Lab 5 Steps to Success

I. Brainstorm Compatibility and "Lift" Studies

II. Temperature and Concentration Studies

Chemical field may be narrowed/changed from Phase I



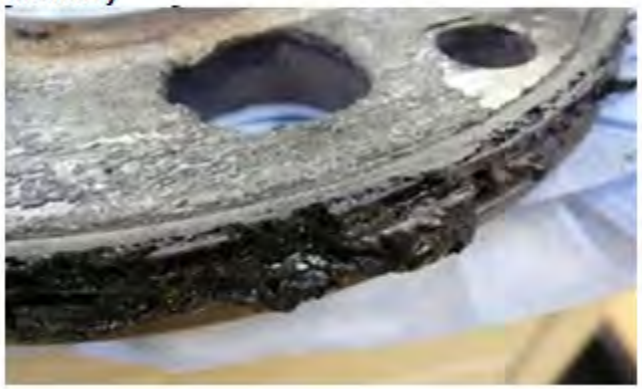
Pilot Testing

III. Mechanical Energy Studies

Number of chemical cleaner candidates further decreases from Phase II

IV. Actual Product Cleaning Studies

Geometries and sizes of parts important to cleaning efficiency



V. Pilot Plant / Scale-up Feasibility Studies

Production volumes or throughput dictated by

How to Get Started?

- Site Visit – Walk through
- Safety Screening – CleanerSolutions
- EHS Assessment – P2OASys
- Performance Testing - Customized evaluations
- Pilot Testing/Implementation - Working with company to verify success of alternatives