

## Reducing VOC Emissions from VOC-Containing Materials

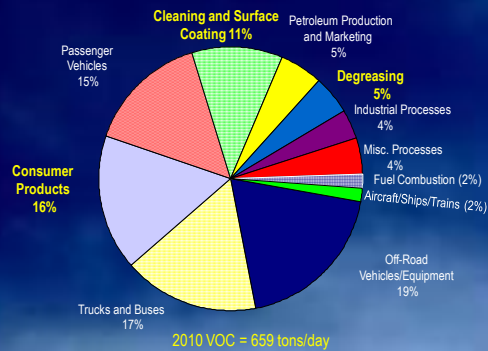
September 28, 2011

## Since 1950s

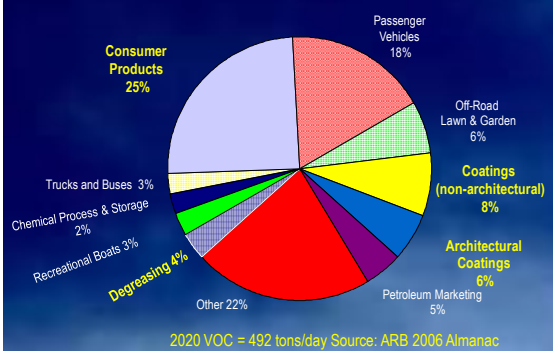
- **Population** -
  - 4.8 Million ↑ 16.5 Million
- **Vehicles** -
  - 2.3 Million ↑ 10.5 Million
- **Manufacturing**
  - \$10.5 Billion ↑ \$203.8 Billion
- **Peak Ozone Levels** -
  - 0.68 ppm ↓ 0.18 ppm\*

\*Extreme Non-Attainment

## Major Source Contribution To VOC (2010)



## Major Source Contribution To VOC (2020)



## VOC-Containing Material Rules

- Dry Cleaning (Rule 1102)
- Boats (Rules 1106 & 1106.1)
- Metal (Rule 1107)
- Buildings (Rule 1113)
- Solvent Cleaning (Rules 1122 & 1171 for industry Rule 1143 for consumers)
- Aerospace (Rule 1124)
- Metal coil and containers (Rule 1125)
- Printing (Rules 1130 & 1130.1)
- Wood (Rule 1136)
- Metalworking fluids (Rule 1144)
- Plastic/Rubber/Glass (Rule 1145)
- Auto refinishing (Rule 1151)
- Polyester Resin (Rule 1162)
- Adhesives (Rule 1168)

Consumer products (regulated by California Air Resources Board)

## Regulatory Requirements

- Applicability and Purpose
- Definitions
- Coating VOC content
  - Prohibits use of high VOC coatings
- Transfer Efficiency
  - HVLP
- Solvent Use
  - <25 g/l

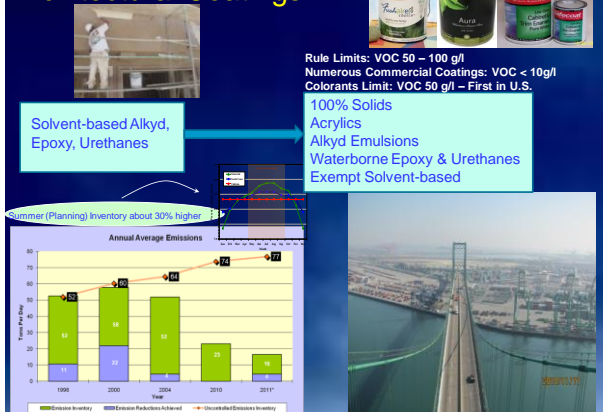


## General VOC Content Limits

| Product Type          | VOC Content(g/L) |
|-----------------------|------------------|
| Adhesive              | 50 - 150         |
| Architectural Coating | 50 - 100         |
| Industrial Coating    | 100 - 420        |
| Inks                  | 225 - 300        |
| Cleaning              | 25 - 100         |

- Limits designed to encourage the use of low and non-solvent technologies

## Architectural Coatings



## Basis for VOC Limits

- Feedback from manufacturers
- CARB Coating Survey
- Commercial volume reporting
- Data search for compliant materials
- Technical Advisory Committee and Working Groups
- Technical Assessments
  - Laboratory Evaluation
  - Field Evaluation
  - Accelerated Weathering



## Staff Findings

- Greater number of compliant or super-compliant products virtually in all coating categories

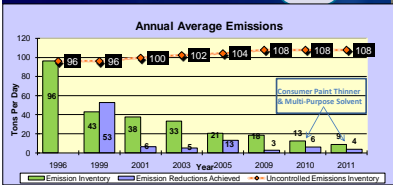
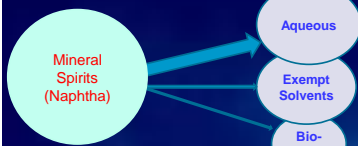
<http://www.aqmd.gov/prdas/Coatings/CoatingsMainPage.html>

- Courts have upheld technical feasibility
- Private Standards Groups conducting paint testing



## Solvent Usage Industrial & Consumer

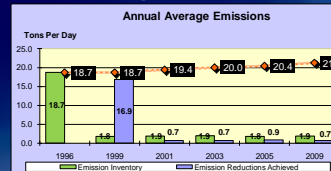
VOC < 25 g/l



## Automotive Parts Washers

### Rule 1171 - Repair and Maintenance Cleaning

- Previously used mineral spirits in parts washers (remote reservoir)
- Replaced by aqueous parts washers and spray cabinets
  - VOC 50 g/l in 1999
  - VOC 25 g/l in 2005



Remote reservoir Spray cabinet

## Vapor Degreasers



1995



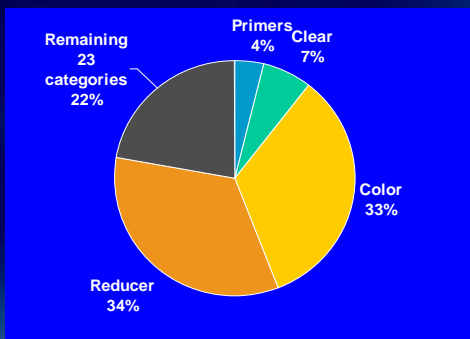
2001

## Auto Body Refinishing (2005)



- Auto body coatings were almost exclusively solvent-borne
- EU Directive 2004/42/EG
  - Requires 420 g/l for all automotive coating(s) in Europe
  - Effective 2007
- SCAQMD and SJVAPCD adopt regulations
  - Mirror the requirements of EU Directive and CARB SCM
  - Effective 2008/2009

## Emission Categories



## Auto Refinishing Regulatory Requirements

- Coating VOC content
  - Prohibits sale and possession of high VOC coatings
- Transfer Efficiency
  - HVLP
- Solvent Use
  - <25 g/l
  - Closed Containers



## Color Coats



- **Water based technology**
  - Reduce with DI water
  - Clean up with DI water
- **Same blending; less mixing**
  - Pre-determined computerized formulations
  - Color matching challenges
  - No specialized mixing equipment
  - Longer shelf life

## Color Coats (Cont.)

- **Different application techniques**
  - Very high volume, low pressure technique
  - 1 or 2 “grip” coats followed by high volume “full” coat
- **High volume air flow required**
  - Initial capital expenditure
  - With high enough air flow process time is same or less



## Color Coats – In Summary

- **They work!**
  - Good (better?) performance
  - Some additional costs but little additional labor
  - Industry acceptance
- **Training required**
  - Need to learn (unlearn) new painting techniques
  - Loss of blending “expertise”
- **Substantial pollution prevention**
  - Significant VOC reduction
  - DI water replaces solvent reducer



2007 “Outstanding Paint” Detroit Autorama winner

## Example CARB VOC<sup>1</sup> limits

| Product Category          | Aerosol (wt. %) | Non-Aerosol (wt. %) | Non-Aerosol Proposed (wt. %) |
|---------------------------|-----------------|---------------------|------------------------------|
| Bath & Tile Cleaner       | 7               | 1                   | 1                            |
| General Purpose Cleaner   | 8               | 4                   | 0.5                          |
| General Purpose Degreaser | 10              | 4                   | 0.5                          |
| Glass Cleaner             | 8               | 4                   | 3                            |
| Paint Thinners            | None            | 30                  | 3                            |

1. Exempts low vapor pressure solvents and fragrance



## Clean Air Choices Cleaner Certification Program

- Modeled after Clean Air Solvent Certification Program
  - 73 participating companies and over 140 certified products
- Ultra-low VOC (<10 g/l) janitorial products currently available and in use
- Prohibits toxics, heavy metals and other chemicals listed on Prop. 65
- <http://www.aqmd.gov/rules/cacc/index.html>



## Objective

- Certify ultra-low VOC janitorial cleaning products
  - Recognize availability
  - Encourage marketing and use



- Reduce VOC emissions and reduce human health and environmental impacts



## Alternative Formulations for Consumer Products

- Traditional product ingredients
  - IPA, 2-butoxyethanol, terpenes, hydrochloric acid, mineral spirits, methylene chloride, alkylphenol and nonylphenol ethoxylates (APE)
- Alternative product ingredients
  - Water-based and highly dilutable
  - Bio-based
  - Low vapor pressure (<0.1 mm Hg)
  - Low toxicity/unknown toxicity
  - Hydrogen peroxide

## General Purpose Cleaners

- Over 600 million gallons sold annually in California
- Mostly water (97%)
- Disposal into sanitary sewer
- Traditionally formulated with IPA, 2-butoxyethanol, terpenes, and APEs
- Alternative products are formulated with ethoxylated alcohol, hydrogen peroxide and terpenes



## Cost and Performance

- Tested products with City of Santa Monica, major school district, office buildings
- Chemical prices are the same
- Adequate performance with only minor increase in labor
  - Floor Wax alternatives have issues
- Nearly invisible transition for most uses



## Metalworking Fluids

- Over 12,000 machining shops
  - Mostly small businesses
- AQMD survey of local manufacturers and distributors
  - 4.2 million gallons of metalworking fluids sold in South Coast (2007)
  - Over 300,000 gallons are high VOC products
- No VOC information for semi-volatile oils



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## Test Method

- Cooperative process with industry
- Thermogravimetric Analyzer (TGA) Test Method
  - ASTM E 1868-10 & Work Instructions for QA/QC
- Acknowledges limited contribution by heavier metalworking fluids
- Reproducible method for semi-volatile metalworking fluids

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## Applicability

- Manufacturing and Assembly operations
- &
- Direct-contact with products made for sale



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## Requirements

- **Prohibition of Sale**  
Six month sell through period
- **Display VOC content and manufacturing date on containers**
  - Beginning 2010 for vanishing oils and metal protecting fluids
  - Effective 1/1/2012 for all metalworking fluids and direct-contact lubricants
- **Streamlined record keeping**
  - No record keeping for Super-Compliant products
- **New test method**  
Transition period for vanishing oils and metal protecting fluids



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## VOC Limits

| Fluid                               | Effective 1/1/2010 | Effective 1/1/2011 | Effective 1/1/2012 |
|-------------------------------------|--------------------|--------------------|--------------------|
| (A) Vanishing Oil                   | 50                 |                    |                    |
| (B) Metalworking Fluid              |                    |                    |                    |
| (i) Metal Forming                   |                    |                    | 75                 |
| (ii) Metal Removal                  |                    |                    |                    |
| (a) General                         |                    |                    | 75                 |
| (b) Precision Metal Removal         |                    |                    | 130                |
| (iii) Metal Treating                |                    |                    | 75                 |
| (iv) Metal Protecting               |                    |                    |                    |
| (a) General                         | 300                |                    | 50                 |
| (b) Military Specified Preservative |                    | 340                |                    |
| (C) Direct-Contact Lubricant        |                    |                    | 50                 |

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## Volatilization of LVP Solvents

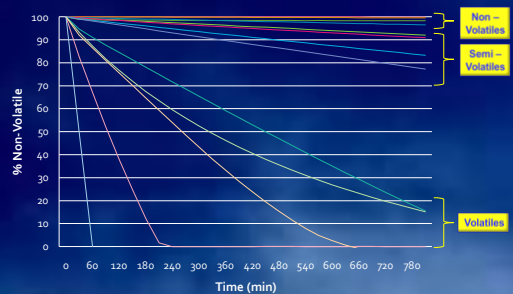
### Background

- **VOC Content of Semi-Volatile Metalworking Fluids**  
Method 24 provides inconsistent results
- **2008 Volatilization Study**
  - Six month test at low temperature (40°C)
  - Led to development of TGA test method (E 1868-10)
- **Similar extended low temperature testing in 2010 shows common LVP solvents are volatilizing**
- **LVP parameters should be reconsidered**
  - Reflect latest scientific data
  - No consistency amongst parameters

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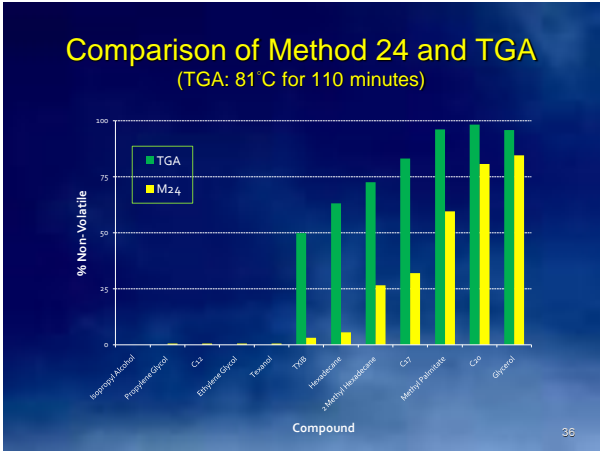
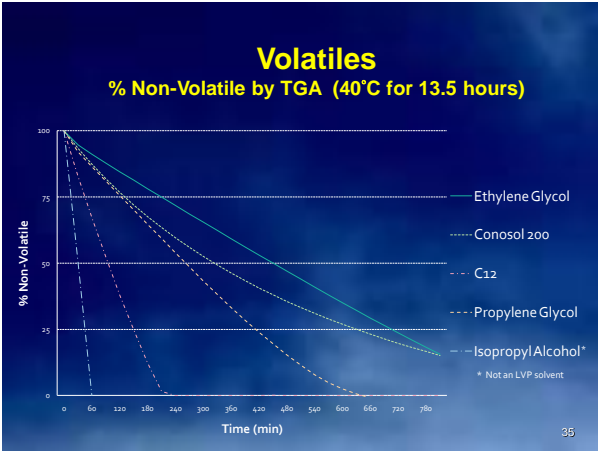
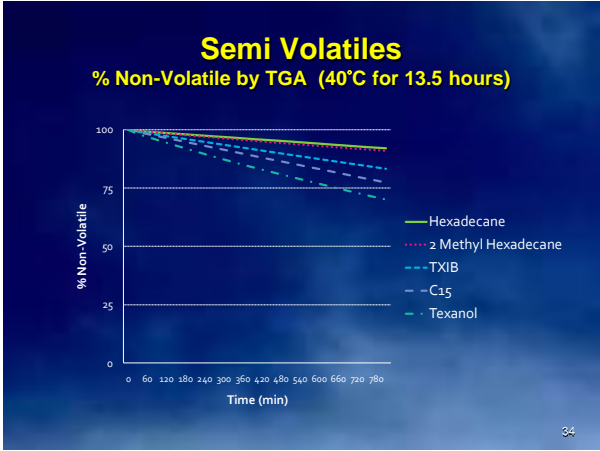
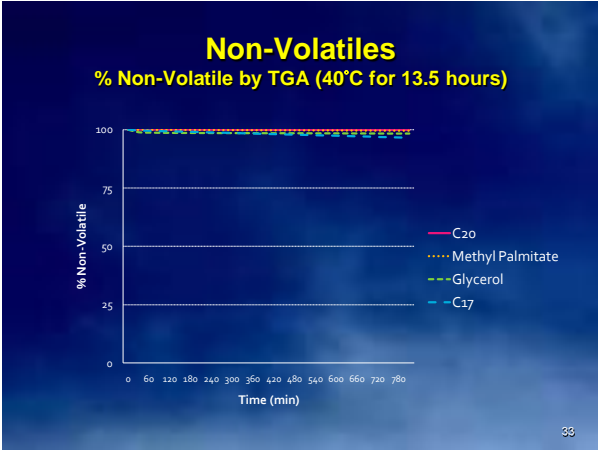
## LVP Solvents

% Non-Volatile by TGA (40°C for 13.5 hours)



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## Conclusions

- Industry can thrive under "smart" regulations
- Inclusive rule development process key to industry acceptance
- Research and development (R&D) funds going towards development of low and non-solvent technologies
- Cleaning operations are major source
- <http://www.aqmd.gov/rules/cacc/index.html>

## Questions or Comments?

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South Coast Air Quality Management District

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