Silane Penetrating Waterproofing Treatments AND Changing VOC Regulations

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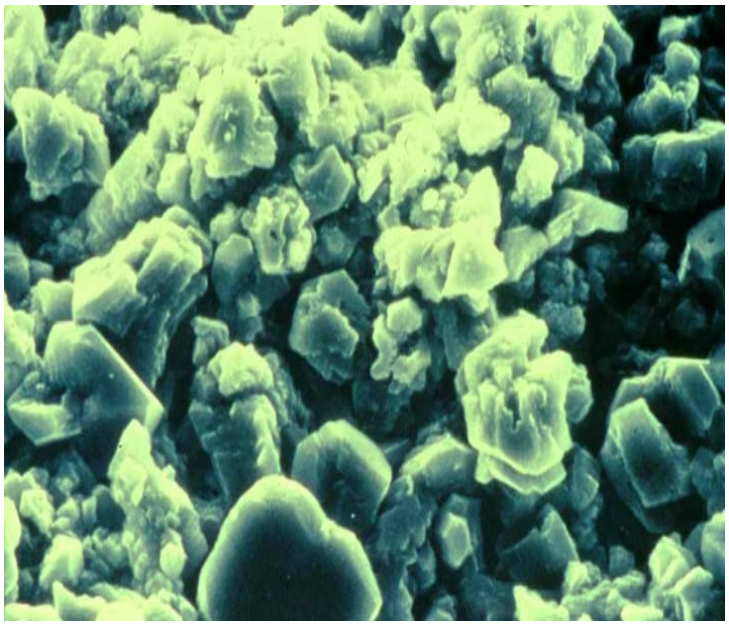
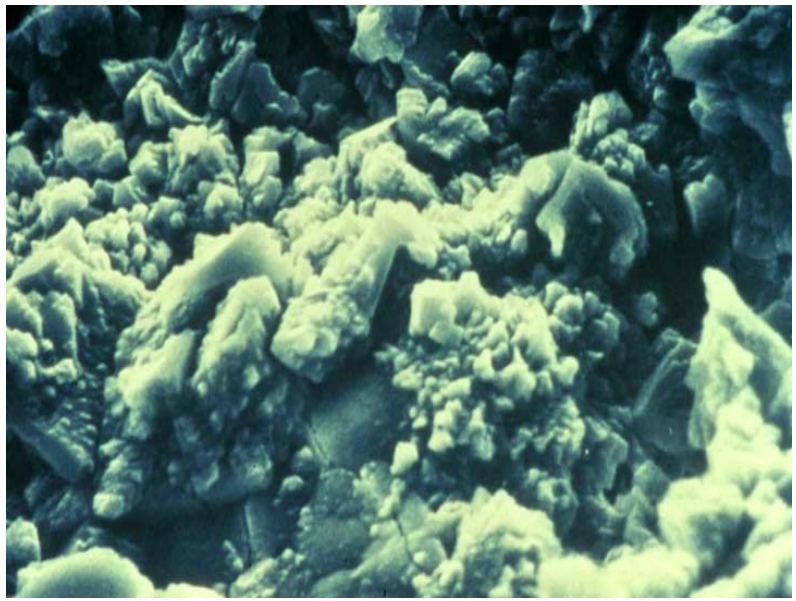
Penetrants

- Forms chemical bond with the walls of the pores, the pores themselves, or both
- Does not change the substrates appearance
- Better long-term effectiveness in traffic abrasive environments
- Does not plug substrate pores
- Leaves the substrate water and salt repellant, yet still permeable
- Actually improves curing time

Silane vs. Untreated Substrate



Silane Treated Substrate



Un-treated Substrate

Recommended Laboratory Tests For Specifying Water Repellents

Test Method	Type/Length of Test	Acceptable Results
NCHRP 244	Series II, Reduction in Water Absorption	80%
NCHRP 244	Series II, Reduction in Chloride Ingress	80%
NCHRP 244	Series IV, Reduction in Chloride Ingress	95%
Alberta DOT	BT001, Type 1b, initial waterproofing	82.5%
Alberta DOT	BT001, Type 1b, waterproofing after abrasion	82.5%
ASTM C672	50 cycles on non-air entrained concrete	0 + running rate
ASTM D1653	Compare % breathable to untreated specimen	80%
ASTM E96	Compare % breathable to untreated specimen	80%

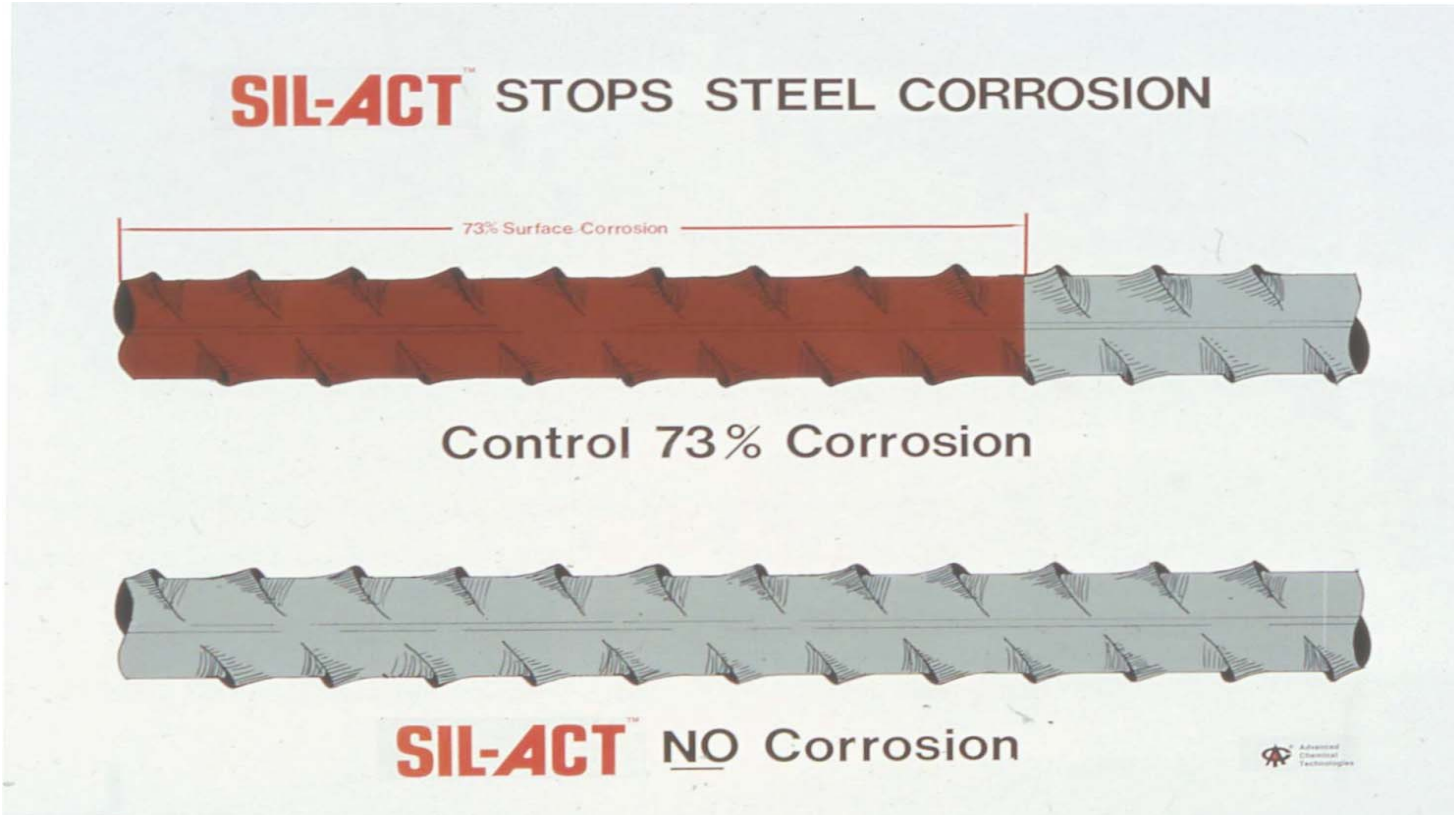
Source: Clear Water Repellents (Kansas City Missouri: Sealant, Waterproofing & Restoration Institute)

Performance Results

Sealer	No Abrasion	1st Abrasion (simulating 5 to 7 yrs. of traffic)	2nd Abrasion (simulating 10 yrs. of traffic)
Acrylic	84%	10%	0%
Epoxy	90%	20%	0%
10% Siloxane	90%	80%	30%
20% Silane in alcohol	85%	80%	40%
40% Silane in alcohol	87%	88%	65%
100% Silane	92%	92%	91%

Source: Paul Carter “Evaluation of Waterproofing Performance and Effective Penetration Depth of Silane Sealers in Concrete” (American Concrete Institute, Fall Convention, 1993)

Steel Corrosion



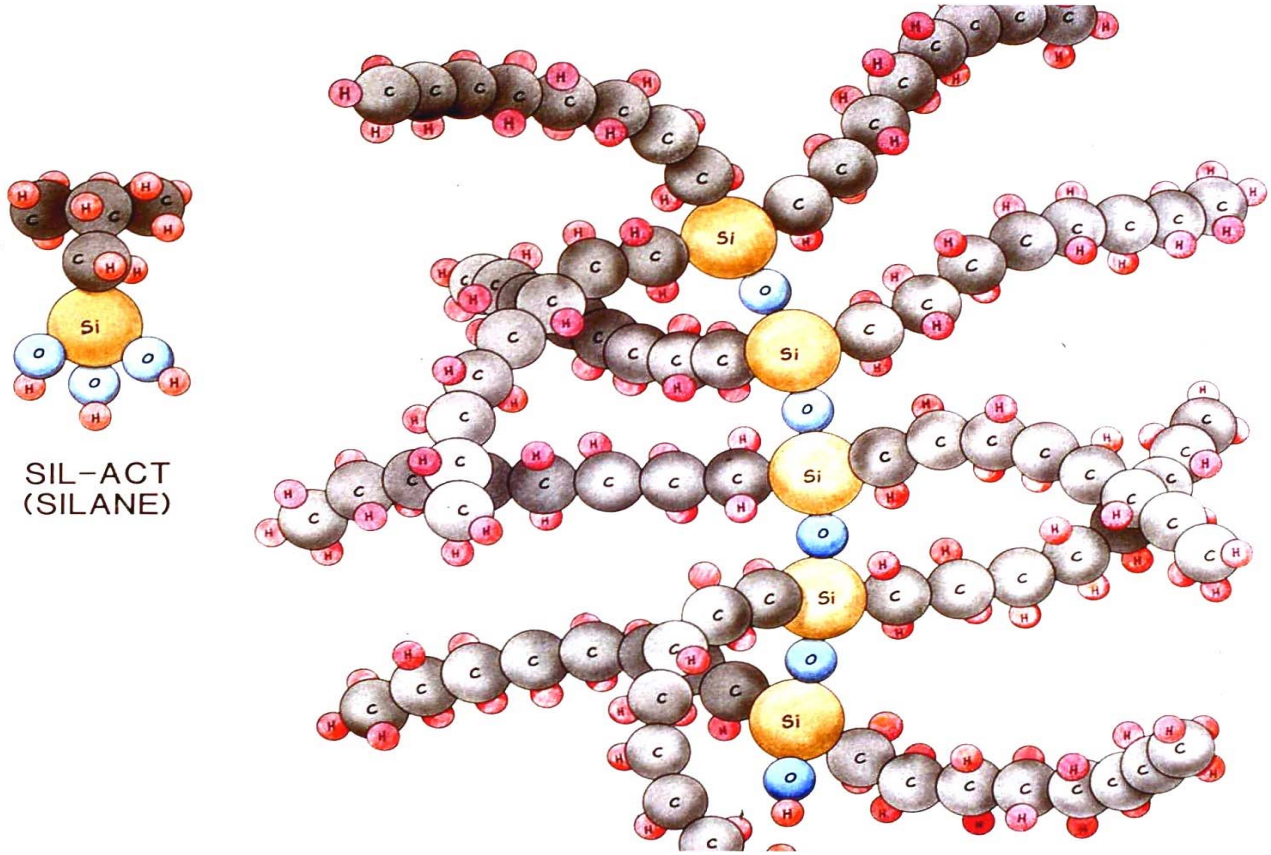
Silane waterproofing treatment prevents:

- Efflorescence
- Spalling
- Delamination
- Steel reinforcement bar corrosion

The Chemistry Of Silane

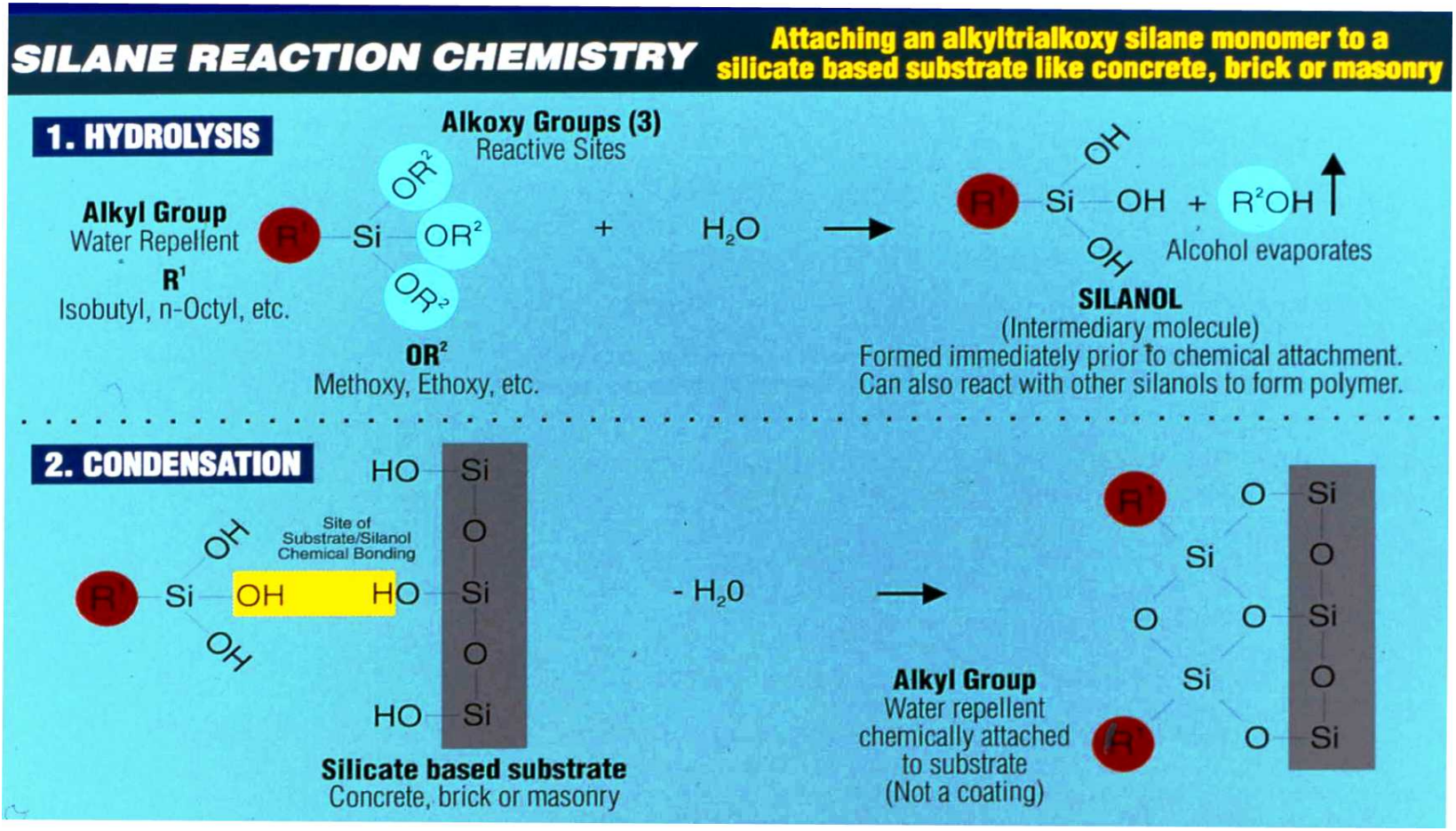
- The silane molecule
- The silane reaction
- Chloride repellent
- Corrosion inhibitor
- Molecular reaction with various treatments

The Silane Molecule

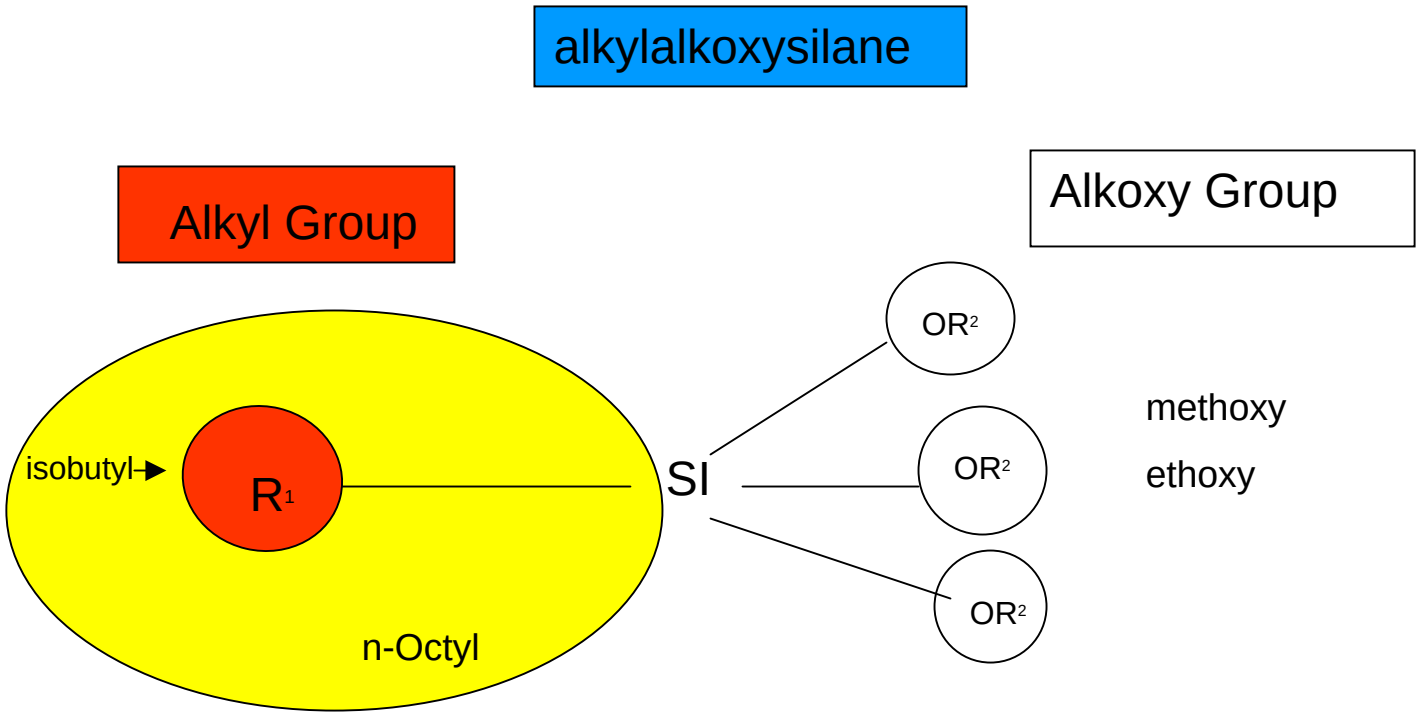


Silane compared to Siloxane

Silane Reaction



alkyltrialkoxysilane



Isobutyltrimethoxysilane

isobutytriethoxysilane

Dries faster than n-Octyls

Structures protected by Silane Products

- Bridges
- Parking Garages
- Airports (including runways)
- Nuclear Power Plants
- Office Buildings
- College campuses
- Anywhere a need to protect concrete and masonry exists

Chesapeake Bay Bridge & Tunnel

Chesapeake Bay, Virginia

- Eighteen miles of structure protected by Silane

Nuclear Power Plant

Palo Verde, Arizona

- Millions Of Square Feet Protected By Silane

Changing VOC Regulation

- Volatile Organic Compounds
- Environmental Protection Agency
- Ozone transport Commission

Air Pollution Transport and How It Affects New Hampshire

May 2004

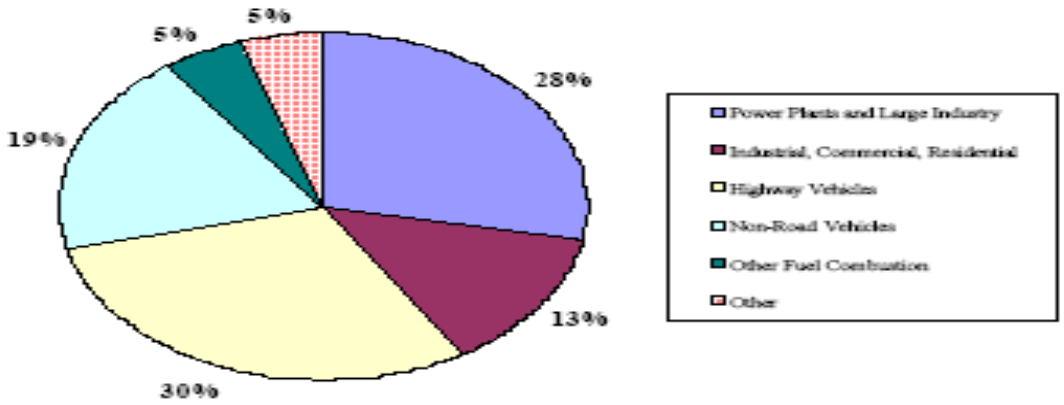
NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

Volatile Organic Compounds

- Have a high vapor pressure and low water solubility.
- Many VOCs are human-made chemicals used in the manufacture of paints, pharmaceuticals, and refrigerants.
- VOCs typically are industrial solvents, such as trichloroethylene; fuel oxygenates, such as methyl tert-butyl ether (MTBE); or by-products produced by chlorination in water treatment, such as chloroform.
- VOCs are often components of petroleum fuels, hydraulic fluids, paint thinners, and dry cleaning agents. VOCs are common ground-water contaminants.

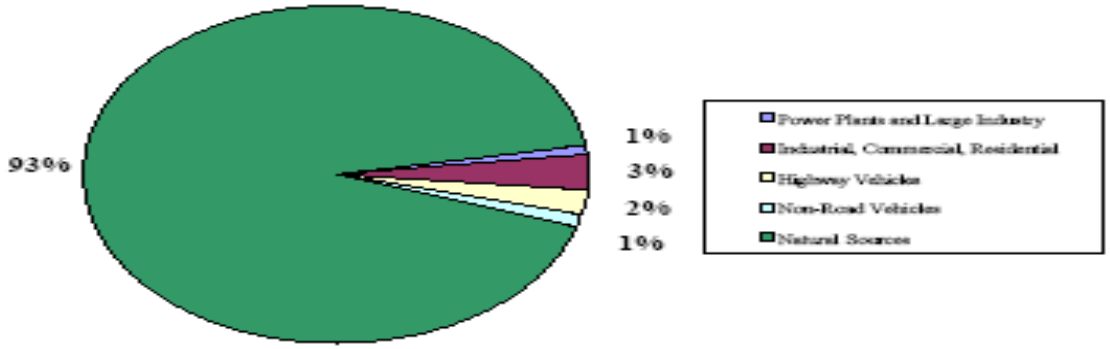
Unlike many other pollutants, ground-level ozone is not directly emitted into the atmosphere from a specific source. Instead, ground-level ozone is formed when nitrogen oxides (NOx) chemically react with volatile organic compounds (VOCs) through a series of complicated chemical reactions in the presence of strong sunshine (ultraviolet light). The sources of NOx and VOCs – called ozone precursors – are many and varied. Almost all NOx emissions originate from human activities related to fossil fuel combustion (see Figure 2.3). Conversely, over 90 percent of VOC emissions in New Hampshire result primarily from natural (biogenic) sources, mainly forests and urban vegetation (see Figure 2.4).

Figure 2.3 - National Nitrogen Oxide (NOx) Emissions by Sector, 1996



Data Source: EPA 1996 National Emissions Inventory (NEI)

Figure 2.4 - Volatile Organic Compound (VOC) Emissions in New Hampshire by Sector on a Hot Summer Day (when emissions are greatest), 1996



Data Source: NHDES and EPA

The US Environmental Protection Agency

- Has long recognized the negative effects of VOC's on air quality
- Enacted the National VOC Emission Standards for Architectural and Industrial Maintenance Coatings
- Established VOC limits on Construction Products

Ozone Transport Commission

- A multi-state Organization
- Represents the Northeastern and Mid-Atlantic States
- Established VOC Limits Lower Than The EPA

VOC Limits By Product Area

Product Area	Current Federal VOC Limit Grams Per Liter	OTC Limits Gram Per Liter
Industrial Coatings	450	340
Penetrating Water Repellents	600	400
Curing and Sealing Compounds	700	350
Form Release Agents	450	250

States And The OTC Model

as of June 2006

- Current states status: Delaware, Maryland, New York, New Jersey, Pennsylvania, Virginia (specifically the Northern Virginia Air District) and the District of Columbia have adopted the OTC model effective January 1, 2005.
- Maine adopted the OTC model effective January 1, 2006.
- New Hampshire is currently drafting rules with an expected compliance date of January 1, 2007.
- Vermont, Massachusetts, Rhode Island and Connecticut have not begun drafting regulations and have not set a compliance date.

California

- Divided Into Air Pollution Control Districts And Air Quality Management Districts
- These Are County Or Regional Governing Authorities
- Most have adopted 400g/l VOC Limits For AIM Coatings
- The Tehama and South Coast Air Districts Have Adopted 100g/l VOC Limits For AIM Coatings

Available Options

- **Use old technologies**. Silicone emulsions, silicates and methyl siliconates have been making a comeback. Marketing techniques to label these products as “new and improved” are in fact misleading. The marketplace rejected these products years ago because of their poor performance. They usually have low active contents (<15%) and high alkalinity (pH > 10). On masonry particularly, they may exhibit characteristics of discoloration, reduced water vapor transmission and minimal penetration.
- **Move to water-borne products.** The benefits of solvent borne water repellents is that they allow wider application conditions (temperature and substrate moisture content) and material stability (longer shelf life). Solvent borne products also have better penetration in most cases. With water borne products, you will still achieve most of the same performance characteristics, with some reduction of the former items.
- **Use existing products with exempt solvents.** There are several exempt solvents that have little or no effect on ground level ozone. However, changing solvent may alter the chemical characteristics of the final formula. Some exempt solvent have negative health effects. For instance, methyl chloroform is considered a primary ground water pollutant.
- **Pay exceedance fees.** The EPA implemented a system whereby the manufacturer pays a fee in lieu of meeting the VOC limits, based upon the amount of VOC over the proscribed limits. However, this option is to be phased out over time.
- **Use products with higher solids.** Some types of products such as acrylics and silicones may darken the substrate if the concentration is too high, however, for most silane products this method is the best solution. With silane products formulated at a higher solid content you usually will obtain better performance, especially regarding penetration and longer shelf life.

In Conclusion, Silane Waterproofing Treatments Are:

- Cost Effective
- Proven water and salt repellents
  - Wiss, Janney, Elstner Associates, Inc.
  - U.S. Department of Transportation
  - Various State DOTs and University Studies
- Protects Both Substrate and Re-Bar
- Easy to apply

Effectiveness Of Silane

QUESTIONS?