

Safer Alternatives for Solvent Applications

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Selected Solvent Applications

- ◉ Solvents are used extensively in numerous applications
- ◉ Applications selected for focus here include several major ones
 - > High solvent use
 - > Many users
 - > Used in industries represented by EPA P2 National Emphasis Areas (NEAs) that involve metals manufacture, fabrication or repair
- ◉ Many other applications
 - > Mentioned later

Current EPA P2 NEAs

- ◉ Food and Beverage Manufacturing and Processing
- ◉ Chemical Manufacturing, Processing and Formulation
- ◉ Automotive Manufacturing and Maintenance
- ◉ Aerospace Product and Parts Manufacturing and Maintenance (Aero)
- ◉ Metal Manufacturing and Fabrication (Metal)

Solvent Applications Covered

- ◉ Vapor degreasing
- ◉ Cold cleaning
- ◉ Paint stripping
- ◉ Industrial aerosol cleaning
- ◉ Coating/adhesive application equipment cleaning/thinning
- ◉ Handwipe cleaning
- ◉ Lubricants/metalworking fluids
- ◉ Coatings and adhesives
- ◉ Anti-spatter formulations

Description of Solvent Applications

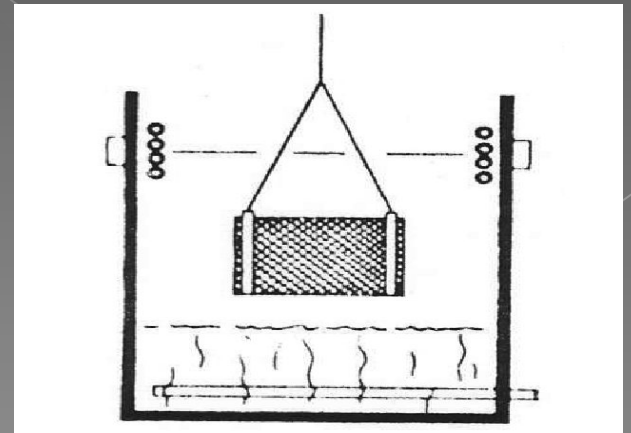
- ◉ Solvents used extensively and in many different ways in applications
- ◉ Approach
 - > Describe how solvents are used in particular application
 - > Indicate what types of solvents are used
 - > Identify potential alternatives
 - > Mention other applications
 - > Present three case studies
 - > Answer questions about applications and alternatives

Vapor Degreasing

- ◉ Used by thousands of companies in the nation
 - › Widely used for cleaning metal parts and assemblies
 - › Used by commercial and industrial companies and aerospace contractors
- ◉ Very effective and forgiving process
 - › Removes range of different contaminants
 - › Parts come out of degreaser clean and dry

What is Vapor Degreasing?

- ◉ A vapor degreaser is a stainless steel tank with a heater in the bottom and a set of cooling coils near the top
- ◉ Liquid solvent is placed in the degreaser and is heated to its boiling point
- ◉ There are solvent vapors above the liquid
- ◉ The vapors are contained in the degreaser by the cooling coils



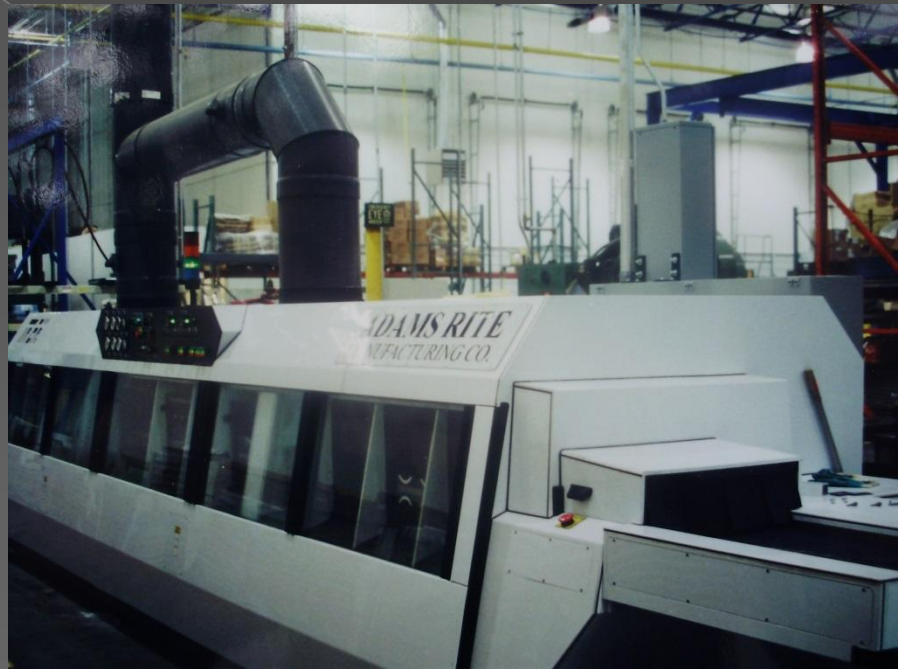
Vapor Degreasing Continued

- ◉ Parts are loaded into the vapor degreaser, generally in a basket or on a fixture
- ◉ The warm solvent vapors condense on the colder parts
- ◉ The contaminants on the parts are carried into the liquid
- ◉ The vapor zone, where the cleaning is done, always has clean solvent
- ◉ Many degreasers are more complex
- ◉ Solvents used in open-top vapor degreasers have no flash point
 - > Commonly rely on TCE, PERC, MC and nPB



Alternatives in Vapor Degreasing

- ◉ Best alternatives taking into account all factors are water-based cleaners
 - > Suitable for vast majority of companies using vapor degreasers today
- ◉ Other alternatives can be used in certain specific types of applications
 - > Soy based cleaners
 - > heat
 - > no-clean
 - > blasting media



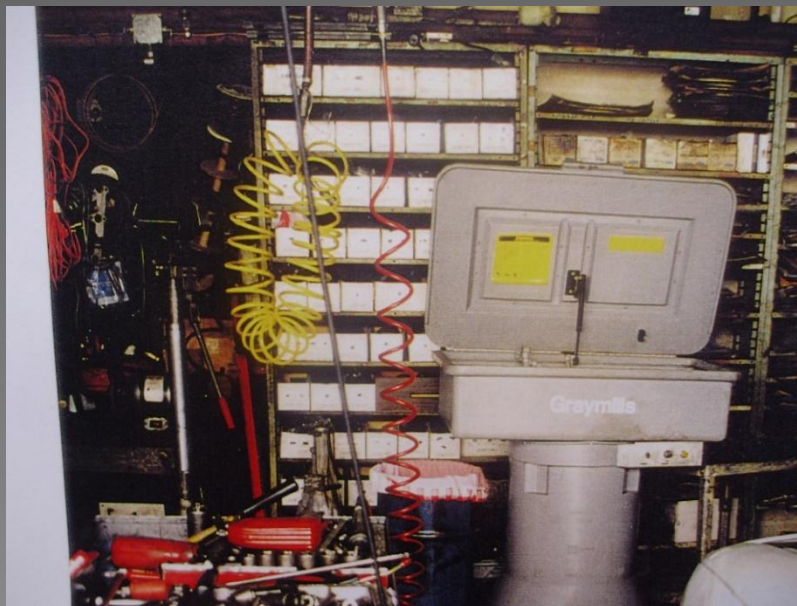


Cold Cleaning

- ◉ Used by auto repair shops and industrial facilities
- ◉ Solvents are used at room temperature in batch loaded cold cleaners or parts cleaners to remove oil, grease and other contaminants from parts of various kinds
- ◉ Solvents used in cold cleaning
 - > Halogenated solvents
 - > Non-halogenated solvents like mineral spirits which are classified as VOCs

Alternatives in Cold Cleaning

- ◉ Water-based cleaners
- ◉ SCAQMD pioneered use of water-based parts cleaners in auto repair and industrial facilities to reduce VOC emissions
- ◉ In later years, all air districts in California adopted similar regulations
- ◉ Infrastructure for cleaning equipment, water-based cleaners and hauling procedures is established in state
- ◉ Provides a blueprint for other states, cities to duplicate



Paint Stripping

- ◉ Many different subsectors use strippers
 - > Rework of metal parts
 - > Aircraft and aircraft parts
 - > Vehicles and vehicle parts
 - Autobody repair
 - Aftermarket cars
 - Automotive paint shops
 - Wheels
 - > Small businesses/users purchase stripper at big box and hardware stores

Paint Stripping Continued

- ◉ Solvents widely used in paint stripping
 - > MC, NMP
- ◉ EPA TSCA regulation bans MC use in consumer product paint strippers
 - > Can no longer purchase MC strippers at big box or hardware stores
- ◉ Environmental community has commitments from companies to stop selling NMP strippers
 - > Can no longer purchase NMP strippers at some big box or hardware stores



Alternatives in Paint Stripping

- ◎ Rework of metal parts
 - > Strip before paint is cured
 - Best option
 - > Benzyl alcohol strippers
 - If coating has cured
 - > Alkaline strippers
 - If coating has cured
 - Can only be used on certain metals including iron, steel, copper and magnesium



Alternatives Continued

- ◎ Aircraft and aircraft parts
 - > Benzyl alcohol strippers
 - Primarily used in dip tanks
 - Sometimes heated
 - > Blasting operations using media
 - Flashjet
 - Plastic media
 - Wheat starch
 - Lasers
 - > Not painting at all
- ◎ Autobody shops
 - > Hand sanding

Alternatives Continued

- ◉ Aftermarket cars and paint specialty shops
 - > Benzyl alcohol strippers
 - > Hand sanding
 - > Media blasting
- ◉ Wheels
 - > Benzyl alcohol strippers



Industrial Aerosol Cleaning

- ◉ Aerosols used by numerous companies for touch-up cleaning during manufacturing or assembly processes
- ◉ Companies like aerosols because they are a convenient way of cleaning and can be used for hard to reach areas
- ◉ Solvents used in industrial aerosol cleaning include halogenated solvents like TCE and many non-halogenated solvents that have high VOC content

Alternatives in Industrial Aerosol Cleaning

- ◉ Applications are very diverse so alternatives are suitable on a case by case basis
 - > Need to balance cleaning capability and evaporation rate
- ◉ Can use spray bottles to eliminate aerosol disposal problem and reduce cost
- ◉ California has banned TCE, PERC and MC in many aerosol cleaning products
- ◉ Alternatives include acetone based products blended with low toxicity glycol ether or hydrocarbon
- ◉ Carbon dioxide propellants can be used to lower VOC content

Coating/Adhesive Application Equipment Cleaning/Thinning

- ◉ Many companies apply coatings and adhesives with spray guns in booths
- ◉ Other application devices include brushes and rollers
- ◉ Solvents used in cleaning and thinning are generally non-halogenated VOC solvents
 - › Lacquer thinner, mineral spirits, MEK, MIBK, toluene, xylene or blends
 - › Can be purchased from suppliers in large quantities or from big box stores



Alternatives in Cleanup and Thinning Solvents

- ◉ Alternatives pioneered in southern California which sets low VOC limit for cleanup solvents
 - > Thinners are regulated as part of coating VOC limits
- ◉ Cleanup solvent alternatives for solventborne coatings and adhesives rely on acetone
 - > Acetone can often be used alone
 - > If necessary, it can be combined with other ingredient like a low toxicity hydrocarbon



Handwipe Cleaning

- ◉ Companies use diverse set of solvents in handwipe operations in manufacturing, assembly or repair
- ◉ Handwipe operations use wipes or rags to wipe down small or large components prior to coating or plating or other types of processes
- ◉ Solvents commonly used for handwipe may include halogenated solvents but most often are performed with non-halogenated VOC solvents
 - Mineral spirits, MEK, MIBK, toluene, xylene

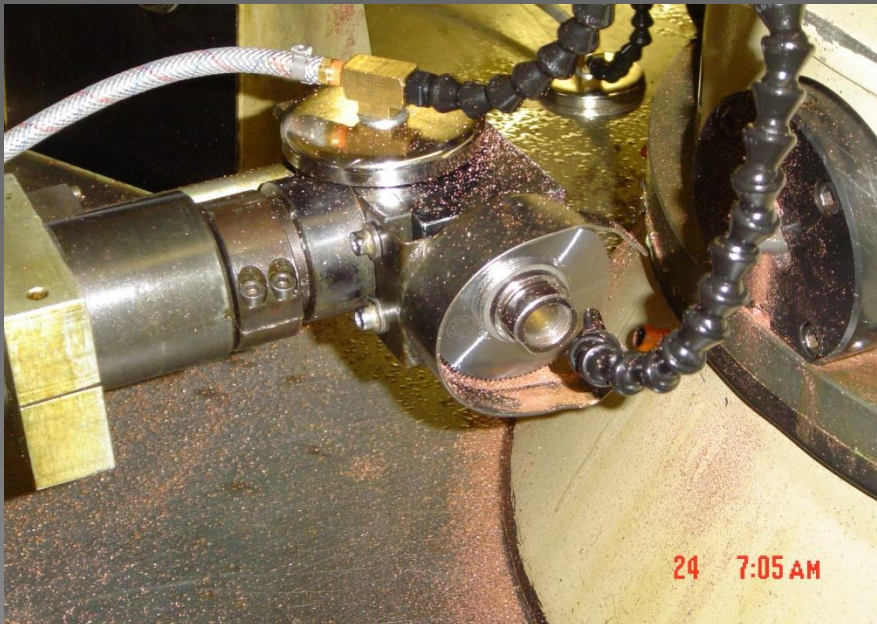
Alternatives in Handwipe Cleaning

- ◉ Alternatives pioneered in southern California which sets low VOC limit for handwipe solvents
- ◉ Best alternative is plain acetone or acetone blends with low toxicity glycol ether or hydrocarbon



Lubricants/Metalworking Fluids

- ◉ Used by many companies for cutting, stamping, forming, bending, rust inhibiting operations
 - > Are stressful operations and metalworking fluids provide cooling, reduce friction, remove metal particles
- ◉ Many currently used formulations are petroleum products which contain aromatic components and are VOCs
 - > Can be classified as low vapor pressure solvents
- ◉ Products are often thinned with mineral spirits or kerosene before they are applied



Alternatives to Petroleum Based Metalworking Fluids

- ◉ Alternatives pioneered in southern California with regulation that limits VOC content
- ◉ Safer alternatives include water-based and vegetable based lubricants and metalworking fluids
- ◉ Water-based lubricants can be thinned with water
- ◉ Alternatives can also eliminate chlorinated paraffins

Coatings and Adhesives

- ◉ Wide variety of different operations used by manufacturers, assemblers, autobody shops
- ◉ Some small shops purchase products at big box stores
 - > Aerosol and non-aerosol forms
- ◉ Many coatings and adhesives are solvent based
 - > Solvents used in industrial coatings are generally non-halogenated but some adhesives rely on halogenated solvents
 - > Can be very complex mixtures with multiple ingredients
 - > Solvent evaporation leads to curing

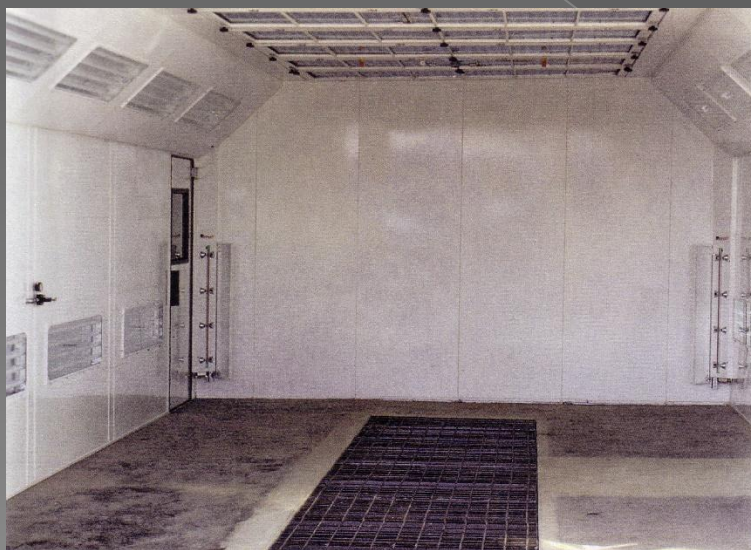
Alternatives to Solvents in Coatings and Adhesives

- ◉ Many alternative types of products which will be suitable on a case by case basis
- ◉ High solids coatings
 - > powder coatings
 - > Roll coating
 - > flow coating
 - > dip coating
- ◉ High solids adhesives
 - > Epoxy adhesives for bonding non-porous substrates
 - > Hot melt adhesives for bonding one or more porous substrates

Alternatives Continued

- ◉ Waterborne coatings and adhesives
 - › May need higher air flow for drying or different staging
- ◉ Low VOC content coatings and adhesives
 - › Generally based on acetone
- ◉ UV and other light curing coatings





Anti-Spatter Formulations

- ◉ Many companies use anti-spatter formulations when they do welding or laser cutting
- ◉ Products are designed to coat the metal parts so metal fines generated through friction and heat don't adhere to the parts or the workstation surfaces
- ◉ Products are generally based on MC but there are certain others that rely on nPB
 - > Solvents are carriers and evaporate during process leaving a coating on the part
- ◉ Numerous products use soy lecithin to prevent adhesion
- ◉ Need to clean parts to remove coating after welding or laser cutting

Alternatives to Solvents in Anti-Spatter Products

- ◉ Water-Based alternatives
 - > Many also contain soy lecithin which is more difficult to clean with water-based cleaners
 - > Some may not give good and uniform coverage and some May have long drying time



Alternatives Continued

- ◉ Ceramic alternatives for workstation surfaces
 - > Not designed to be removed



Many Other Solvent Applications Not Covered

- ◉ Cleaning
 - > Electronics and microelectronics
- ◉ Paint Stripping
 - > Wood refinishing
 - > Bathtub refinishing
 - > Boat stripping
 - > Contractor stripping
 - > Consumer product strippers
- ◉ Dry cleaning
- ◉ Spotting chemicals
- ◉ Auto aerosol cleaning

Other Applications Continued

- ◉ Graffiti Removers
- ◉ Coatings and adhesives
 - > Wood coatings
 - > Architectural coatings
 - > Furniture adhesives
- ◉ Printing equipment cleaning
- ◉ Pharmaceutical equipment cleaning
- ◉ Release agents and mold cleaning
- ◉ Floor wax strippers
- ◉ Biocide control formulations

Case Study--Plating Company

- ⦿ Company is a jobshop and provides plating services
- ⦿ Parts made of stainless steel, copper, brass, aluminum and carbon steel
- ⦿ Uses three types of polishing compounds to polish parts
- ⦿ Used large nPB vapor degreaser for many years
- ⦿ Did testing, found suitable water-based cleaner alternative
- ⦿ Evaluating quote on alternative ultrasonic cleaning system



Annualized Cost Comparison for Plating Company

Cost Element	Vapor Degreaser	Water Cleaning System
Equipment	-	\$3,235
Cleaner	\$26,680	\$1,144
Energy	\$3,650	\$1,572
Labor	\$22,132	\$22,132
PPE	\$250	-
Disposal	\$300	\$1,100
Total	\$54,814	\$29,183

Case Study--Machine Shop

- ◉ Jobshop has 21 machining stations and machines parts for aerospace industry
- ◉ Substrates include aluminum and stainless steel
- ◉ Used petroleum based lubricant and mineral spirits parts cleaners
- ◉ Converted to water-based parts cleaners
- ◉ Converted first to a water miscible cutting and grinding lubricant
- ◉ Later converted to a synthetic vegetable ester lubricant



Annualized Cost Comparison for Machine Shop

Cost Element	Petroleum Lubricant	Ester Lubricant
Capital Cost	-	\$1,079
Lubricant Cost	\$1,584	\$3,402
Maintenance Labor Cost	-	\$3,720
Machining Labor Cost	\$249,600	\$224,640
Disposal Cost	\$360	\$1,025
Cleaning Change Cost	\$11,534	-
Oil Dilution Cost	\$594	-
Total Cost	\$263,672	\$233,866

Case Study--Ducting Manufacturer

- ◉ Company manufactures ducting for aerospace and industrial applications
- ◉ Has to meet aerospace and REACH requirements
- ◉ Uses laser cutting operation for fabricating parts to correct size
- ◉ Used large 100 gallon nPB vapor degreaser and converted to existing water cleaning system
- ◉ Used specially formulated nPB anti-spatter formulation containing soy lecithin
- ◉ Tested many commercial water-based anti-spatter products
- ◉ Water cleaner supplier formulated water-based anti-spatter



Annualized Cost Comparison for Ducting Manufacturer

Cost Element	nPB Anti-Spatter	Water-Based Anti-Spatter
Anti-Spatter	\$72,000	\$8,580
Application Equipment	\$1,037	\$104
Labor	\$19,368	\$19,368
PPE	\$3,480	-
Total	\$95,885	\$28,052

Issues in Solvent Alternatives

- ◉ Solvent applications are diverse and complex
 - > Need to understand what the safer alternative options are
- ◉ Companies trust vendors and vendors will try to influence companies
 - > Companies must know about the alternatives so best solution can be adopted
- ◉ Solutions have to be practical and based on common sense
- ◉ Regulations can and have spurred innovation in alternatives
 - > California and certain other states

Issues Continued

- ◉ Regrettable substitutes must be anticipated
 - › Regulators, vendors and P2 providers have made mistakes
- ◉ Nothing is essential
 - › Ozone depleting substances, global warming substances, California regulations

Conclusions

- ◉ In solvent applications, users have switched from one to another less regulated material
- ◉ Best strategy is to find a permanent solution so you don't have to convert again
- ◉ Many safer alternative methods will reduce costs or only increase costs slightly

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