Project Area 2

Reduction/Elimination of VOCs In cleaning operations

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Centro Para Prevenção da Poluição (C3P)

Solvents:

Organic compounds that have the specific property of dissolving water insoluble contaminants (such as grease, oils, waxes, carbon deposits, fluxes and tars) without suffering chemical changes

Applications:

Cleaning operations of metals, plastics, fibreglass, printed circuits boards and other materials, prior to painting, plating, heat treatment, repair ...

Activities that use organic solvents:

- Metal-working industries
- Printing industry
- Production of chemicals
- Production of plastics
- Production of textiles
- Production of glass
- Production of paper

Classification of solvents:

- **Hydrocarbon Solvents (aromatic and halifatic)** (pentane; n-hexane; cyclopropane; cyclohexane; cyclohexene, benzene; toluene; xylene)
- **Chlorinated Solvents** (1,1,1-trichloroethane (TCA); trichloroethylene (TCE); tetrachloroethylene (PERC); dichloromethane) the most toxic and dangerous to the environment
- **Oxygenated Solvents** (methyl ethyl ketone (MEK), methyl iso-butyl ketone (MIBK))

Selection of solvents

Solvent selection is based on the solubility of the substance to be removed and on the toxicity, flammability, flash point, evaporation rate, boiling point, cost, and several other properties of the solvent

Solvents may be used in liquid form (cold cleaning) or in vapour form

Cleaning techniques:

- Batch cleaning machines (Cold cleaners and open-top vapour systems)
- Continuous cleaning machines or Conveyorised degreasers (using cold or vaporized solvent)
- Equipment cleanup

Factors influencing emissions:

- Physical and chemical properties of the solvent (volatility, viscosity, boiling points, and surface tension)
- Leaks, splashing and spilling of solvents
- Solvent management operations (filling and draining of cleaning machines, water/solvent separators, solvent regeneration)

Factors influencing emissions:

- Process operation (start-up and shutdown conditions, existence of covers, turbulence from high conveyor belt speeds and from manual removal of parts, drying of parts)
- Exhaust systems used without a carbon adsorber

Cold cleaners

Emissions:

- Waste solvent evaporation
- Solvent carryout
- Solvent bath evaporation
- Spray evaporation and agitation

Open top vapour systems

Emissions:

- Carry-out
- Exhaust systems
- Waste solvent evaporation

Continuous cleaning machines

Emissions:

- They are usually enclosed, what leads to less solvent emitted per amount product than is the case with other technologies

Cleanup

Emissions from solvent evaporation:

- Storage and handling of fresh and spent solvents,
- Solvent evaporation from the cleaned surfaces
- Evaporation as the solvent is splashed or sprayed
- Evaporation from solvent-soaked rags or cleaning tools

Emissions Prevention Techniques:

Process Elimination:

- Determine whether parts need to be cleaned
- Use easy-to-clean or no-clean rust inhibitors and lubricants
- Review the handling process of the parts to determine why parts are getting dirty and take action to prevent it from happening in the future

Emissions Prevention Techniques:

Input Material Substitution:

- Use elbow grease. When possible, clean by brushing and wiping
- Use aqueous-based cleaners
- Use solvents with a low vapour pressure and high flash point
- Use citrus or terpene cleaners

Emissions Prevention Techniques:

Evaporation Reduction:

- Use an air-lock vapour degreaser
- Install refrigerated coils on the freeboard above the primary condenser coils
- Working emissions are reduced by approximately 20-50 percent for above freezing coils and 30-80 percent for below freezing coils

Emissions Prevention Techniques:

In-Process Recycling:

- Use counter-current rinsing
- Skim/filter and reuse aqueous cleaners
- Reuse solvents by installing filtration or distillation units
- Install a bioremediation parts washer that uses enzymes to eat oil and grease

Emissions Prevention Techniques:

Waste Segregation:

- Segregate solvents to allow recycling
- Keep solvents out of used oil
- Keep fuel, brake fluid, and other fluids out of solvents to prevent the mixture from becoming hazardous
- Keep solvents out of aqueous cleaners

Emissions Prevention Techniques:

Procedures/Scheduling:

- Reduce dragout by increasing drain time
- When dipping parts, lift them such that it reduces dragout

Equipment Layout/Piping/Automation:

- Install sliding lids on solvent tanks
- Increase the freeboard height to significantly reduce solvent evaporation
- Install automatic parts lift on vapour degreasers
- Use drain racks to reduce dragout
- Drain parts using a rotating rack

Emissions control techniques for cold cleaners:

- Covers
- Distillation or incineration of waste solvent
- Use of a water layer of 5-10 cm on top of the solvent
- Increased freeboard ratio
- Internal drainage rack

Emissions control techniques for open top vapour systems:

Design issues:

- Covers
- Freeboard refrigeration devices
- Hot vapour recycle or superheated vapour
- Increased freeboard height
- Vacuum chamber cleaning machines
- Drying tunnel
- Rotating baskets
- The use of carbon adsorption

Emissions control techniques for open top vapour systems:

Working issues:

- Decreasing the speed at which parts are moved
- Reducing room drafts
- Limiting the horizontal area of the load to be cleaned to 50 % of the cleaning machine solvent/air interface area
- Detecting and repairing routine leaks
- Not bypassing carbon adsorbers during desorption cycle
- Replacing the carbon bed often

Emissions control techniques for continuous systems:

- As these degreasers are usually enclosed no extra primary measures are useful

Emissions control techniques for cleanup solvents:

- Substituting a less volatile solvent
- Reducing usage rates
- Better management of the spent solvent