MINNESOTA
TECHNICAL
ASSISTANCE
PROGRAM

Reducing solvent emissions from vapor degreasers

FACT SHEET

The following information identifies the numerous factors affecting solvent emissions, and provides detailed information on how to reduce these emissions. In individual degreasing operations, these factors are likely to vary significantly in importance.

Emissions Due to Drag-Out

Reduction techniques	Estimated % Reduction
(1) Withdraw parts from the degreaser when they stop dripping. Withdrawing moist parts from the vapor zone results in a 60% reduction in solvent emissions compared to withdrawing dripping parts. Parts should be left in the vapor zone (below the cooling coils) at least until no drops are visible on the parts.	60%
(2) Hold parts in the freeboard zone until all parts are completely dry. Holding parts for a short time just above the cooling coils in the freeboard zone can result in 40% less emissions than if the parts are immediately withdrawn from the vapor zone. When removing parts from the degreaser, hold parts in the vapor zone (below the cooling coils) at least until all dripping from the parts stops (one to two minutes, for smaller parts). Then leave parts in the freeboard zone until all parts are completely dry. If time allows, lengthen the hold time in the vapor zone.	40%

Note: Parts that are wet and dripping usually 'indicate that the temperature of the parts is considerably less than the vapor temperature When this occurs, the rinsing effect of the vapor degreaser may not be filly utilized and the parts may remain dirty. Rinsing (vapor degreasing) may not be necessary in this application

Note: During the vapor zone hold, vapors condense on the cold part, completely coating it in liquid As the part warms up and approaches the vapor temperature, liquid will drip off the part faster than it recondenses. Some liquid will remain on the part until it reaches the vapor temperature, which will take a long time Therefore, for all practical purposes residual liquid will remain when parts are removed from vapor. If parts are taken immediately

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out of the degreaser this residual liquid will quickly evaporate into the unsaturated air and be lost. If there is a hold in the freeboard zone, the residual liquid will still evaporate quickly into the unsaturated air, but since the solvent vapor is heavier than air and is still directly above the unit, much of the vapor will fall back into the vapor zone and be recaptured.

The best way to control drag-out emissions is through the use of a programmable transport system, since even with excellent training on the need and methods for controlling emissions, it is physically diffcult, if not impossible, for a person to hold heavy parts away from their bodies for any length of time. Ifprogrammable transport systems cannot be justified, set up a stand for hanging parts or baskets at appropriate levels, and provide timers to keep the hold time above the minimum required for your application,

(3) Use parts holding fixtures that promote better drainage. Unknown
The effect of using better fixtures for holding parts (racks or baskets) was not measured. Position parts so draining is promoted and liquid hold- up is minimized. Minimize the surface area, the weight, and the heat capacity of the fixture or basket to reduce drag-out caused by the parts holder. Consider using a rotating basket to drain complex parts.

Emissions Due to Diffusion

Reduction techniques

(1) **Add freeboard height to degreasers.** Degreasers with 75% freeboard will have about 30% less solvent emissions than degreasers with 45% freeboard when both are idling and open. Degreasers with 100% freeboard will have about 15% less solvent emissions when idling than ones with 75% freeboard. 15-30%

$$\% \text{ freeboard} = \frac{(\text{too of the cooling coils to the lip distance}) \times 100}{\text{width (shorter dimension) of the degreaser mouth}}$$

(2) Keep an idling degreaser covered. A covered, idling degreaser will have about 15% less emissions than an uncovered degreaser. 15%

Note.- Drafts or inadequate freeboard or chiller capacity would greatly, increase the value of covers.

(3) Reduce vapor displacement. The effect on emissions caused by high volume parts displacing vapors above the cooling coils was not measured. Try slower hoist speeds or the stop-and-go technique to unknown

(continued)

Estimated
% Reduction

correct a displacement problem. A withdrawal speed of less than **10** feet-per-minute (fpm) may be required for large loads.

Note: Both of the above techniques allow the condenser coils to cool the vapor before it is lost. Vapor displacement works on the same principle that causes the level of water in a tub to rise when a solid object is placed in that tub. Vapors above the coils are more likely to diffuse out as they warm up, and they are more likely to be carried out by drafts or by parts being withdrawn.

Emissions Due to External Drafts

Reduction techniques

(1) **Avoid using lip vents, or keep vents turned off.** A degreaser without lip vents (or vents turned off) will have 15% less solvent emission than a degreaser with a vent. — 15%

Note: Odors or high concentrations of solvent in the workplace generally come from liquid solvent dragged out on parts, splashed out by sprays, or leaked from external fittings. The lip vent will never capture these emissions. First, correct your procedures, and then use a lip vent only if additional protection for workers is needed Or use a lip vent in conjunction with a scrubber to limit emissions from your building. Then, ifpossible, compensate for the higher vapor losses by adding freeboard to your degreaser.

(2) Eliminate external drafts around the degreaser. The effect on solvent emissions from a degreaser after eliminating external drafts from fans and ventilators (possibly the chiller fan), compared to a degreaser exposed to drafts, was not measured. — unknown

Note.- The effect will depend primarily on the speed and direction of the draft. Use the lip vent estimate described above as a point of comparison. To reduce or eliminate drafts, redirect air away from degreasers, consider placing baffles around the degreaser or between the degreaser and the draft source, or eliminate the source of drafts.

Emissions Due to Internal Drafts

Reduction techniques

(1) **Slow the speed at which parts are moved.** Parts moved through the vapor zone at speeds of 10 fpm vertically will have emissions that are 30% less than parts moved at 20 fpm. — **30%**

(continued)

Estimated
% Reduction

*Note: Manual moving of parts is typically in the 30-100 fpm range. **If** parts with large cross-sections are moved between sumps in a more sophisticated degreaser, horizontal speeds may be important also to avoid drafts. Slower speeds are recommended for very heavy loads to avoid vapor collapse.*

(2) **Keep large cross-sections of parts 50% smaller than the corresponding degreaser section.** The effect of emissions of parts with very large cross-sections in the direction of movement through the vapor zone was not measured. As a rule keep the cross-sectional areas of parts less than 50% of the corresponding degreaser section. — unknown

(3) **Sliding covers may reduce drafts and turbulence.** The effect of using a sliding cover compared with using a hinged, or lifting cover was not measured. Each time a hinged cover is opened, induced drafts and turbulence will carry out some vapor. The magnitude will depend primarily on how often the degreaser is uncovered and how fast air moves above the degreaser. If lip vents are used, place the sliding cover between the vent and the vapor. — unknown

Emissions Due to the Use of Sprays

Reduction techniques — Estimated % Reduction

(1) **Minimize the use of sprays, and keep sprays at temperatures near the boiling point.** Not using solvent sprays inside a degreaser will result in 30-50% less solvent emissions than if sprays are used. Minimize spray use and assure that spray temperatures are near the solvent boiling point - avoid cold sprays in a vapor degreaser. — ***30-50%***

Note: Use of sprays may indicate that either the solvent or the vapor degreasing operation is inadequate for your cleaning task - review your options. Sprays increase emissions by inducing drafts inside the degreaser, and the spray stream itself will carry air or vapor along with it. Cool or cold spray will condense vapors, thereby collapsing the vapor blanket and sucking air below the cooling coils. At a minimum, this air will carry some vapor out with it as the vapor blanket is reestablished and pushes the air out. (Note - as long as the vapor blanket is collapsed, the unit is not functioning as a vapor degreaser). Careless spraying can result in liquid solvent being splattered out of the degreaser entirely.

(2) **Keep the spray nozzle below the cooling coils.** Holding the spray nozzle below the cooling coils will result in 30% less emissions than if the nozzle is kept above the vapor blanket. — ***30%***

(continued)

Consider positioning the spray nozzle permanently below the coils and manipulate the part for cleaning.

Note: Drafts that are above the cooling coils in the degreaser are more likely to carry vapors out of the unit entirely.

(3) Use short spray bursts. Keeping spray bursts short will result in 15% less solvent emissions than spraying for intervals longer than 10 seconds. 15%

Note: Long bursts of spray induce larger drafts and are more likely to collapse the vapor blanket.

Reducing Solvent Emissions by Purchasing New Equipment

Reduction techniques

(1) **Superheat the vapor.** Raising the vapor temperature above its normal boiling point (superheating) will reduce emissions by 90% compared with having the vapor temperature at the solvent's boiling point. 90%

*Note: The elevated temperature allows parts to dry in the vapor zone completely and quickly. In a standard degreaser design, parts remain wet with solvent as long as they remain in the vapor zone Drying reduces or eliminates the need for a freeboard hold The superheated vapor temperature would typically be **150%** of the normal boiling point. Retrofitting an existing degreaser with superheated vapor may be possible in some cases.*

(2) Install freeboard cooling coils. Adding freeboard cooling coils (0°F) near the top of the degreaser will reduce idling losses by 15%. 15%

Note.- Freeboard coils are a second set of coiling coils placed in the freeboard zone, and are usually refrigerated. Freeboard coils decrease diffision by keeping vapors cold and heavy; heavy vapors are less susceptible to drafts. However, these coils add cost and dehumidify air in the freeboard zone. This additional water can overwhelm standard water separators, which can lead to solvent acidification, equipment damage, and high waste disposal costs. Make sure your water separator is adequate for the task, or better provide a second, large, water separator for the Freeboard coils.

(3) Install secondary condenser coils. For HCFC's (modelled using CFC-11 [a refrigerant]), adding secondary coils (0°F) just above the primary condenser coil (45°F) reduces CFC-11 idling losses by 70%. *70%*

(continued)

Estimated
% Reduction

(4) Install a third coil for dehumidification. Adding a third, dehumidification coil (0 °F) near the degreaser lip reduces CFC-11 idling losses by an additional 80%. **80%**

Note: DuPont (Ramsey, 1991) recently recommended a three coil system to control idling emissions from the new HCFC's. A main coil (T=5O°F) condenses most solvent. A second coil (0°F) overlaps or is slightly above the main coil and captures additional solvent. A third coil located near the lip of the unit dehumidifies the air, ***which*** *prevents ice build-up on the secondary coil.*

From this it can be inferred that for higher boiling halogenated solvents (e.g., CFC-113 or trichloroethane), the best coil configuration would be a dehumidification coil operating at the same temperature (0°F) as the main condenser coil to eliminate internal convection currents.

The information in this fact sheet is based on tests run by Branson, Inc. of Danbury, Connecticut, and E.I. DuPont De Nemours and Company of Willmington, Delaware, as well as tests compiled by the U.S. EPA. Branson directly measured solvent loss under various conditions intended to simulate typical industrial situations. Tests were run on both CFC-113 and l,l,l-trichloroethane. DuPont tests to measure idling losses were run using CFC-11 as a surrogate for HCFC 123.

Manufacturers of vapor degreasers and solvent are a good source of advice on emission reduction. The manufacturer of your equipment may be able to provide assistance in reducing the emissions from your specific unit.

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