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Vapor Phase Cleaning: How It Works and What Can Go Wrong

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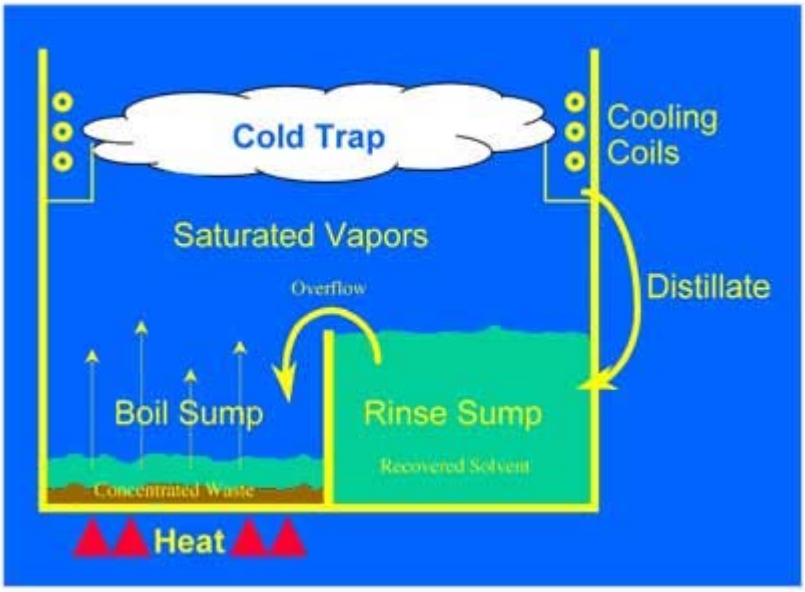
Vapor phase cleaning is an old technology which has recently seen a resurgence in popularity. The reasons for this change are beyond the scope of this article, but an equally important issue is the proper functioning of this simple cleaning system To function properly, vapor-phase cleaning has only two requirements: a temperature difference between the solvent vapors and the items being cleaned, and a solvent tailored to the contamination.



Vapor phase cleaning fundamental works by introducing solvent fumes, which are relatively hot, onto the relatively cool surface of an item being cleaned. The vapors are created by boiling the solvent in a sump at the bottom of the machine. The temperature difference causes the vapors to condense onto the part being cleaned just as water condenses on the outside of a cold drink. The liquid solvent dissolves the contamination without mechanical agitation. As more solvent condense, droplets form and drip from the item being cleaned back into the boiling sump, carrying the dissolved fluxes, oils or grease with it. Reheated in the boiling sump, pure solvent vapors are continuously regenerated for additional cleaning.

Obviously, in this type of system the vapors have a tendency to escape from

the confines of the cleaning tank like steam from a tea kettle. Modern vapor-type cleaning systems must be equipped with the appropriate features to minimize solvent losses. These features include designing taller machines ("freeboard") to help trap the solvent in the tank. At least one layer of condensing coils must ring the top of the tank, and the best systems offer additional layers of refrigeration that create a very cold, very dense barrier which traps the solvent vapors.

The process, while fundamentally simple, can be disrupted several ways. First, as the product is submerged in the vapors, it is warmed. Depending upon the mass of the item and temperature differentials, the item being cleaned can reach temperature equilibrium quickly. This ends the condensation process and cleaning stops.

To extend the cleaning process, solvents like 1,1,1-TCA or NPB which use higher temperatures may be selected. This uses more energy and increase operating costs, and higher temperatures increase the likelihood that the solvent vapors will penetrate through the cold barrier. Therefore, systems designed for the "high boiling" solvents as well as for "low boilers" with very high vapor pressures must have additional cooling coils to retain the solvent in the tank.

Often the solvent is insufficiently aggressive to clean the item passively, or at least to clean it before temperature equilibrium is achieved. Solvency can be enhanced with ultrasonic agitation, but this requires the item be submerged in the solvent momentarily. Ultrasonic enhancements are highly effective, but have the potential to damage to delicate components.

Cleaning also can be enhanced by spraying solvent onto the item with a convenient spray wand. Unfortunately, older or cheaper machines often provide wands which are too short requiring the operator to put their arm into the vapor barrier. This disrupts the vapor barrier and increases solvent losses. Spray wands also bring operator involvement into the process, which means the results will vary depending upon the enthusiasm or skill of the technician.

Any motion in the vapor barrier destabilizes the barrier. Solvent losses also

are increased by liquid solvent entrapped in nooks and crannies on the item being cleaned, known as "drag-out losses." Clever engineering and mechanical enhancements - such as sliding covers, automated programmable hoists, extended dwell times in the freeboard zone, and "super-heat" which moves the items through a super-heated zone 10-15° hotter than the vapors and thereby drying them - can minimize these losses.

For more details about easy, fast and convenient vapor degreasing and the solvents used in these systems, click to VertrelSolvents.com.

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Since MicroCare packages the electronics industry's broadest line of solvent alternatives, it is one of the few sources of unbiased, hands-on experience with all of cleaning chemistries ranging from old-style CFCs through to the newest formulations included in this report.

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- For additional information about the ozone-safe DuPont HFC solvents, check out the Vertrel® solvents web site.
- For other information about the Bromothane™ brand of nPB solvents, check out the Bromothane™ web site.
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