Tech Article

# Vapor Degreasing: An Economical Choice for Precision Cleaning

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*The internal workings of vapor degreasers tend to be remarkably simple, which is one characteristic that makes them so highly cost-effective. Crucial to the process is the selection of a nonflammable "low-boiling" cleaning fluid which makes the liquid-vapor-liquid cycle fast and reliable.*

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In the finishing industry today, the most common precision cleaning system is based on water technology. This is understandable, because aqueous cleaning has become a tried-and-true process since the elimination of common vapor degreasing solvents due to suspected ozone depletion. But aqueous cleaning systems tend to have large footprints, require significant capital investment, guzzle electricity at a prodigious rate, are maintenance intensive, and require processed water and waste-water treatment systems. Fortunately, there is another cleaning option, one from the history books. If you're willing to go "back to the future" it's time to revisit vapor degreasing.

Vapor degreasing was more widely used in the 1940s to clean automotive and aviation parts. However, it grew out of favor during the 1970s and 1980s due to the environmental and health concerns of the cleaning solvents used. Many manufacturers switched to water-based cleaning during the 1990s. However, better, environmentally-responsible cleaning fluids are here. So, many are looking to the benefits of vapor degreasing again.

## Cleaning with Vapors and More

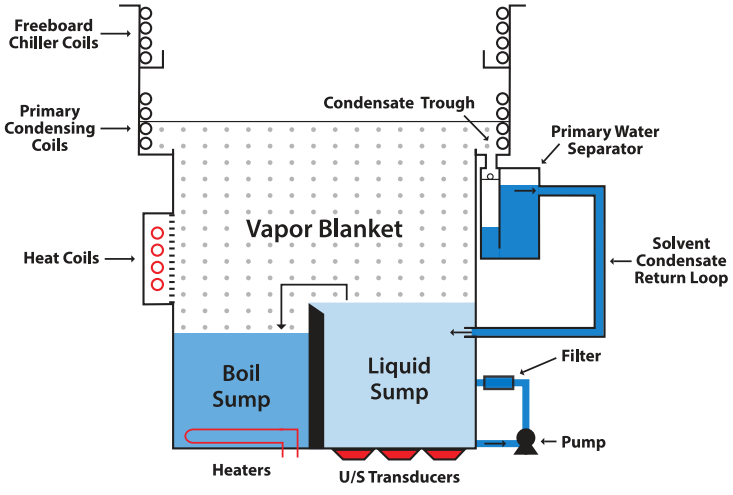
To a certain degree, the term vapor degreasing is a misnomer. Certainly, it is possible to clean in the cleaning fluid "blanket" of vapors, with the cleaning fluid vapors condensing to liquid on the part. But for faster, more reliable cleaning in the vapor degreaser, immerse the parts into the cleaning liquid. There liquid surrounds the parts, entering those nooks and crannies, maximizing fluid contact and cleanliness.

## How Vapor Degreasing Works

The concept behind vapor degreasing is very simple. A vapor degreaser boils a cleaning liquid into a vapor. It then contains the vapors, cools the vapors back into a liquid, and collects this purified liquid for continuous use. It is not only a cleaner but a continuously recycling system.

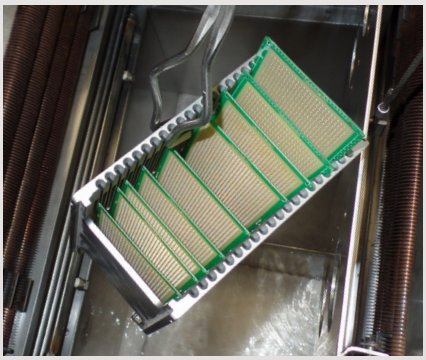
The cleaning fluid in the "boil" sump heats to its boiling point, usually 100-170°F, depending upon the cleaning fluid. The heat can be provided with electric heating elements, hot water coils, steam coils or the heat from a "heat pump" refrigeration unit.

### Simplified Schematic of a Modern Vapor Degreaser



*Dirty parts are immersed in cleaning fluid.*

*Vapor degreasing is ideal for cleaning heavily soiled, complex parts.*



*Vapor degreasing is used for cleaning electronic circuit boards.*

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**Little Energy to Heat**

It's noteworthy that even a small water-cleaning system will consume considerably more energy in heating the cleaning solution than a vapor degreaser of comparable capacity. This is because water has a much higher "specific heat" and a much higher "latent heat of vaporization" than vapor degreasing cleaning fluids. This fundamental characteristic of water also explains why it takes so many BTUs to dry the parts after they have been cleaned in an aqueous system. In contrast, some small vapor degreasers operate on 120v power supplies.

Once boiling, the cleaning fluid produces a clear, dense vapor that rises through the machine, displacing the air in the degreaser. Eventually the vapors rise up and reach the lower set of cold coils, called the "primary condensing coils." These coils chill the cleaning fluid vapors and condense it back into its liquid state. This liquid drips into a condensate trough that is under the primary condensing coils and around the interior circumference of the machine. There it routes through a water separator, decanting any water that may have condensed on the condensing coils and removing it from the solvent.

**Recycle and Reuse**

At this point, the distilled cleaning fluid directs back into the "rinse sump" from the water separator. Since the rinse sump already is filled with clean fluid, the addition of clean, newly distilled cleaning fluid causes the sump to overflow into the boil sump. This completes the distillation cycle. This addition of this fresh, pure fluid maintains a consistently clean rinse sump. It also washes contamination and particulate back into the boil sump and concentrates there.

**Equipment Considerations for Enhanced Cleaning**

Numerous options are available which make this process even simpler, cleaner, and faster. The rinse sump has a circulating filtration system to remove insoluble contamination (particulate). A common option is for the rinse sump to be fitted with ultrasonic transducers to enhance cleaning. Automated hoists can not only free up technicians from lifting parts in and out of the system, but ensure the proper cycle time and part movement takes place which can lead to reduce solvent use and more consistent cleaning.

**Minimizes Fluid Diffusion**

Another important feature of modern vapor degreasers is the second set of cooling coils, located above the primary condensing coils. They are the "freeboard chiller coils". The freeboard chillers lower the temperature and humidity of the air above the vapor blanket. These coils are always colder than the primary condensers, but usually around -20°F. The purpose of these coils is to cool and dehumidify the air above the vapor blanket in order to minimize cleaning fluid diffusion from the saturated vapor blanket into the air thereby minimizing cleaning fluid losses. In addition, since the freeboard chillers dehumidify the area above the vapor blanket, minimal water condenses on the primary condensing coils, which helps maintain solvent integrity.

### Reduces Drag-Out Fluid Consumption

Lastly, another option in the degreaser is the installation of “super-heated” coils. These coils superheat the vapor blanket above the “normal” boiling point of the cleaning fluid. This superheated vapor quickly heats the freshly-cleaned parts. This assures that all the condensed fluid on the parts is vaporized and recovered under the vapor blanket. This process guarantees that the parts are dry before being removed from the system. This minimizes solvent drag-out and cleaning fluid consumption.

### A Good Investment

There are many manufacturers of vapor degreasers world-wide. Depending upon the size and features, popular new vapor degreasers start at $15,000 and go up from there. Depending on the cleaning application and unique process requirements, the technology exists to handle the largest parts and highest volumes. These large machines, when properly designed, operated and maintained are extremely efficient with minimal solvent consumption. Pound for pound, nothing out-performs the cleaning efficiency of a modern, tight, vapor degreaser.

### Comparing Costs: Water or Cleaning Fluid?

Despite the historically proven performance advantages of a vapor degreaser, many engineers worry about the operating costs of a degreaser. After all, water is typically inexpensive while ozone-safe cleaning fluids cost $1,500-$10,000 per drum. Can vapor degreasers truly be less expensive to run than water cleaning systems?

### Lowest Cost-Per-Part-Cleaned

The answer is unequivocally yes. The best way to evaluate the operating costs of different types of cleaning systems is to compare them. Compare them on a cost-per-part-cleaned basis. This provides an apples-to-apples comparison that can illuminate the hidden costs of water cleaning.

### Capital Investments

First, tabulate the acquisition and installation costs. Included among these are direct capital costs of the cleaning system (the hardware itself and the support systems). Plus, waste water treatment systems, and so on. In addition, the indirect capital costs (the floor space, upgrades to the facility’s electrical system, plumbing costs, etc.).

### Operating Costs

The next step is to estimate the direct operating costs for both systems. This includes the cleaning fluid or water costs. Plus, energy costs, labor costs, waste disposal costs, inventory costs that change due to faster or slower cleaning cycles, and any other direct expense that touches the cleaning system. Engineers also will need to take into account the personal time needed to operate and maintain the cleaning equipment. Vapor degreasers typically are almost maintenance-free; aqueous systems can be much more complex and time-consuming.

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## Why Consider Vapor Degreasing?

**A properly designed, operated and maintained vapor degreasing process offers many advantages**

- Use minimal floor space
- Minimize energy consumption
- Minimize cleaning fluid consumption
- Distill and recycle the cleaning fluid for continued use
- Minimize waste disposal
- Minimize chemical exposure
- Provide consistent, reproducible cleanliness performance
- Completely automated
- Easy to maintain
- Does not require a chemist to run
- Easily cleans complex configurations
- Provide the lowest cost per part cleaned

### Cleaning Fluid Cost

Then there is the cleaning fluid cost. Evaluating the cost of the cleaning fluid is simple. The proper way to estimate solvent costs is not to compare the cost-per-pound, but to compare the cost-per-part-cleaned.

For example, a modern vapor degreaser will use approximately 0.062 pounds of cleaning fluid/hour/square feet of cleaning fluid/air interface when in use. A typical 10-gallon degreaser has about 2.5 feet of cleaning fluid/air interface. So, it will lose about 1.25 pounds of cleaning fluid in an 8-hour work day (less than a cup of cleaning fluid). If the cleaning fluid priced at roughly $3 per pound, the cleaning fluid cost for a day of cleaning is under $4 and the cost-per-part, assuming 1,000 parts were cleaned that day, is $0.00372 per part. When these costs are tabulated and then divided by the total number of parts cleaned by the system, the true cost of cleaning becomes apparent.

### A New Look at Vapor Degreasing

For decades, vapor degreasing has proven to be the most consistent and “head-ache” free cleaning process for the manufacturing engineer. Vapor degreasing has come full cycle. Many engineers have realized that it is a safe, economical and environmentally-acceptable cleaning method.

Energy demands and new environmental concerns are local factors generating an increased interest in the vapor degreasing process. If a current aqueous cleaning system is reaching the end of its life cycle, now is the time to explore vapor degreasing as an alternative in your manufacturing plant.

### Vapor Degreasing – a Process to Consider

In order to obtain the desired results in the most economical and environmentally acceptable manner, it is an imperative that the degreaser system be properly configured, operated and maintained. In addition to the hardware issues, the proper cleaning fluid selection requires careful analysis. It depends the contamination being removed. When analyzing the application, always define the soils first. Then select the chemistry that removes those soils. Lastly select the equipment that uses the chosen solvent properly.

It is clear that the revitalization of the vapor degreasing concept is here. In today’s world, quality, reliability and energy-efficiency are paramount. The old process of vapor degreasing meets this criteria. It is truly is a modern, planet-friendly, and cost-effective cleaning process to consider.

**About the author:**
*John Hoffman, Technical Consultant for MicroCare, has specialized in the field of critical cleaning for more than 50 years. He holds a BS in Chemistry from Rutgers, Philadelphia College of Textiles and Science (now Jefferson University). Hoffman helps companies update their critical cleaning processes to improve productivity and boost quality in a safe, and environmentally-acceptable manner. He is an expert on vapor degreasing, modern cleaning fluid technologies and thermodynamics. For more information, visit www.microcare.com.*

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