Tech Article

The Explosive Facts About Oxygen System Cleaning

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It is important to ensure all oxygen system components like pipes, hoses, tubes, regulators and meters are clean and dry to avoid potential explosion risks

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Liquid or gaseous oxygen system components are often soiled during manufacturing and must be cleaned and dried prior inspection, assembly and packaging. The slightest contamination or residue left on the systems' moving parts may cause friction. This friction could produce enough heat that when combined with access to a fuel source (residue) could combust, auto-ignite and possibly explode inside oxygen-rich systems.

Cleaning and inspecting components like hoses, tubes, pipes, regulators and meters is crucial for the medical oxygen system to perform safely and to comply with rigorous industry quality standards such as ASTM G93 - 03(2011) which is considered the Standard Practice for Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen-Enriched Environments.

Oxygen system contaminants typically fall into three categories. Organic hydrocarbon-based greases and oils. Inorganic pollutants such as nitrates, phosphates, water-based cutting oils and other acids and solvents. And lastly, particulates including but not limited to lint, dust or welding dross.

Multiple Cleaning Methods to Choose

Depending on the contaminants encountered, there are different ways to clean medical oxygen system components.

- Mechanical cleaning uses wire brushing, sandblasting or grinding to remove scale, paint, coatings or welding dross.
- Aqueous cleaning, with or without detergents and spray agitation, typically uses very hot water or steam to remove water-soluble contaminants. However, the detergent must be rinsed off and the parts dried before further processing.
- Alkaline or caustic cleaning using caustic salt dissolved in water removes grease, wax and hydrocarbon oils. The caustic solution is applied using swabbing, spraying or immersion, but the cleaning solution must be rinsed well to prevent parts damage.
- Vapor degreasing is a lesser-known but highly effective method for cleaning medical oxygen system parts. It is a simple thermo-mechanical process that boils and condenses a specially-engineered low-boiling, non-flammable cleaning fluid to remove parts contaminants. It cleans, rinses and dries parts in one machine making the cleaning process simple, repeatable and easy to validate.

Vapor Degreasing: A Better Cleaning Alternative

Vapor degreasing uses a closed-loop system containing two chambers, the boil sump and the rinse sump. The boil sump contains a low-boiling, non-flammable cleaning fluid. Parts are immersed and cleaned inside the heated fluid. Once cleaned, the parts mechanically transfer to the rinse sump for a final rinse and dry in more pure, uncontaminated fluid, or inside the fluid vapors themselves. In just 6-20 minutes the parts come out of the vapor degreaser clean, dry, and spot-free.

Choose the Right Vapor Degreasing Fluid

What really makes vapor degreasing optimal for medical oxygen system cleaning is the advanced cleaning fluids inside.

- *Excellent Materials Compatibility:* Modern vapor degreasing fluids are ideal

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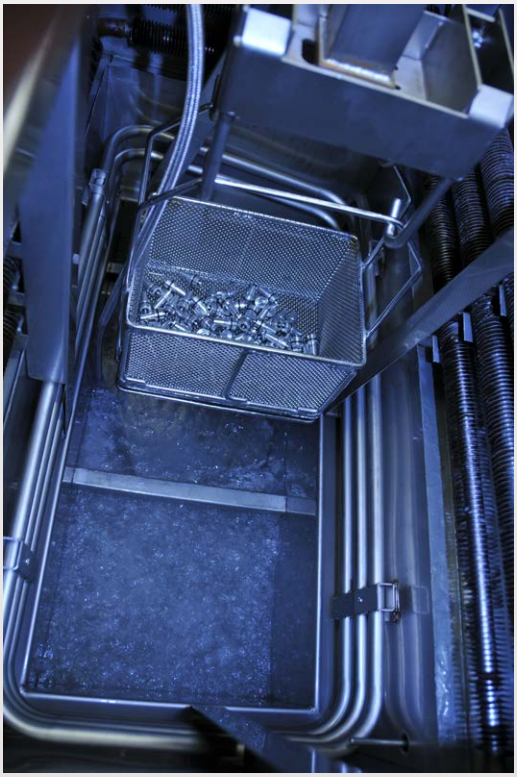
Vapor degreaser cleaning is a well-engineered process that is simple, predictable and repeatable



Vapor degreasers provide excellent cleaning results on parts of any size and almost any geometry

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for use on a variety of materials including stainless steel, copper, low carbon steel and plastics. They have a low boiling point and heat of vaporization which translates to greater safety for sensitive or delicate oxygen system parts like gaskets, seals and parts made from mixed materials.

- *Thorough Cleaning:* New, advanced vapor degreasing fluids have low surface tensions and are less viscous than water. This allows the fluid to easily flow through small, complex parts to clean them thoroughly, both inside and out. It also enables the fluid to flow back out from inside the components, preventing contaminants from getting trapped.
- *Sustainable Cleaning:* Vapor degreasing fluids traditionally used in production facilities include n-propyl Bromide (nPB), Trichloroethylene (TCE) and Perchloroethylene (Perc). Many manufacturers are actively searching for alternative fluids that clean just as effectively but without the worker safety or air quality concerns of the traditional solvents. There are several effective and sustainable options available that offer better worker exposure levels and feature low GWPs (global warming potential) and zero ODPs (ozone depleting potential) characteristics.
- *No Reside, No Rinsing:* Contrary to aqueous or caustic cleaning, solvent-based cleaning fluids do not require an extra rinsing step and since the cleaning fluids are water-free, they remove the potential for rust.
- *Hostile to Pyrogens:* Vapor degreasing does not use water, making it hostile to pyrogens. Water, and some of the detergents used with it, are a natural breeding ground for bacteria and mold. A minuscule amount of moisture left in hard-to-reach areas can encourage their growth and for this reason many medical oxygen system fabricators are turning to vapor degreasing and solvent-based cleaning fluids to minimize the bioburden risk.
- *Improved Workplace Safety:* Many modern vapor degreasing fluids are non-flammable for improved safety in the workplace by virtue of their azeotropic properties which ensures they are thermally stable and safe to use.

More Vapor Degreasing Benefits

- *Easy to Validate and Use:* Aqueous cleaning requires engineers to monitor and test to ensure the mixture of water, detergents, and other additives are consistent throughout the cleaning process. When modern cleaning fluids are utilized, there is no need for complicated process monitoring and controls at every stage in the cleaning process. Due to the fluid(s) ability to maintain purity levels, production managers get peace of mind that there is no variation in the cleaning fluid chemistry while simultaneously reducing process costs. Additionally, modern solvent-based cleaning fluids in a vapor degreaser offer advantages over older chlorinated solvent technologies by eliminating stabilizers and/or acid acceptance testing.
- *Cleans Components of Any Size:* Vapor degreaser fluids provide excellent cleaning results on parts of any size and almost any geometry. One vapor degreasing machine is adaptable to can clean a variety of valves and control devices as well as finished assemblies ranging in size from small to quite large and in quantities from single parts to multiples. As a general rule, if the part (or finished assembly) fits into the vapor degreaser, the part can be effectively cleaned. Most parts are cleaned without the need for special fixturing (other than a basket to hold the parts) which means that a wide variety of part geometries and part sizes can be accommodated with minimal set up complexity.

Ask for Help

Cleaning medical oxygen systems made to transport and store pure liquid or gaseous oxygen requires the greatest care and attention to safety. Any particulate or residue contamination could cause a catastrophic explosion within the system. Small and complex tubing, gages, pumps, filters and valves can all entrap contaminants, making cleaning them a challenge. Contamination varies widely: from simple particulate to difficult grease, wax and oil residue. Vapor degreasing using modern, nonflammable vapor degreasing fluids is an excellent method to effectively clean these soils and reduce the potential for fire or explosion when exposed to oxygen-rich environments.

Microcare can help those looking for help in selecting the best nonflammable, fast-drying and residue-free cleaning fluids. We can help determine which vapor degreasing fluids will work best on specific soils and substrates.

About the author:

Elizabeth Norwood is a Senior Chemist at MicroCare, LLC, which offers precision cleaning solutions. She has been in the industry more than 25 years and holds a BS in Chemistry from the University of St. Joseph. Norwood researches, develops and tests cleaning-related products. She currently has one patent issued and two pending for her work.
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