

## How the Right Chemistry Can Help You Improve Your Parts Cleaning

**Joe McChesney**

*KYZEN Corporation*

Nashville, TN, USA

### INTRODUCTION

In an industry where production time, volume and quality are critical, it's increasingly important to ensure metal parts obtain desired results and meet specifications established. Since metal parts cleaning is fast becoming the industry standard, facility managers must become well versed in the extensive cleaning processes and chemistries available that will provide the performance level required. It is essential for facility managers to learn the differences between aqueous and solvent cleaning solutions and the advantages and disadvantages of using each approach.

### CHEMISTRY FIRST

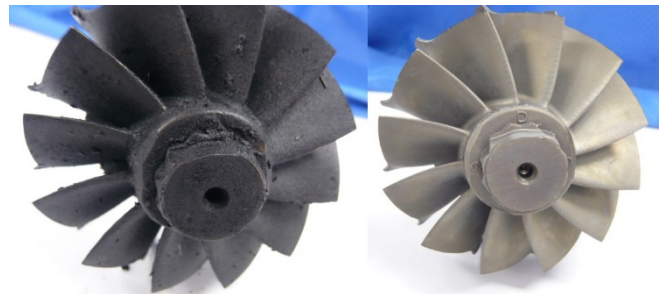
For a chemical process to take place, it must include: *cleaning solution, soil compatibility, solution concentration, solution temperature, proper exposure period and required mechanical action*. Cleaning performance is directly related to the selection of the cleaning equipment and proper chemical process. It takes the correct combination of all these ingredients to achieve maximum results for production, quality, personnel safety and environmental requirements.

To effectively use a cleaning chemistry, a facility manager must understand the benefits and guidelines for using cleaning solutions in conjunction with available cleaning systems.

Metal parts need to be cleaned to:

- Remove oil, chips and other soils before moving to the next operation
- Prepare metal parts for coating or plating
- Meet inspection and cleanliness specifications
- Prepare for packaging/assembly

Figure 1 - Before and After



Soils and contaminants must be removed in order to meet these types of guidelines set by manufacturers:

- Critical performance
- Reliability
- Process requirements
- Personnel Safety

Recent increased demand for quality and reliability calls for continuous improvements. Superior cleaning performance (aqueous or solvent) requires cleaning compatibility with substrates, process efficiency, environmental compliance, as well as worker safety (EH&S). (See cleaning process guide chart - Figure 2.)

**General Aqueous Cleaning** consists of blended water and water soluble chemical components. These compounds can include additives (surfactants, solvents, acids, alkaline building agents & inhibitors) to enhance the process performance or meet specific needs. Ideal compounds are rated as low or no VOC (*volatile organic compounds*), not HAPs (*hazardous air pollutants*), non-flammable or combustible and not GWP (*global warming potential*). Normally diluted with water between the chemistry ranges of 2-15%, these cleaning products rinse easily with water. There are numerous of these products on the market, and they are generally designed for use with all types of spray and immersion washers. Some companies add the use of ultrasonic cleaners or other types of mechanical action to enhance particulate removal.

**Aqueous Cleaning Chemistries Include:** Emulsifiers, Non-Emulsifiers (oil splitting), Acidic (pH <4), Mild Alkaline (pH 9-12.5), Neutral (pH 4-9) and High Alkaline (pH >12.5).

No cleaning machine will perform properly without the appropriate chemical process (cleaning solution, solution concentration, solution temperature, proper exposure period and any required mechanical action). It takes a combination of all facets to achieve maximum results for production, quality, personnel safety, and environmental compliance.

Typical **Aqueous Cleaning Systems** are designed to match process needs:

- Production volume, parts geometry, parts size and material handling
- Type of chemicals to be used (alkaline/neutral/acid)
- Soils removal
- Waste streams – wash tanks
- Waste stream – rinse tanks
- Foot-print and/or floor space
- Energy requirements

When selecting cleaning equipment to provide appropriate mechanical and thermal energy, some features should be considered:

- Cleaning = Time + Temperature + Mechanics + Chemistry
- Recycle – recirculate wash solution
- Multiple rinse stages
- Drying system design vs throughput!
- Centralized Unit vs cellular

Figure 2 – Cleaning Process Guide



Figure 3 – Parts Cleaning Spray



Consider developing a matrix (See figure #4) to identify the best option for your manufacturing application.

Figure 4 – Chemistry Type Matrix

CLEANERS	SOIL TYPE				MATERIAL			PROCESS				
	OILS / COOLANTS (POLAR)	OILS (NON-POLAR)	CARBON / SMUT / OXIDES	LAPPING / BUFFING COMPOUNDS	STEEL / MAGNESIUM / TITANIUM	ALUMINUM / ZINC / DIE CAST	BRASS / COPPER / BRONZE	SPRAY SYSTEMS	ULTRASONIC CLEANING	IMMERSION WITH AGITATION	VACUUM VAPOR DEGREASING	CORROSION PROTECTION INCLUDED
Insert Chemistry Type	•	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•	•

**General Solvent Degreasing** is an existing process many manufacturers use today. Today’s cleanliness specifications for precision and critical cleaning indicates that most metal parts cannot have any contaminant residue or rinse water residue on the end product, thus increasing the interest in solvent cleaning agents.

It’s important to note that the use of solvent in manufacturing is growing. In addition to the cleanliness specifications mentioned above, solvent cleaning is increasing due to superior performance when compared to the inability of water to properly perform in certain criteria, component spacing and restrictive drying process. Materials compatibility is similarly a major area for concern where solvent is superior!

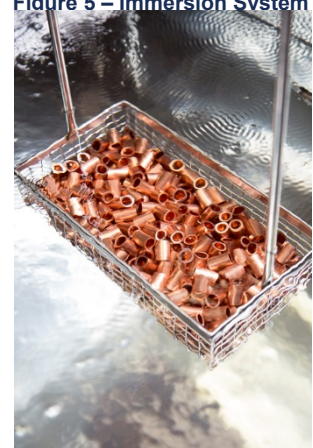
Unlike aqueous cleaners that must be matched to specific process substrates, solvents can generally offer:

- Multi-metals compatibility
- Multiple elastomers compatibility
- Multiple lubes removal compatibility
- Ease of application
- Assured drying
- Very low surface tension
- Lower energy consumption therefore lower cost of operation
- Less floor space requirement

**New Solvents vs Old Solvents**

There are several commonly used solvents in the industry. They range from low to high operational temperatures and types of chemical composition such as chlorinated, brominated, fluorinated, alcohols, and others. The main difference is environmental and health characteristics of the solvent. Most solvents (old and new) will clean; however, numerous solvents are being phased out or are becoming more regulated by the government because of personnel exposure limits and air emissions. Users today are evaluating these new options in order to provide a safer workplace.

Figure 5 – Immersion System

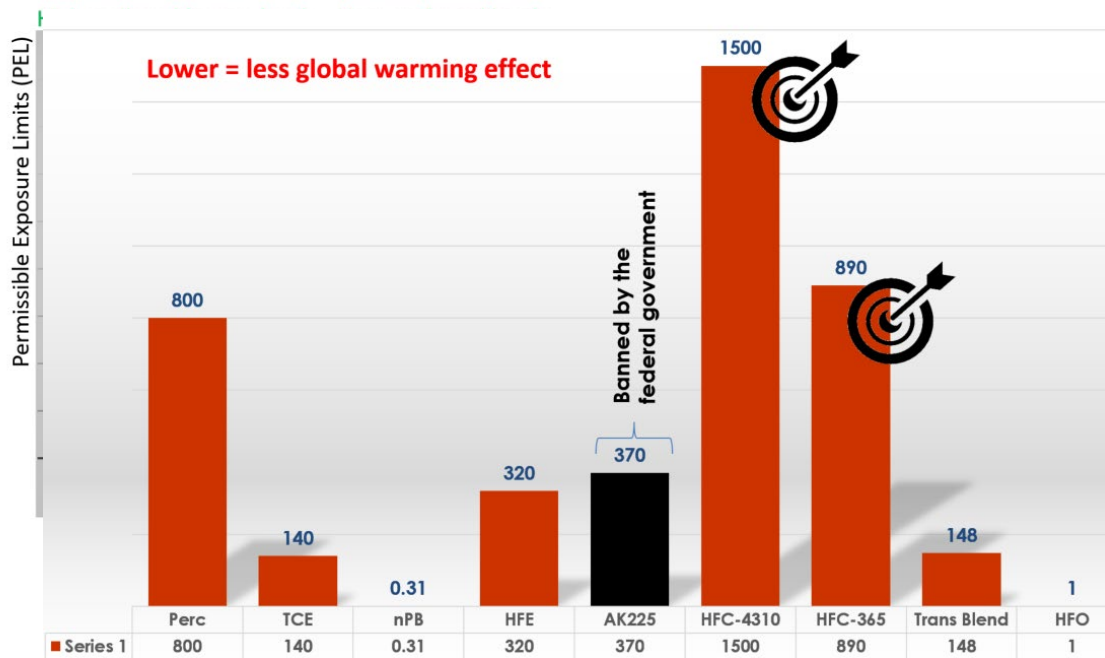


Based on regulatory concerns, many chemical manufactures have devoted resources to research and development. Recently a new generation of solvents emerged in the market. These new chemistries offer the following improvements:

- Favorable environmental properties
- Operational temperature (lower = less energy consumed)
- Global warming potential rating (reduced global warming effect)
- Surface tension (wettability)(lower = better penetration/fast drying)
- Personnel Exposure Limits (OSHA)(higher = safer workplace)

Refer to figure 6 to compare typical solvents in today’s market.

Figure 6 – Chart



**Emerging new solvents** that contain no chlorine, bromine, or fluorine are called “modified alcohols” and “refined hydrocarbons”. These solvents are used in vacuum degreasers which drastically reduce solvent consumption as well as offers the operator maximum isolation from the process. These units are the lowest emissive loss degreasers currently available in the market.

Highest Rated New Solvents are based on:

- Highest PEL limits for personnel safety
- Lowest Global Warming Potential
- lowest surface tension
- VOC FREE or very low rating
- Non-flammable
- Carbon footprint contribution
- Operation temperature
- Multi-metals/lubes compatibility
- Rapid drying – generally residue free
- Stability

Recommended New Solvents based on highest rating taking several factors into consideration (no particular order): Modified Alcohols, HFOs, HFEs, Refined Hydrocarbons and Trans Blends. **Note:** each solvent has different characteristics that need to be carefully reviewed to meet specific applications and process specifications.

**Choosing Aqueous or Solvent Process** is the metal parts manufacturer's choice, but "the right chemistry" will help you improve your parts cleaning. Many characteristics and different aspects have to be evaluated. It is recommended that before selecting a new process, compatibility and efficiency testing should be performed. In some cases, one process is generally perceived or proven as superior based on several different inputs; however, tests could indicate that process isn't the most appropriate for your manufacturing needs.

**Get Informed!** There is an abundance of information available and easily accessible in today's world to consider the best cleaning method to suit manufacturer's needs. From government resources, environmental organizations, equipment and chemical suppliers, to technical papers and consultants. Many companies will perform cleaning analysis of your parts using a specific process to verify the results before you make a commitment. Use these resources to supplement your decision!