



How To Reduce Steps Required In Non-Ferrous Surface Finishing by Mike Valenti

TECHNICAL WHITE PAPER

Title: How To Reduce Steps Required In Non-Ferrous Surface Finishing

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I. Introduction

The cleaning and surface preparation of non-ferrous, “soft” metals can require multiple and complex steps. Manufacturers using these alloys continue to require more efficient and less complex processes.

This white paper will demonstrate how a novel new type of chemistry can have a positive impact on process improvements through all steps of an operation including cleaning, brightening, waste treatment, and maintenance of equipment. It will further demonstrate the ability to eliminate certain process steps traditionally needed to achieve the desired finish.

For purposes of this paper we consider the following alloys:

Copper Alloys	Aluminum Alloys
99.9% Copper	1000 Series
Beryllium Copper (97.75% Cu, Be 2.0%)	3000 Series
Yellow Brass (65% Cu, 35% Zn)	5000 Series
Cartridge Brass (70% Cu, 30% Zn)	6000 Series



II. Challenges Finishing Copper and Aluminum

The finishing of parts made from various copper and aluminum alloys traditionally require many distinct and separate process steps, and both come with their own unique needs. Below we discuss the specific challenges that come with finishing copper and aluminum.

Copper Alloys

- **Cleaners** - Most brass and copper processes currently utilize alkaline (pH over 7.0) based cleaners. While very effective at removing lubricants, oils, and metal shavings, these do not offer any ability to remove surface tarnish or add brightness to the parts. Traditional acid based cleaners are typically not effective at removing these soils.
- **Deoxidation** – Acids are used to deoxidize brass alloys. Organic acid salts and/or strong mineral acids are normally used.
- **Brightening** – For parts requiring a high luster or more polished look, strong mineral acid bright dips, or peroxide based chemical polish is required.
- **Final Seal** – Copper and its alloys are highly susceptible to tarnish so a seal or anti tarnish is needed to preserve the finish.
- **Waste Treatment** – While not an actual step of the parts finishing process, the waste treatment process can be greatly affected by the chemistries used, and copper waste generated.

Aluminum Alloys

- **Cleaners** – Aluminum parts can have difficult lubes, oxides, and finely divided aluminum that must be removed.
- **Etching/Smut** – Heavy Alkaline or Mineral Acid based processes can lead to over etching or smut. Smut removal requires additional steps using Nitric Acid

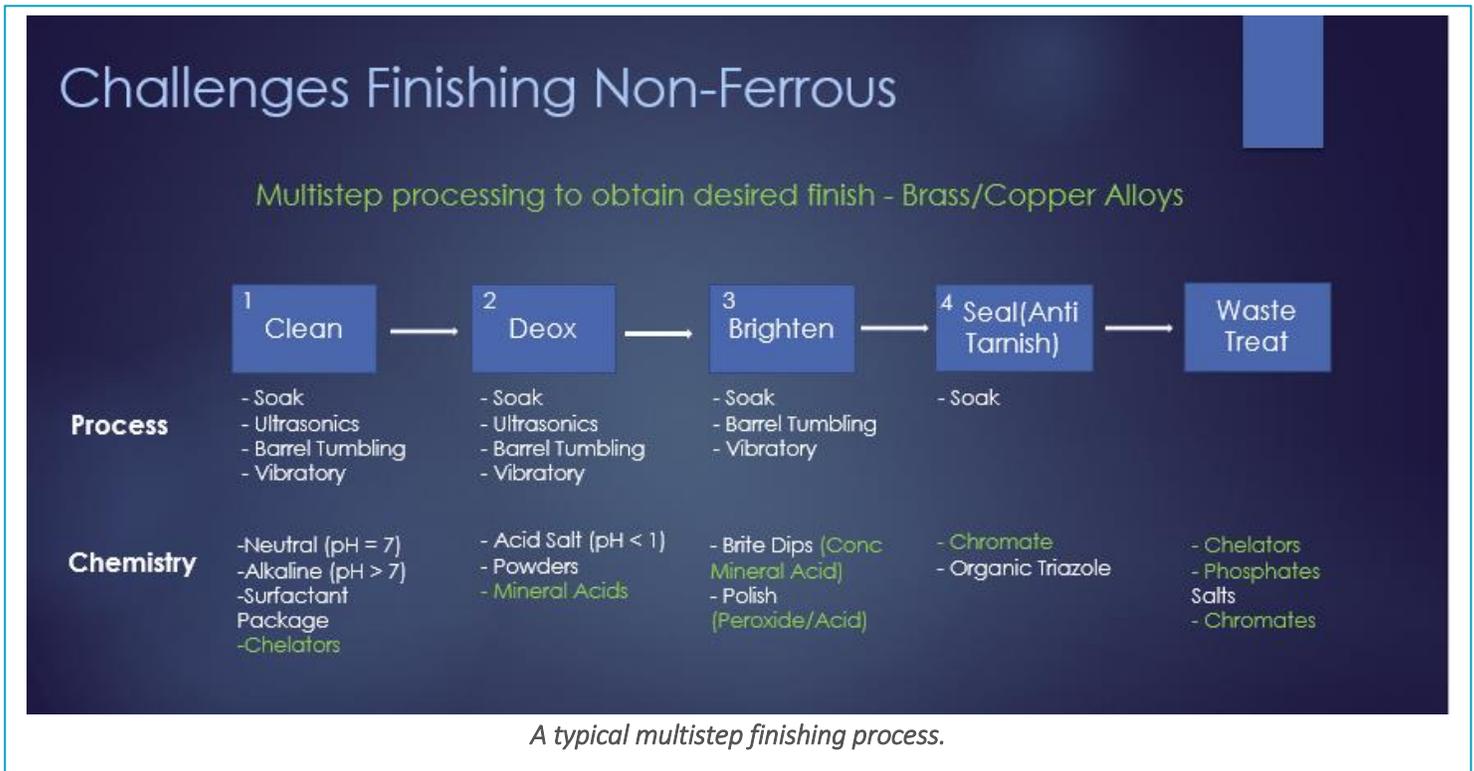


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- **Equipment & Waste Treatment** – Silicates used in typical aluminum cleaners can reduce etch and smut, but contribute to scale build up in equipment and waste treatment problems.

One of the most challenging soils to remove from aluminum are lubricants made from stearates. These stearate lubes can react with aluminum during high energy processes such as impact extrusion (deep drawn) making them problematic.

Stearate contamination can lead to discoloration during heat treat steps, and adhesion issues during coatings or printing processes.



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Challenges Finishing Non-Ferrous

Example: Chemical Polish Line - Brass/Copper Alloys



A closer look at the chemical polish line process.

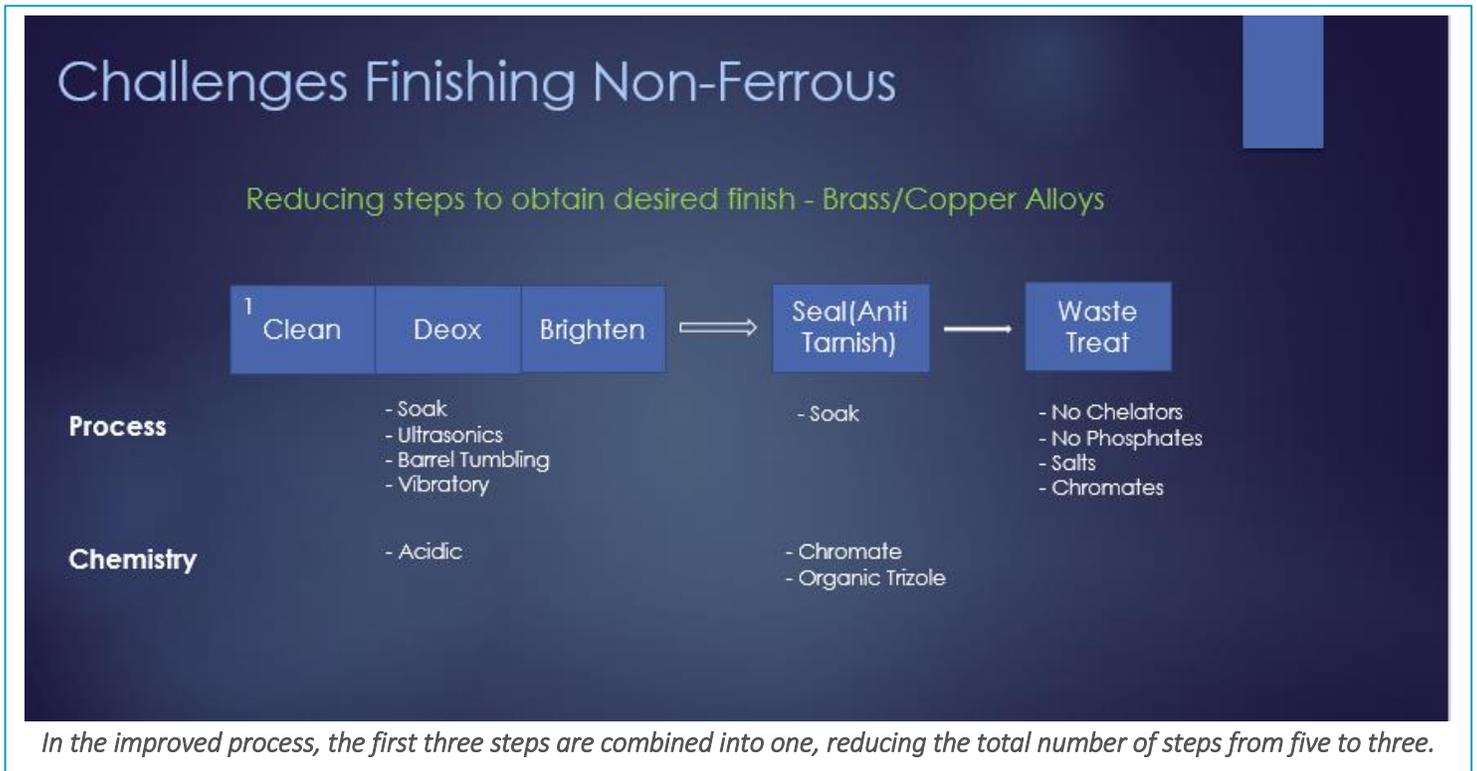
While these process steps have been proven over time to effective they present the following challenges:

- Many steps result in higher probability of a problem down the line, such as contamination and maintaining clean rinses.
- Handling of more hazardous chemistries. Concentrated mineral acids (sulfuric and nitric acids), fumes, peroxide stability, powders, and dust. Copper, zinc, and lead contamination in cleaner tanks requires chelators to prevent redeposition on parts and reduce scale buildup. These problems require more frequent tank dumps and maintenance. Over etching of parts that results in rejects.
- Chelators interfering in waste treatment operations. Offsite waste disposal costs.
- Phosphates from cleaners.



III. Overcoming Challenges

We now have more novel chemistry available to overcome these challenges, resulting in more effective process improvements. This chemistry allows us to combine cleaning/deox/brightening steps and mitigate waste treatment problems.



Process improvements can and should be obtained by working on all aspects of an operation. In a metal finishing operation, the following offer the best improvements.

- New or Innovative Chemistry
- Improved Equipment
- Better Process Control

The focus here, however, will be on innovation in process chemistry.



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As mentioned earlier, **acid based chemistry** is a key component in the finishing of copper alloys. We need acids, but not all acids are created equal. There are two general classes of acids that can be used: **Mineral Acids (Inorganic)** and **Organic Acids**.

Mineral Acids	Organic Acids
Hydrochloric, Sulfuric, Phosphoric, Nitric	Acetic, Citric, Formic, Oxalic
Historically used for many deoxidation and brightening steps for Brass/Copper Alloys	Historically used for many de-oxidation steps for Brass/Copper Alloys
Formulated properly are excellent at deox/brightening	Formulated properly are good pickling/deox
High Ka Values, high dissociation in water	Low Ka Values, lower dissociation in water
Dangerous – Handling, Fumes, Safety Concerns, Disposal	Most are safe to handle, low fuming, powders
Low margin for error – Aggressive attack on alloy, difficult to control	Higher margin for error – Less aggressive attack on alloy, more forgiving
Application Specific	Application Specific
Hydrochloric, Sulfuric, Phosphoric, Nitric	Many chelate metals, problem for waste treatment systems



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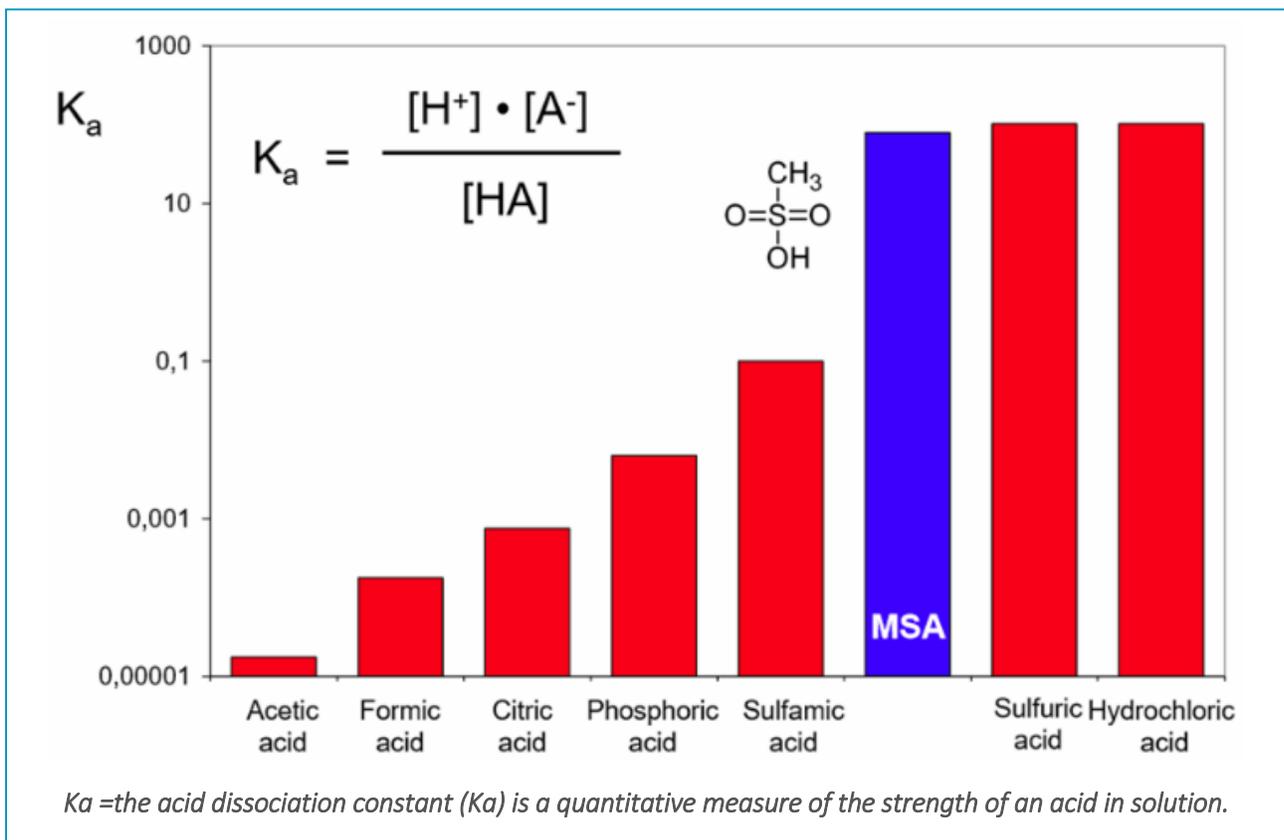


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There are some classes of Organic Acids that can give us the best of both worlds.

Sulfonic Acids and Methane Sulfonic Acid

Based on the organic functional group, $-SO_2OH$, Methane Sulfonic Acid can behave as a strong acid, similar to strong mineral acids, but without all the associated undesired properties and process problems.





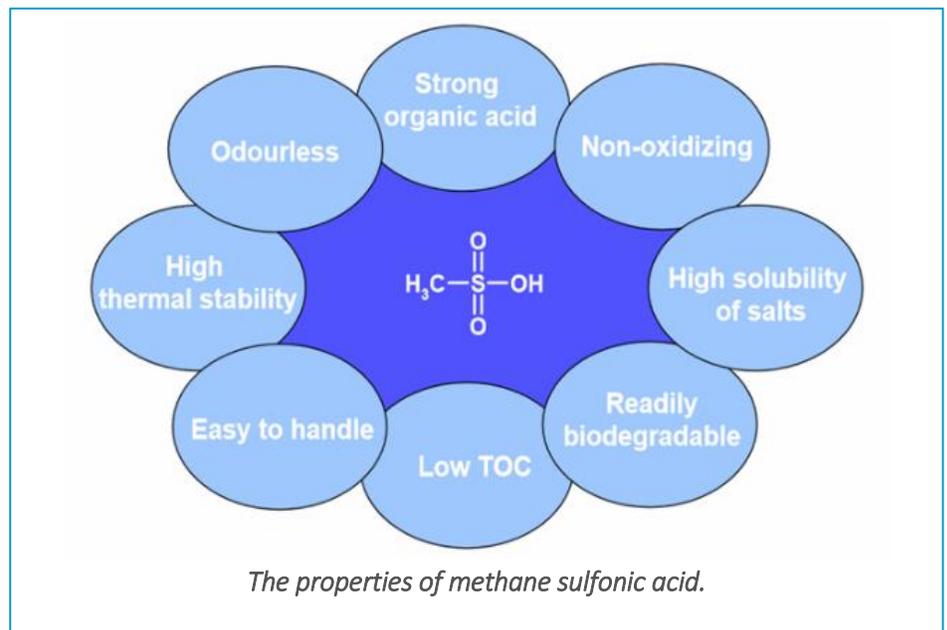
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Another key feature of methane sulfonic acid is that it does not chelate metals. This allows for spent cleaning solutions and rinses to be processed through standard waste treatment systems. Chelators can interfere with removal of metals from waste stream in a WWT system.

Hubbard-Hall's line of organic acid cleaners works to clean, deoxidize, and brighten while reducing the stages in the cleaning process. They are optimized to clean

- Forming lubricants
- Machining oils
- Light oxidation
- Scale from metallic parts

These products are highly concentrated and contain no mineral acids, chloride, citric acid or other chelating agents. They possess high detergency, are a DfE approved wetting and solvent system, and readily dissolve metallic soaps.





IV. Case Studies

This section details three customer experience case studies wherein the cleaning process was improved by using Hubbard-Hall's organic acid cleaning products.

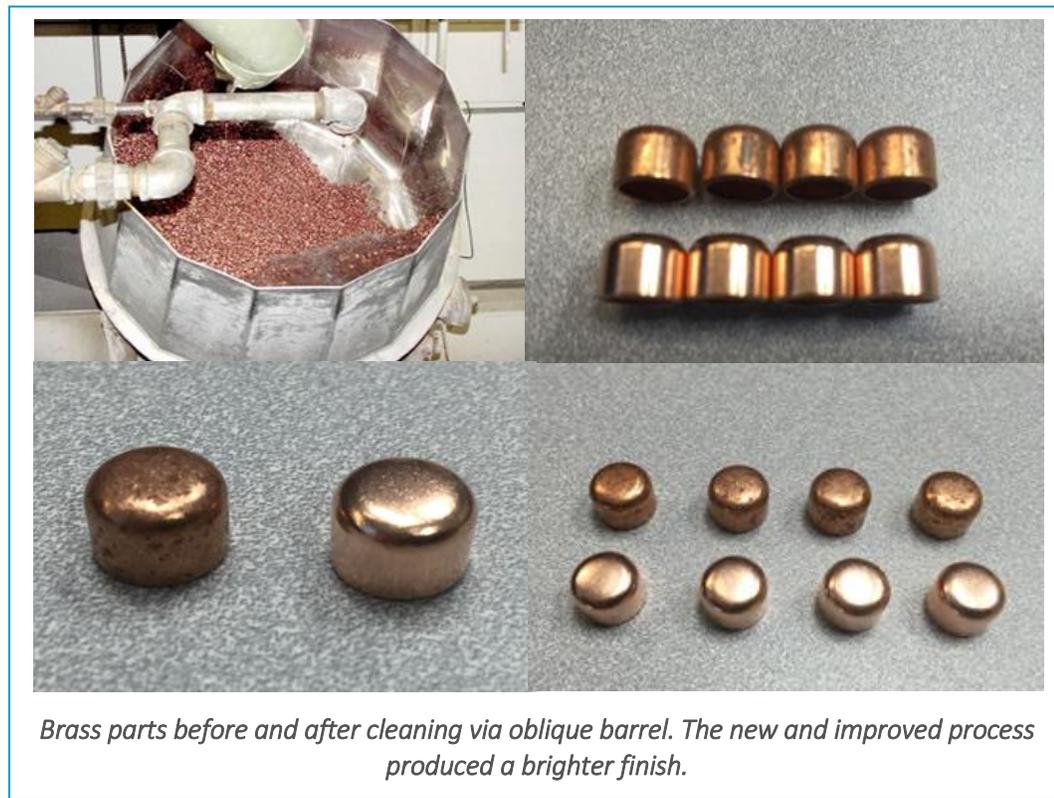
Case Study 1: Cleaner/Brightener formulated with Methane Sulfonic Acid, Cartridge Brass

This customer was an ammunition manufacturer seeking to optimize their cleaning process.

- **Standard Process:** Oblique Barrel, 4 Chemicals, 8 Steps
- **Improved Process:** Oblique Barrel, 1 Chemical, 4 Steps

Discovered Benefits:

- Productivity Improvement
- Cleaner/Brighter Parts





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Case Study 2: Cleaner/Brightener formulated with Methane Sulfonic Acid – Machined Brass

Prior to the introduction of a Hubbard-Hall organic acid cleaner, this manufacturer of machined brass plumbing fittings was dissatisfied with their cleaner, which had been causing multiple pain points during their process.



This manufacturer of machined brass plumbing fittings was dissatisfied with their cleaner.



Drag out of the oil saturated cleaner into the rinse tanks will result in oil in the rinse, which will redeposit onto the parts, causing dirty parts and plating issues. this manufacturer of machined brass plumbing fittings was dissatisfied with their old cleaner.

Standard Process:

- Clean, 5 stage washer and separate brightening process.
- Cleaner tanks dumped weekly – oil saturation, outside waste disposal costs.
- Waste could not be treated due to chelators in cleaner.

Improved Process:

- Clean and brighten in one process.
- Enabled waste treatment in-house.
- Methane sulfonic Acid is non-chelating, but makes highly soluble metal salts to prevent redeposition of Copper onto parts.
- Ability to split oils for effective removal from the process bath.

Discovered Benefits:

- **60%** Productivity Improvement
- **\$90,000** Savings In Waste Disposal
- Eliminated Waste Disposal Costs



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Case Study 3: Cleaner/Brighter formulated with Methane Sulfonic Acid – Impact Extrusion Aluminum (Deep Drawn Cans)

This manufacturer of rechargeable batteries was seeking a higher quality clean for the cans of their battery cans.



Standard Process:

- Immersion Washer with Ultrasonics.
- Strong alkaline (base metal attack) and silicated cleaners not allowed.
- Hard to remove stearate lubes, neutral phosphate cleaners not effective.
- Post heat treatment causes defects with improper cleaning

Improved Process:

- No base metal attack.
- High solubility of stearate lubes.
- Bright lustrous finish without attack or etch.
- No post heat treat issues

Discovered Benefits:

- Productivity Improvement

Quality Improvements



V. Conclusion

The surface preparation of Non-Ferrous metals such as Copper and Aluminum alloys can be challenging and complex. The advancements in organic acid cleaners can help reduce the challenges associated with these alloys and also produce better quality parts in your process.

This new organic acid chemistry technology when formulated correctly can contribute to significant process improvements:

1. Reduced number of process steps
2. Increased productivity
3. Quality improvements
4. Improvements in waste disposal and waste water treatment systems

Want to learn more? Visit our website or contact Mike Valenti today for all your questions on cleaning and brightening of non-ferrous metals: mvalenti@hubbardhall.com.

Want to see the new cleaning technology in action? Request a demo and send in your parts to have our cleaners tested on them in our state of the art labs. Read below to review the different products to choose from, and request a demo on our website [here](#).

Meet Hubbard-Hall's Family of Organic Acid Cleaners:

Our new family of organic acid products works to aid in this improved process, and is formulated for the following properties:

- Highly concentrated
- High detergency
- DfE approved wetting and solvent system
- Readily dissolves metallic soaps
- Contains no mineral acids
- No chloride
- Non-fuming
- No citric acid or other chelating agents





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This new line of cleaners offer three options based on your type of application: soak, spray or mass finishing (vibratory).

- [Soak Cleaner - Aquaease 2289](#): This is an acidic cleaner that is optimized for soak cleaning. Aquaease 2289 will not remove heavy scale from stainless steel alloys. Download the Aquaease 2289 product bulletin [here](#).
- [Spray Cleaner - Aquaease PLA 915](#): If you are looking for a low foam acidic cleaner, Aquaease PLA 915 is our recommended product. It is used for the removal of a variety of soils and oxides. Download the Aquaease PLA 915 product bulletin [here](#).
- [Mass Finishing \(Vibratory\) - Lusterbrite CBA](#): Lusterbrite CBA is a liquid cleaner-burnishing compound especially formulated for both conventional barrel and vibratory finishing operations. Download the Lusterbrite CBA product bulletin [here](#).



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