Mass Finishing Review: Burnishing

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This is perhaps the most popular mass finishing application. Process attributes include:

- Applicability to all base metals, stamped, drawn, molded parts.
- Produces a bright, smooth, highly reflective surface.
- Removes surface organic soils and scales, facilitating surface preparation before a plating cycle.
- Can be non-aggressive, where there is very little metal removal from the surface.
- The focus is honing and removing surface imperfections.
- The base metal surface is leveled and polished prior to additional finishing.
- Improves brightness and leveling of the plated finish. In some instances the plating deposit thickness can be decreased.

Burnishing can be quantitatively expressed as a measure of the distance between high and low points on a metal surface (peaks to valleys). This can be instrumentally measured and interpreted as an RMS (root mean square). The lower the RMS value, the flatter or more leveled the surface. For example, an RMS value of 1 describes a more highly burnished surface than one having an RMS of 5.

There are two classifications for burnishing:

1. *Burnishing*. Parts are processed with either ceramic or porcelain media, or without media (part on part). The expected finish is for general brightening and leveling.
2. *Ball burnishing*. Parts, usually softer metals such as aluminum and brass, are processed with case-hardened steel or stainless steel media, producing maximum brilliance. This can be accomplished before transfer to a plating cycle or after plating, to improve the final luster of the finish.

Shine rolling is another mass finishing process that has some similarity to burnishing. In shine rolling, parts are usually processed without media for purposes of deburring and enhanced luster.

Burnishing compounds are available as powder and liquid concentrates. Effective burnishing compounds should contribute these operating benefits:

- Provide a thin lubricating film. Lubricity is very important.
- Water hardness tolerance
- pH buffered for the application
- Rust and corrosion inhibition
- Flexible foaming characteristics (high and low)

Active components of the burnishing compound work on the part surface, leaving a residual film. This is usually seen by the water break condition after post-burnishing rinsing. Standard soak cleaning should remove this film as part of a surface preparation cycle before plating. Application features for burnishing systems vary somewhat between liquid and powder concentrates:

Application: *Liquid type*

- Significant handling and control benefits in flow through vibratory systems.
- Easily used in horizontal and oblique barrels.
- Can be metered as pre-diluted or in ratio with water.
- The working solution concentration may range from 0.5 to 2.0 vol%.
- In vibratory equipment, the solution works through the load and drains out at a continuous flow rate of 1 to 5 gal/ft^3/hr.
- Per the surface finish requirement, the solution pH may range from 3 to 11.

A liquid system offers several benefits. Direct handling of the concentrate is minimal, benefiting worker safety. In some applications a sufficient amount of product may be consumed, permitting the use of returnable containers, such as totes, thereby eliminating packaging disposal requirements. The concentrate as a pre-diluted working solution, is metered in at a fixed rate, continually delivering fresh, active working solution to condition the parts. Equipment requirements are rather simple. The drum or tote of concentrated stock solution is connected to a calibrated pump, set to deliver the prepared solution at the preferred flow rate, diluted with the required volume of water. Depending on desired quality and effectiveness, the "one pass" solution may be recycled, until determined to be spent. Other than the enclosed horizontal barrel, parts can be easily sampled to examine progress of the cycle. In horizontal barrels, the concentrate is added along with water and the optional media. Final preparation is made before the barrel burnishing cycle begins. All the benefits and simplified operation are contingent upon proper cycle development. This is true for any mass finishing cycle.

Application: *Powder type*

- Preferably added to horizontal and oblique barrels. The use in vibratory equipment is compatible, especially for shorter cycles.
- Addition rates of 1 to 4 oz/gal of burnishing compound per gallon of required water.
- Working solution containing parts and optional media tumble for a desired time.
- The working solution pH range may be mildly acidic, but usually more toward a pH range of 7 to 11.

The powdered burnishing compound is added new for each cycle run, thereby insuring fresh, optimized chemical mix to condition the parts. Powdered systems offer benefits in that particular active components may be formulated into the blend, exceeding the amount that can be dissolved into a liquid product. Soaps, certain conditioners and surfactants are some components affected in this way. Powdered burnishing compounds are equivalent in effectiveness to their liquid counterparts.

Trouble Shooting Tips

Problem	Possible Cause	Correction
Dull, hazy finish	Oil and grease in film	Preclean before burnish
Dull (no oily soils)	Scale	Descale first
Parts stained, rusty, tarnished	Insufficiently dried parts	Dry quickly after rinse
Media and parts float	Excess compound, water	Adjust concentrations
Parts cushioned	Excess compound	Adjust concentrations
Rust, corrosion	Very low compound conc.	Adjust concentrations
Scratchy, dull	Very low compound conc.	Adjust concentrations
Media, parts corrode	Very low compound conc.	Adjust concentrations

Handling, pre-dilution, metering and application is a benefit of the liquid burnishing formulations.

Additional facts

- Burnishing cycles typically range from 20 to 60 minutes. Longer cycles may be required based on specific testing and evaluation.
- Rust inhibitors protect steel parts. In particular, they protect steel media for long, dependable service life.
- Inhibitors prevent tarnishing and darkening of brass and copper alloys, as well as corrosion of zinc and aluminum.
- Acidic burnishing effectively removes smut and carbon deposits off steel after descaling and deburring, before the final burnishing treatment.
- Descale, de-tarnish, and burnish copper, brass and bronze in one step.

Media

Six shapes of case-hardened steel media are normally used: ball, ball cone, diagonal, oval, pin and wheat. The ball is best used, unless specific geometric shapes result in lodging or insufficient media to part surface contact. Keeping steel media clean and protected with a rust inhibitor will prevent pitting and rusting.

Ceramic and porcelain types are available in surface finishes that permit their use in deburring or descaling and burnishing, without the need to change the media. These types may exhibit a smooth, glazed surface, containing a fixed amount of selected abrasives. Different shapes preferentially work on and condition specific geometrically formed parts. Keeping the media clean is key to effective burnishing. In general, media-to-parts ratios of 10:1 to 20:1 are used in burnishing cycles. This, in relation to chemistry and concentration of the burnishing process and mechanical action of the equipment, are factored into optimum media-to-parts ratio.

Equipment

Horizontal and oblique barrels are charged with media, burnishing compound, and sufficient water. For many process cycles, loading the barrel to 50 to 60% of total capacity is sufficient. This loading and barrel speed are critical to obtaining the best slide zone. This is where parts, media and active chemicals slide together, facilitating optimum action of media and chemicals on the parts. Since this only occurs on the downward slide in the barrel, testing is required to determine proper loading. Barrel speed must also be set to prevent centrifugal forces (usually at too high a rotation speed) that would prevent the parts from sliding.

Vibratory equipment makes use of vibrational and rotational energies to work with media and burnishing chemicals. Mechanical work is constantly being performed on parts. The effect is faster action. Trial evaluations should be conducted to optimize energy setting of equipment in relation to chemistry type, concentration and media-to-parts ratio. *P&SF*

Answers to I.Q. Quiz #433

1. **Silicones** - they can devastate the entire plating line. Polyacrylate foam suppressants are fine.

2. Faraday's Law states that **96,500** coulombs (one Faraday) will deposit the **gram** equivalent weight of a metal

3. **False.** Magnetic gages are used for the non-destructive measurements of the thickness of **non-**magnetic deposits on steel,

4. One of the primary reasons is that, depending on the anodizing conditions, the electrolyte can dissolve some of the coating.

5. **Amphoteric**. For example, aluminium hydroxide in reaction with acids will behave as a base: $Al(OH)_3 + 3H^+ \rightarrow Al^{+3} + 3H_2O$ and in reaction with bases it will act as an acid: $Al(OH)_3 + 2OH^- \rightarrow AlO_2^- + H_2O$