Faster Mass Finishing

Chemical accelerators speed metal removal on many substrates . . .

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Webster's Dictionary defines the word accelerator as one that accelerates, or a substance that increases the speed of a chemical reaction. In the world of mass finishing, the term "accelerator" describes any chemical product that accelerates the process of metal removal from parts.

Accelerators are not new; however, new products have been derived from older ones. In mass finishing, all chemical additions could be considered "accelerators." Any component of a process that enhances the metal removal (media, machine, chemicals) is an accelerator.

Today, "accelerator" describes a chemical used in various forms and at different pH. They are not only used on carbon steel, but are formulated for aluminum, brass, stainless, titanium and zinc.

Chemically enhanced mass finishing works on the following principle: An accelerator chemically converts a surface to one that is more easily removed than the original substrate material. Media scrubs away this surface under controlled conditions.

Conventional processes rely on the amplitude of the vibratory bowl, the abrasive qualities of the media and long process times to remove surface imperfections. This procedure often requires a secondary refinement step in a less abrasive media to produce a surface suitable for subsequent chromium plating or buffing operations.

As the chemical is introduced into the vibratory bowl or tub, a reaction occurs between the chemical and metal alloy. The surface of the part is made up of tiny peaks and valleys that are coated with solution. The chemistry inhibits the valleys and only the peaks are removed by the scrubbing action. The process re-

VIBRATORY finishing equipment.

moves metal at a controlled rate without hydrogen embrittlement. Tests have established that embrittlement is not a by-product of this process.

Some chemistry is designed to operate at a constant pH value. Others will see a change in pH value usually rising as the process continues. Most all processes are followed by a secondary neutralizing or burnishing step to obtain a more reflective surface and provide corrosion resistance.

Traditional mass finishing. A typical process for finishing a part such as a wrench is as follows: The part is forged, trimmed to remove excess material and then subjected to multiple abrasive belting steps to shape and profile it. As many as four belting steps are used to obtain a surface suitable for subsequent vibratory finishing. Heat-treatment hardens the wrench, and the ends of the wrench are then machined.

The finishing process normally would take multiple steps using dif-

PARTS FINISHED using chemically accelerated vibratory finishing.

ferent media for each step. First a rough-cut media would be used to remove heat-treating scale and the deepest belting lines. Then parts would be transferred to a fine cut media to provide a smooth surface for plating. Combined processing times of 20 to 40 hrs are not unusual.

The chemically enhanced process uses the same vibratory finishing machine. However, here the similarity ends. The chemical process allows the use of media that is less abrasive and in some cases non-abrasive. Since the process relies on chemistry to help remove metal, media can be used that is suitable for both the cut step and the second step of surface refinement.

The chemical is fed to the vibratory machine at a rate consistent with the parts load. Flow rates vary according to application, but in most cases are significantly less than standard finishing compounds. Parts are processed to remove all surface belting lines in four to 12 hrs.

The finished plated parts can have finishes of 2Ra to 4Ra. For parts coming directly from the forge with only trim burr removal, processes have been developed combining two steps of finishing: a rough cut, then a refining step. Chemically accelerated finishing is routinely used to remove abrasive belting lines of 50 grit and up, CNC turning lines and forging pits from steel parts.

Types of Accelerators. Chemical accelerators are manufactured in three basic forms: liquids, powders and slurries (high-solid-content liquids).

pH Range. Liquid chemistry and slurries range from 3 to 6.5 pH. Powders are typically lower, around 1.3 to 5 pH. The preferred form is liquid, since it is more easily delivered to the finishing machines with greater control than powder products. Powder or dry products require make-up tanks and mixing at point of use. Ventilation equipment and sometimes heated water are required for powder products as well.

Applications. Materials such as aluminum, brass and zinc are reliably processed using chemically enhanced finishing. Aluminum extrusions, die castings and aluminum machined parts are refined using alkaline chemical accelerators. The process of metal removal is controlled using inhibitors to retard surface pitting.

Brass parts are refined using special chemistries. Brass forgings, gravity castings, and low-pressure die castings are processed similarly to the steel accelerator sequence. Brass castings, for example, can be deskinned using ceramic media and chemistry. Process times are significantly shorter than conventional methods. Brass forging door hardware and plumbing fittings can be polished using non-abrasive media in a one-step operation. The resulting reflective surfaces can be steel-ball burnished to reduce process steps prior to color buffing.

Zinc castings are prone to porosity and care must be taken to remove enough material to prepare surfaces for subsequent procedures without exposing the porosity. Acidic accelerators are used to process zinc parts.

Titanium is one of the most difficult to finish using accelerator chemistry. The nature of titanium is to resist attack. However, significant metal removal takes place using chemical accelerators. For example, a titanium aircraft-engine blade was successfully finished to remove unwanted surface contaminants to a depth of 0.005 inch in five hrs.

Carbon Steel makes up the majority of chemically enhanced mass-finishing processing. Steel parts are processed using a variety of chemical products with a pH as low as 1.3 to as high as 6.5. Non-heat-treated and heat-treated steel parts are suitable for the chemical process. Parts that have been hardened often are processed faster than soft parts due to differences in metallurgy. Heat-treated parts with a hardness of 40 to 50 Rockwell C are commonly finished to surface readings of 2RA to 4RA.

An additional benefit of the procedure is the removal of scale from the heat-treating process. Some scales keep the chemistry from working effectively. They require either mechanical removal prior to the vibratory processing using a process such as shot blasting or a descaling process in the vibratory system.

Stainless Steel. Magnetic and nonmagnetic stainless steels are suitable for chemical processing. As with titanium, one can expect the materials used for these metals to be more aggressive than those used with carbon steels.

Pros and cons of chemical mass finishing. Reasons for considering chemical mass finishing are as follows: Standard equipment and media can be used; Media is usually slow wearing; Eliminates hand labor, reducing costs; Fewer machines required for equal product output; Reduces water use and chemical consumption; Removes surface belting or machine marks quickly and efficiently; and Less radiusing, retaining the net shape of the part.

The negatives of chemical mass finishing include: Modifications to drains are required in some applications; More care needs to be taken to feed product since it requires chemical feed pumps not flow meters; Not good for burr removal; and Less radiusing takes place due to shorter process times.

Waste Treatment Requirements. Chemically enhanced mass-finishing processes require waste treatment. Alloying elements in the metal products, chromium, copper and zinc will require treatment according to local, state and federal discharge requirements. Typical procedures for treating vibratory wastes are similar to a chromium destruct cycle. Waste streams are treated in a batch system or delivered to the existing plant waste treatment system. A typical treatment cycle is as follows:

1. Waste discharge pH 7

2. Lower pH to 2.0-2.5 pH

3. Raise pH to 7.5-9.5 (depending on hydroxide to be formed)

4. Flocculate and precipitate the metal hydroxide

5. Filter press or sludge settling tank.

Brass, titanium, and zinc materials differ in their treatment requirements and disposal, however the basic procedures are similar. After sludge removal, the clean water can in some cases be re-used for make-up solutions, and the sludge cake is often suitable for non-hazardous landfill.

Effects of process on machine and media. A standard vibratory machine is suitable for most chemically enhanced mass-finishing processes. For more aggressive chemistry, coated drain fittings are required to prevent corrosive attack.

Media Selection. Medium- to low-cut polishing media is used for chemically enhanced finishing. Plastic, nonabrasive ceramic and porcelain media is used also. The selection of media is critical to the success of the process.

Chemically enhanced finishing is not a panacea for mass-finishing problems. As with most new procedures, the temptation is to exploit the technology before proper development takes place. Chemically enhanced mass finishing has been in existence since the early sixties. It has developed as a method of speeding metal removal with consistency and reliability, offering increased production from the same equipment. The future of this process is assured as new applications are developed.

User friendly liquid chemistry is being developed to reduce the equipment required to institute the process into existing work centers. Chemical mass-finishing methods are producing increases in value, beauty and reputation. **PF**

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