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Clean Machines

Considerations when purchasing a parts-cleaning system.

Parts-cleaning technology has evolved dramatically the past few decades. And during that time, the number of cleaning chemistries and types of equipment has risen significantly.

These factors require purchasers of parts-cleaning products to educate themselves about the available options. Doing so will help them choose the system that best fits their needs.

Cleaning Methods

Cleaning is defined as the removal of soil or unwanted material from the substrate to which it clings. Producers of machined parts often remove a variety of contaminants, including dirt, greases, chips, oxide films and metalworking fluids.

Sometimes, cleaning is required prior to subsequent processes, such as plating, painting, the application of conversion coatings or adhesives, soldering, welding or brazing. Other times, parts are cleaned for reasons pertaining to aesthetics, health, safety or regulations, or to meet specification requirements. Knowledge of these requirements is critical to selecting the proper equipment and chemistry for a cleaning application.

There are four main ways to clean parts:

- mechanical (scrubbing, brushing, abrading, spraying, blasting);
- dissolution (the contaminant dissolves in the chemistry);
- chemical reaction (saponification, emulsification, chelation, neutralization); and
- detergency (wetting, lifting and suspending contaminants).

Eliminating a contaminant from a part often requires using these methods in combination. The proper combination depends on the substrate, the nature of the contaminant and the degree of cleanliness required.

Besides the removal mechanism, a number of related parameters also influence the cleaning process. They are length of cleaning time, agitation method, chemistry (type and concentration of the cleaning solution) and cleaning-bath temperature. Let's look at each in order.

All images: Safety-Kleen

The most popular parts cleaner is a simple sink on a drum, which works with either a solvent or aqueous solution.

Time. Generally, the longer a contaminant is subjected to a cleaning process, the easier and more complete its removal. Time sometimes is the only factor that can be adjusted to ensure maximum cleaning. In some cases, though, a part can spend too much time in a cleaning chemistry. This can damage it or lead to soil redeposition.

Cleaning times for metal parts typically range from 2 to 30 minutes, depending on the contaminants and the cleaning process. Because "time is money," it is important to minimize the time factor whenever possible.

Agitation. Manufacturers of cleaning equipment offer a variety of agitation sources. The most common are manual scrubbing, enhanced immersion (mechanical action other than soaking), ultrasonic energy and low- or high-pressure spray systems.

Variables that will determine the best method of agitation are part size and configuration, the contaminants to be removed and desired throughput.

Chemistry. Different chemistries are designed to remove different contaminants. An acid-based aqueous solution, for example, removes rust stains much more effectively than a solvent with a mineral-spirits base.

With aqueous cleaners—as well as some formulated complex solvents—the concentration level can influence performance.

In general, the higher the concentration level the cleaner the part. It is important, however, to prevent the concentration from reaching a level that leads to redeposition, filming, staining, corrosion or foaming.

Bath temperature. Adjusting the cleaning-bath temperature 10° or 20° can dramatically affect efficiency. Certain contaminants, like greases and waxes, are easier to remove at higher temperatures. Bath temperature also can affect the physical and chemical characteristics of many cleaning chemistries, including their foaming level, corrosion-controlling capability, stability and lifespan. Additionally, as the bath

COMMON CLEANING SYSTEMS

Equipment	Category	Advantages	Disadvantages
Sink on drum	Manual	Low cost, low energy consumption, simple to use	Labor intensive, works best on light soils, simple parts
Soak tank	Manual	Low cost, allows parts to soak, simple to use	Labor intensive, works best on light to moderate soils, oil slick may form
Recycling sink	Manual	Reduces hazardous waste generation, provides clean solvent as needed	Labor intensive, works best on light to moderate soils, equipment initially more expensive than traditional manual washers
Immersion tank with agitated platform	Automated	Relatively low cost, allows parts to soak, low labor cost	Oil slick formation may require skimming, moderate cleaning action
Immersion tank with liquid turbulation and agitated platform	Automated	Increased soil removal, reduced cleaning time	More expensive, needs filtration, oil slick formation may require skimming
Immersion tank with ultrasonics	Automated	Removes heavy soils, high-efficacy (precision) cleaning, works on complex parts with blind holes	Higher initial costs, oil slick formation may require skimming, high energy consumption
Low-pressure spray washer	Automated	Cleans faster than most, less temperature dependent, low fluid volume	Higher initial cost, high energy consumption, less effective on blind holes and internal surfaces
High-pressure spray washer	Automated	Superior cleaning, low fluid volume, less temperature dependent	Higher initial cost, high energy consumption, greater risk of foaming, less effective on blind holes and internal surfaces

temperature rises, so do energy costs and the potential hazards to workers.

Manufacturers of cleaning chemistries provide the optimal operating temperatures for their products. Users should follow the recommendations.

Types of Equipment

Industrial cleaning equipment falls into two main categories: manual and automated. Manual units include the most common type of parts washer—the sink on a drum—as well as many nonagitating wash tanks that can be used for a combination of soaking and hand-scrubbing operations.

Increasingly, manufacturers are replacing their existing parts washers—both manual and automated units—with ones that recycle solvents. Recycling does not necessarily reduce labor, but it does greatly extend solvent life. This decreases waste-removal costs. Additionally, constant freshening of the solvent improves cleaning performance, which may shorten the cleaning time required.

These benefits are offset to a degree by the higher initial cost of a parts-cleaning machine that can recycle solvents. Manufacturers should weigh the higher initial outlay—a recycling-capable machine costs up to five times more—against the potential productivity gains and reduced waste-disposal costs such a unit would provide.

Automated systems are rapidly gaining popularity. Again, these machines cost more than most manual washers, but they typically require less labor to operate and offer greater cleaning power. Typical automated equipment options include agitation platforms, ultrasonics, and low- and high-pressure spray washers.

Chemistry Choices

Many types of highly effective cleaning chemistries are available to complement today's parts-washing machines. Some are recommended for specific applications; others can be used in multiple applications.

The following properties are considered the most desirable for cleaning chemistries: low surface tension, allowing penetration of small surfaces and contaminant barriers; high density, to aid in removing small particles; high volatility, resulting in rapid drying; good solvency, which promotes removal of organic contaminants; low cost per use; low toxicity; nonflammability; leaves little residue on parts; and easy to clean up, recycle or dispose of.

The most widely used cleaners are:

Aliphatic hydrocarbons. Includes a wide range of organic solvents, such as mineral spirits and kerosene. Commonly used in manual parts washers, because they exhibit superior cleaning characteristics and are compatible with most metals, plastics and rubbers. Tend to be recycled by distillation.

Perfluorocarbons (PFC). Highly stable, costly specialty cleaners. Chemical inactivity, low toxicity and low flammability make them effective. Often used by manufacturers of electronic, medical, aerospace and other precision products.

N-methyl-2-pyrrolidone (M-Pyrol or NMP). High-flash, low-volatility cleaner for specialty cleaning applications. Popular for removing paint.

Aqueous. Covers a variety of cleaners, which pose less of a health threat to workers than solvents. Other benefits: nonvolatility; excellent for many types of contaminants; highly biodegradable; low toxicity; potentially lower material and waste-disposal costs; and solutions can be tailored to specific types of parts and contaminants. Initial machine investment may be higher, and the use of aqueous cleaners may require tighter process controls and the rinsing or drying of parts.

Abrasives. Hard particles are added to the cleaning chemistry or completely replace it. Particles abrade the part, leaving a smooth, clean surface. Common abrasives include baking soda, sand, aluminum oxide, frozen pellets of carbon dioxide, plastic beads, starch and silicone carbide. In some cases, abrasive cleaners can be recycled.

Parts cleaners with automated solvent recycling minimize waste. Shown is Safety-Kleen's Model 250.

Choosing a System

Selecting the right system is the most important contributor to a successful cleaning program. The ideal system operates in the shortest time possible, uses the least hazardous cleaning chemistry, generates the least amount of waste, cleans parts so they meet the minimally acceptable level and meets these criteria for the lowest cost.

There are a number of basic steps that should be taken when choosing a cleaning system. First, thoroughly evaluate the current cleaning process requirements, including, at a minimum, the substrate to be cleaned, the contaminants to be removed and the level of cleanliness required.

Second, re-evaluate current cleaning processes with the aim of eliminating some. This can be accomplished by minimizing the contaminants to be removed. An example would be reducing the number of metalworking fluids and lubricants currently used at a facility, which, in turn, would lower the number of cleaning systems and chemistries required.

Weigh the pros and cons of various equipment and chemistry combinations when selecting a parts cleaner.

Third, list, evaluate and rank the cleaning options available. Weigh the advantages and disadvantage of various equipment and chemistry combinations. Study current and potential regulatory requirements that may affect equipment and chemistry use. And when considering equipment, take into account requirements related to ventilation and personnel-protection equipment.

Last, identify the top system options and discuss them in detail with appropriate equipment and chemistry suppliers. Give potential suppliers dirty parts to evaluate and clean—preferably on-site.

Clearly identifying and understanding specific cleaning needs—and weighing all the options against those needs—should lead to the selection of a cleaning system that meets specific requirements in the most efficient, cost-effective manner possible.

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