Theory of Operation: How Parts Cleaning Works

MART defines the term *to clean* as *to overpower the soils*. The MART Parts Washer is a high-impact pressure, high-temperature, industrial water-based cleaning system that uses a combination of the following factors to achieve cleaning results:

Power x Temperature x Chemical x Time = Clean

The relationship of these variables can be varied in an infinite number of ways to achieve the same level of cleanliness. Your own needs determine the relative value of each variable. Keep in mind that the MART Parts Washer provides one of the highest blasting powers in the cleaning industry, allowing you to reduce the wash-cycle times for your parts to a minimum. Additionally, the high blasting power allows you to operate the washer at lower cleaning temperatures, thus saving energy, and using less chemical than spray washers

The *exact* combination of the factors must be determined for your application, based on the types of soils to be removed, the degree of cleanliness required, the cycle time required, the types of parts to be cleaned, and so on.

How the Parts Washer Works

The parts washer operates on a timed cycle. The operator places the parts to be cleaned in the washer on the turntable, closes and latches the door, and then starts the timed cleaning cycle.

During the cleaning cycle, a high-temperature, high-pressure, water-and-detergent cleaning solution blasts soils from the parts.

After the cycle has stopped and the steam has exhausted, the operator removes the cleaned parts.

The parts washer utilizes closed loop, waste minimization technology, continuously reusing its cleaning solution and effectively reducing pollution potential. And, because the washer is fully enclosed, it is safe for the operator, since the high-pressure, high-temperature spray is locked inside the cabinet

In order to better understand how the four factors affect cleaning, let's look at each one

more closely:

Power
Temperature
Chemical
Time

Power

The first key factor in the parts washer's ability to clean is *power* -- the blasting power required to strip even the toughest soils from industrial parts

Pressure and Flow = Power

Power means the physical forces that remove the soils. The following formula expresses in horsepower (HP) the "cutting power" of the solution blasted from each nozzle tip:

HP = (GPM x PSI) / 1714

where
GPM (gallons per minute) = flow per nozzle
PSI (pounds per square inch) = pressure

In general, MART systems blast with four to 100 times more "cutting power," depending on pump size, than jet spray systems.

What really counts, however, is *impact pressure* -- the force of the spray at the target surface. It is impact pressure that most directly affects how quickly and effectively the soils, like grease, oil, road soil, dirt, carbon, and paint are removed. The impact per square inch of a given nozzle depends on the following.

flow and pressure produced by the pump
type of nozzle
spray pattern distribution
spray angle

MART cleaning systems achieve an optimal balance of these factors to provide the highest impact pressure at the part surfaces.

Closed-Loop System and Grit-Blasting

The MART Parts Washer is a closed-loop system. This means that none of the washing

or rinsing solution is discharged. Therefore, as soils are removed from parts, a patented feature reclaims the grit and blasts it back at the wash load to provide a vigorous scouring action, without any damage to parts. Thus, the grit becomes a valuable cleaning medium and actually acts to increase the impact pressure.

Note: In applications where the wet grit blast is not desired, MART can provide fine filtration, including micron filtration, to remove it.

In terms of results, wet grit blasting means that the dirtier the parts washer gets, the faster it cleans. This feature is desirable for most rebuilding applications and some manufacturing ones.

Temperature

As temperature increases, grease and oil become more fluid; that is, their viscosity decreases. Since grease is the primary binder that holds and contains the soils on the parts, higher washing temperatures above 160° F (71° C) generally produce better cleaning results.

Secondly, chemical is more aggressive at higher temperatures. As a general rule, for every 10° F (-12.22° C) rise in temperature above 160° F, a chemical reaction doubles in speed.

Chemical

Chemical is the third key factor in overpowering industrial strength soils and removing them from the surface of parts. While chemicals are necessary to enhance the cleaning process, the MART Parts Washer does not rely primarily on chemical concentration. This is because the MART sales technician workes with you to determine your cleaning needs, such as:

Required degree of cleanliness
Nature of the soils to be removed
Pump size and performance requirements
Size, shape and surface of the parts to be cleaned
Applications and usage of the parts washer in your shop

Because your MART Parts Washer's configuration can be customized specifically to meet your requirements, the washer will successfully meet your cleaning standards when charged with a *light* chemical concentration, as compared to conventional washers. In

general, this means that a 2-5% concentration by volume of a quality non-foaming chemical compound will give excellent cleaning results. However, like temperature and power, the exact type and amount of chemical are subjective and depend on your shop's needs

Chemical cleaners fall into three general categories:

Organic solvents
Emulsion cleaners
Aqueous (water-based) alkaline cleaners

MART parts washers use an aqueous (water-based) alkaline cleaner, not a solvent, so you don't have to deal with solvent vapors or hazardous-waste contaminants. Generally, the water-based alkaline cleaner is composed of water, an alkali source, a sequestrate, a surfactant package, and corrosion inhibitors.

A *sequestrant* is a binding agent that prevents undesirable chemical reactions, such as those that would form insoluble products like hard-water soap scum. The *surfactant* is a substance that lowers surface tension in order to penetrate and loosen soils. It coats oil droplets to prevent them from recombining. A *corrosion inhibitor* slows down the rate of chemical reaction that produces rust.

The water-based alkaline cleaner works by undercutting the soil, then "popping" it from the part surface. Light oils float to the solution surface, where they can be skimmed or filtered off. Heavier soils from the parts sink to the bottom, and can be filtered or removed as sludge.

A key feature of this type of cleaner is that you only have to dispose of the *contaminants* as waste -- the washer can recycle the *liquid* indefinitely, with replenishment of the chemical concentration as needed.

Removal of Soils

The water-based alkaline cleaner in a MART Parts Washer readily removes the following soils:

Cutting oils
Shop dirt
Low-melt waxes
Rust preventatives
Finger prints
Paint
Cosmoline
Varnish
Grease
Mill markings
Diesel carbon
Carbon dust
Coolants
Road soils
Oil and chips

Applications

The water-based alkaline cleaner has many applications. It is successfully used, for example, in the following ways:

Pre-clean
Before teardown
Before plating
Before Re-assembly
As the finishing process before packaging
Before painting
During in-process cleaning
Before anodizing

Usage

When you work with a water-based alkaline cleaner, remember these points:

1. Most parts "flash"-dry within a minute or two after removal from the washing cabinet.

2. Parts that sit for some time before the next in-process operation are protected by a layer of corrosion inhibitor.

3. You can easily remove the corrosion inhibitor by a water rinse. MART can provide an optional Auto Rinse Cycle (ARC) for your washer that will remove all chemicals and oils with heated fresh water to "flash"-dry parts without rusting.

4. If you need to dry the parts quickly, MART can provide an air or heated drying phase.

5. All parts and materials washed in a MART Parts Washer are clean and paintable without further preparation.

6. In cleaning parts, you will have to periodically adjust the chemical concentration.

Time

Time lets power, temperature, and chemical do their work in overpowering soils and

removing them from parts. If soils are heavy and built-up, for example, setting a longer wash-cycle time will clean the parts.

MART Parts Washer wash-cycle times are more efficient than those of conventional washers, due to the greater power of the system. This power comes from the following:

MART pump technology
MART oscillating Power Blast Manifold

General Information and Conclusion

This section, "*Theory of Operation*," has given you an overview of how the MART Parts Washer operates.

MART defines the term *to clean* as *to overpower the soils*. *Cleanliness* is proportional to the combination of the following factors:

Power
Temperature
Chemical
Time

The *exact* combination of these factors is variable and depends on your cleaning standards and operating requirements for the materials that you are cleaning. Since cleaning standards vary from shop to shop, through testing you can achieve an optimal balance of these four factors to meet your cleaning standards.