KYZEN
Where Science and Care Converge.

WORLDWIDE ENVIRONMENTALLY RESPONSIBLE CLEANING TECHNOLOGIES

THE FIVE FORCES OF CLEANING

Cleaning is a common operation in all walks of life.

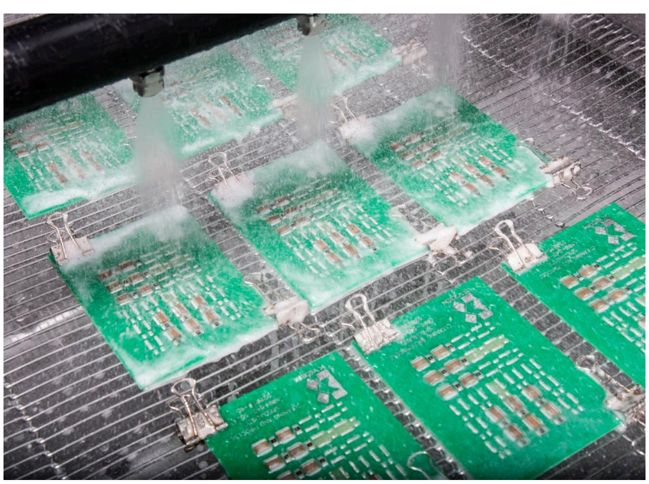
We clean the bathroom in our house, the dishes we used for dinner last night, our face, our hair, our clothes, our children and even our cars. While the practice of cleaning is common to all, the cleaning "processes" are very different. Some are manual, some are automatic, some use high pressure, others merely soak.

We may use hot water to clean our clothes and our dishes, but only warm water when we clean our hair, and even cooler water when we clean a young child's hair. We may not be sure what temperature the water is at the car wash.

We also know the clothes washer cycle runs about 30 minutes and the dishwasher roughly an hour. But do you know how long you scrub your hair when shampooing? How many seconds, or minutes do you brush your teeth? How much pressure do you use when brushing your teeth or polishing your grandmother's silver, or cleaning the patio furniture at the end of the summer?

So, while everyone knows a great deal about cleaning, most of that "knowing" is automatic. Chances are you shampoo your hair for about the same length of time whenever you do it, even though you most likely don't know how long it takes.

Each of these examples is unique to the individual. Everyone relies on their internal "clock" to guide them close to the same time and effort every time. But, what if you are teaching someone else or have a special process that needs a high level of precision to be successful, like a manufacturing process? You can't rely on "motor memory;" you need a detailed, precise process for cleaning.. Just what are the steps that need to be specified and followed to assure a proper manufacturing process? We'll address those in the next section.



A Proper Manufacturing Cleaning Process

A modern manufacturing process requires specific methods and procedures. We will address how we can develop those methods and procedures for the cleaning portion of any manufacturing process.

FORCE 1: Compatibility and Baseline Effectiveness Match

It starts with the part or assembly you are planning to manufacture. Is your product made of plastic, fabric, or metal? Metals are most common today, and they require additional questions about the type of metal. Is it iron, mild steel, stainless steel, aluminum, copper, tin, lead, brass, bronze, or something else? The list is endless, but very important. Every metal has the risk of being attacked or damaged by the environment, the manufacturing process and more specifically, the cleaning agent used. This is known as compatibility. Making sure that your part and any cleaning agent you are considering are compatible is an essential step one.

This is often an easy step. Most suppliers conduct extensive tests on their products for compatibility and freely share that data with their clients. Likewise, as a manufacturer using specific materials of construction, you are likely highly schooled in what substances can harm your products. In most cases, the combination of your expertise and that of your suppliers will serve you well regarding this issue. In some cases, exposure testing may be conducted to confirm these "informed assessments."

A second dimension of compatibility is whether the cleaning agent has an affinity to clean the soil. Baby shampoo is unlikely to clean the road tar from your car door, and it's not likely that you would choose a road tar remover to help a child clean their hands. This match is an important and early consideration best done when evaluating compatibility in general.

Once you know that the materials you are considering are compatible, and have established a base level effectiveness match, you have completed your assessment of the First Force of Cleaning – compatibility and baseline effectiveness match with your parts. You can now proceed to considering the true variable in the cleaning process itself.

Let's say you have a compatible and reasonably well-matched material. That first force is relatively independent of the other forces, which are very much dependent on each other.

Figure 1. The 4 Dependent Forces of Cleaning

The graphic depicts the interplay between these four forces. But, before we get into how they inter relate, lets briefly review them individually.

FORCE 2: Cleaning Product Concentration

There is a wide range of cleaning materials available to manufacturers.

Traditional solvents that are used at 100% or neat can be used in vapor degreasers, vacuum solvent machines and in some cases, as hand-wiped application. When you pick a solvent, by and large you are using 100% concentration.

Aqueous products come in different concentrations, and each task has a recommended concentration for best results. Some cleaning challenges require a higher concentration to get the job done. For instance, you may need more soap to clean a football team's muddy uniforms than a swim team's towels.

Concentration is also tied closely to temperature and cleaning time. In some cases, you can clean faster with lower concentrations, just by using hotter water.

Concentration is directly correlated with the cost of operation. Higher concentration requires more cleaning agent, which impacts the cost of operation. However, it can be offset by savings in process time or adjustments to temperature.

FORCE 3: Cleaning Time

Most users want to clean as fast as possible. Time is money, and less time is associated with less cost. While this can be true, the shorter time can also require increased temperatures (and energy costs along with equipment wear and tear), as well as high cleaning agent concentration (which translates into more purchases). If time is indeed money, any savings need to be balanced with the likely increased costs in other areas.

Time can also have a major impact on the equipment being selected for the operation. High speed equipment can be larger (with higher through put capacity) and often comes at a higher cost. Getting the requirements correct up front and balancing the potential costs is important to designing and procuring an effective and economical cleaning process.

Concentration is also tied closely to temperature and cleaning time. In some cases, you can clean faster with lower concentrations, just by using hotter water.

Concentration is directly correlated with the cost of operation. Higher concentration requires more cleaning agent, which impacts the cost of operation. However, it can be offset by savings in process time or adjustments to temperature.

FORCE 4: Temperature

As in the example of cleaning your dishes at home, higher temperature generally improves and speeds up cleaning. There are certainly soils and substrates where high temperature is a technical problem, but they are relatively rare. It is common for cleaning systems to operate above 140°F, and temperatures approaching 200°F can be appropriate for difficult soils. Of course, depending on compatibility, there are many substrates where high temperature can have negative effects. Therefore, by adding a temperature consideration to the compatibility evaluation you can set a maximum allowable temperature for the substrate under evaluation.

To summarize, 150°F, or the highest temperature that a part can safely be exposed to in the cleaning process, is a good place to start when determining your cleaning process.

FORCE 5: Mechanical Energy

Cleaning efficiency and effectiveness are always enhanced by mechanical energy. Of course, the energy cannot be so robust that it damages the substrate. This is a rare, but obvious risk when evaluating a particular substrate. Mechanical energy is available in many forms, and often particular cleaning systems are designed to employ one, or sometimes, more types of mechanical energy. Common sources of energy are spray impingement (either in air or below the fluid level), ultrasonic energy, oscillation of the substrate within the cleaning fluid, turbulence within the cleaning fluid providing cleaning fluid flow across the surface of the substrate. Not every source of mechanical energy is suitable for every substrate. High pressure sprays might not be a good choice for small, fragile substrates, but may be an ideal choice for large flat surfaces with few tough-to-reach areas. There are similar considerations for all the types of mechanical energy available, and a thoughtful review of those considerations is always a good approach.

CONCLUSIONS

The 5 forces are easy to understand:

- **FORCE 1: compatibility and baseline effectiveness match with your parts**
- **FORCE 2:** Cleaning Product Concentration
- **FORCE 3:** Cleaning Time
- **FORCE 4:** Temperature
- **FORCE 5:** Mechanical Energy

Their interrelationships are also easy to understand, but more nuanced.

Together with your cleaning agent supplier, you can balance these forces and enjoy properly cleaned parts in your manufacturing operation!