Designing Environmentally Safe Compounds for Mass Finishing

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Mass finishing compounds have very specific functions. These include cleaning and degreasing, burnishing, surface improvement, deburring, descaling and inhibiting. To carry out these functions, mass finishing compounds must have certain chemical and physical properties. Many times, however, compounds can be designed with environmentally safe components that can offer characteristics comparable to traditional compounds. In addition, some compounds can be designed to be recycled or reused, while others still can be designed to be treated more easily than traditional compounds.

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INTRODUCTION

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There are many concerns when designing compounds. Is the compound biodegradable? Is the compound water soluble? What is the pH of the compound? At what concentration is the compound used? What is the compound used for? What contaminants might be in the compound that would cause the effluent to be out of compliance with local municipality regulations? Can the compound be dumped down the sink?

The best way to answer these questions is to explain how compounds are used and why compounds need certain raw materials formulated into them. Once we know why a certain compound is designed the way it is, we can ask, "Is there a more environmentally friendly way to formulate the compound?"

COMPOUND FUNCTIONS

Of the functions compounds carry out, cleaning and degreasing is the most important since the part must be clean to successfully carry out other functions such as burnishing or deburring. There are two basic types of cleaning compounds – organic and aqueous. Organic cleaning compounds are those found in traditional solvent systems such as mineral spirits, chloroethanes, MEK, and acetone. These types of cleaning compounds are not soluble in water which offers great environmental and treatment concerns. Indeed, most of these organic cleaning compounds must be hauled away as hazardous waste.

Aqueous cleaning compounds are those that are water-soluble. These types of cleaning compounds usually are formulated with surfactants (Surface Acting Agents). Surfactants are usually large molecules with a hydrophilic (aqueous – water soluble) part and a hydrophobic (organic – oil soluble) part. The hydrophilic part allows the substance to be water-soluble while the hydrophobic end helps pull the oil soluble contaminant into the aqueous phase. Aqueous cleaning compounds can often be treated on site or sent to a municipal treatment center to be treated as water.

Aqueous cleaning compounds offer another advantage over organic cleaning compounds. They can be built with caustic raw materials which help clean oils from dirty parts. Some animal and vegetable fats and oils will react with a highly alkaline material to form a soluble soap. This is known as saponification. Many recent developments in synthetic oils make them react as animal or vegetable fats and oil and they can become saponified also. Not only is the oil gone, but soap is formed in the process adding extra cleaning

ability. One downfall of saponification is that many soaps that are formed add extra foam to the system. The only cleaning mechanism offered by organic solvents is that of the solvent nature of the compound in dissolving organic contaminants.

Abrasive cutting, of which deburring, radiusing, and preplate refinement are major operations is another very important function of mass finishing. These compounds must be designed with lubricity and part impingement in mind. Many deburring compounds contain chelating agents to quicken the cut down process. Chelating agents chemically react with metal atoms to form complex, water-soluble ions. This is good for the deburring process but not good for the treatment process since once the chelating agents react with the metal atom, they don't like to let go.

Along with chelating agents, many abrasive cutting compounds contain lubricants or high-foaming surfactants to help cushion the mass to help the media produce a smooth mirror-like finish. In the abrasive cutting process the media acts like a grinding wheel or file to cut down the surface of the part. The compound must keep the media and part clean, while carrying the contaminants (oil, broken down media, and metal chips) away before they have a chance to redeposit on the part. Foam helps accomplish this.

In burnishing, like deburring, the compound and media work in unison to provide a smooth and shiny surface of the part. Most burnishing processes utilize steel media and acidic compounds. Metals tend to get brighter, the more acidic the compound. However, if the compound is too acidic, the process becomes too reactive and an oxide of the metal can occur causing tarnish or darkening of the part.

Finished parts usually are very susceptible to rusting and oxidation processes. As a consequence an inhibiting compound must be used to slow down the damaging reaction. Many inhibiting compounds work by either slowing down the oxidation process or by redirecting it. Organic inhibiting compounds coat the part to keep moisture off. Parts must be dry for organic inhibiting compounds to work optimally; if water is trapped under the oil, rust can occur. Aqueous inhibiting compounds are more affected by humid conditions. Organic inhibiting compounds usually give longer protection but must be removed before any subsequent processes are performed on the parts.

COMPOUND CONCERNS

The biggest concern of vibratory compounds is the pH of the solution. Most vibratory compounds are designed to be used at 1-10%. In addition, for some processes a very low pH or a very high pH is required to carry out the function. To get a compound to have a pH range of 4-4.5 at 1%, the concentrate may have a pH reading of 3 or below. Likewise, to get a cleaning compound to have a pH of >10 at 1% the concentrate pH may approach 14. Most municipalities require that effluent streams be between pH 6 and pH 9. It is obvious then that many waste streams would have to be neutralized to be sent to the waste municipal treatment facilities even if no other contaminants were present.

Another concern of vibratory compounds is the foam level of certain compounds. As stated before, many deburring compounds are built with high foaming surfactants to help cushion the mass to provide a smooth finish. The foam in the waste stream can cause excess air into the water adding to treatment woes for the municipal treatment facility as well as cause general cleanup problems if the foam spills over the machine onto the floor.

Chelating agents are added to many vibratory compounds. Chelating agents hasten the deburring, cleaning, and burnishing processes by chemically reacting with metal atoms to form water-soluble complex molecules. The concern of chelating agents is at the treatment step for the waste stream either onsite or at the municipal treatment center. Some compounds can be formulated with nonchelating agents and be very effective. However, generally, nonchelating compounds do not work as quickly or give as good luster or shine.

Another concern of vibratory compounds is their form. Compounds come in three forms solid, liquid and paste. Solid compounds are formulated as comparable formulas to liquid compounds or as a mix of compound and an abrading species. The biggest concern of solid compounds is that they add particulate matter to the waste stream. Also, they can plug drains and lines as they build up with extended use.

Pastes are in between solids and liquids. They are designed as a mixture of liquid and solid and contain suspended abrasives or emulsified polishing agents. Pastes are normally used in fine polishing operations. Pastes, like solids, add considerable particulate matter to the waste stream and tend to plug drains and hoses.

Most liquid compounds are designed as pure, homogeneous solutions, while some liquid compounds are emulsions or dispersions. Liquid compounds are the most popular form of vibratory compounds because of their ease of handling and the lack of their interference in waste streams. The challenge is to design homogeneous liquid compounds that are effective for the desired end result.

WASTE TREATMENT

All vibratory processes generate wastewater. The process, in conjunction with the various government guidelines and regulations determines how the spent fluid must be handled. The vibratory compounds, with the exception of their pH level cause minimal influence on the waste stream. It is the presence of dissolved metals, dissolved solids, and emulsified oils which can make the effluent stream out of compliance of discharge codes.

The treatment of a waste stream can vary from very simple as evaporation or settling to very complex including chemical treatment and ultra filtration. Settling tanks allow a given retention time for the spent fluid to release either oils, which can be skimmed or solids which fall to the bottom of the tank. Settling tanks are usually a part of every waste treatment setup. Sometimes, however, if there are a large number of solids, the

entire waste stream can be handled as a slurry and the entire stream can be treated without settling out the solids beforehand.

There are several onsite treatment options depending upon level of treatment desired and end use of the treated water. The type of media used in the process also has a significant impact on the treatment process. For example, if a process is utilizing ceramic media, the particles added to the waste stream from the wear of the media would have to be calculated into the waste treatment procedure. There are additives that can be added to the waste stream and coagulate the particles. The coagulated particles could then be more easily filtered from the stream leaving a clearer fluid. The coagulated material many times is non hazardous, but would have to be tested to make sure it could be sent to a landfill or handled as hazardous waste.

Waste streams containing dissolved metals are more complicated to treat than waste streams with particulate matter in them. Most metals however, will drop out of the solution when the pH is adjusted to an appropriate level and an additive which precipitates and flocculates metals is added.

If a higher level of purity is desired, sub micron filters can be used. These filters can be as fine as molecular weight levels and actually separate the solids as well as emulsified oils from the effluent stream. This is known as ultra filtration and is quite common in the reuse technology. Membrane filtration can be expanded even farther to reverse osmosis in which the filter media will only allow a molecular weight of water or less through the system. The system is used primarily to treat water to drinking standards and is usually not required at the industrial level.

CONCLUSION

Vibratory compounds are necessary in many industries to help deburr, clean, burnish, and improve surfaces. All vibratory processes produce waste streams. It is through selection of vibratory compounds and treatment processes that the negative effective of vibratory compounds can be minimized. Many vibratory compound waste streams can be treated with standard treatment procedures. Many times with appropriate treatment procedures and pH adjustment the waste stream will be compliant with government regulations and guidelines.

Organic compounds are still used somewhat-mostly in solvent cleaning systems. Sometimes organic compounds are necessary to carry out the specific task. Organic compounds, however, are harder to handle as waste. Many times the only alternative is to have them hauled away as hazardous waste. Aqueous compounds are finding more uses in industries as cleaning/degreasing, deburring, descaling, or inhibiting compounds. They can be very effective while still remaining environmentally friendly. Many times, aqueous waste streams can be treated onsite to be reused or sent to municipal treatment centers. Another option is to evaporate the water out of the waste stream to reduce the volume by 90% and send the remaining out to be disposed of as hazardous waste.