Metal Finishing Terms You'll Want to Know

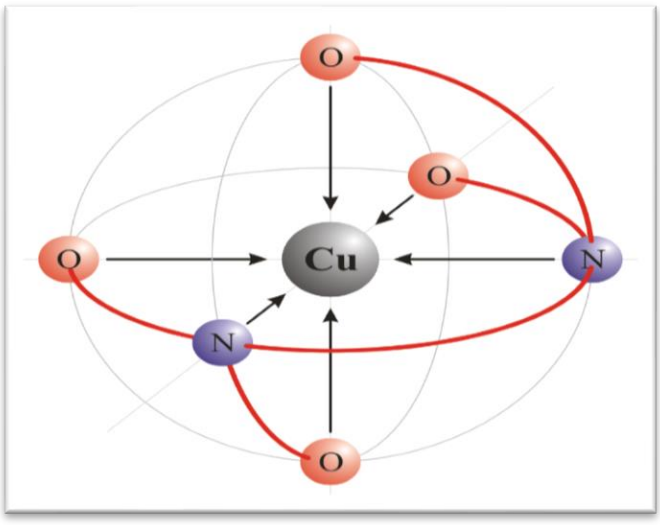
Over time, words generate loose terminology that may incorrectly define a specific activity or condition. In the metal finishing industry, think: *bind versus bond, strip versus remove, empty versus purge, wet versus hydrate, etc.* The stakes in using the right terminology are high, because getting it wrong can confuse meaning, intent, and perhaps how appropriate work or corrective action is to be done.

1. Chelating Agent

The chelating agent is typically an organic acid having more than one active bonding site. Some of the commonly referred to chelating agents as used in metal finishing are:

- EDTA (ethylenediaminetetraacetic sodium salt)
- NTA (nitrilotriacetic acid)
- Cyanides (salts of sodium and potassium)

From a pure chemistry perspective, the chelating agent strongly attracts metal ions, involving the inner orbital electrons. The following diagram illustrates the chemical strength of the EDTA bonding sites to the Copper metal ion, which makes for a truly remarkable bond.



The resulting molecules are very strong and stable due to corresponding affinities for electronic stability. In layman's terms, the chelating agent acts as a bear trap, tightly holding onto a soluble metal. Chelating agents are typically found in mass finishing compounds, metal strippers, cleaners, plating salts and plating additives. Their impacts range from softening hard water, derusting and descaling and inhibiting chemical attack on sensitive metals to the complexing of metals in cyanide-based plating solutions.

While providing several advantages in metal finishing processes, the presence of chelating agents can create problems with wastewater treatment systems. The chelate-to-metal bond is very stable even over a wide range of solution pH. Over the years effluent discharge limitations have become progressively tighter. **Very** low parts per million (ppm) levels for most heavy metals are the norm.

Dedicated R&D has yielded a new, effective group of waste treatment additives called metal precipitants. Tight chelate-to-metal bonds can be readily broken with the addition of these precipitants. (Examples of such treatment agents are sulfides and polysulfides.) Their effect is to chemically split the chelate-to-metal bond, forming the insoluble metal sulfide precipitate.

Not all precipitants are alike, a group of older-generation precipitants were found to be toxic to aquatic and marine species. This can represent a significant problem, as many treated water

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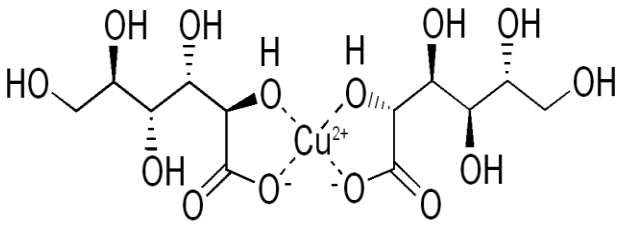
discharges go directly or indirectly to public waterways. A newer generation of precipitants is just as effective to breaking metal-to-chelate bonds, but not toxic to aquatic and marine species.

As a first step toward their removal from the wastewater system, the application of metal precipitants is accepted protocol for converting soluble metals to their insoluble species. Metal precipitants are essential to optimizing wastewater treatment and all-important compliance.

2. Complexing Agents

Complexing agents are organic compounds that also bond to metal ions. They do so through their affinity for outer electrons. This accounts for the somewhat weaker stability of the bond to metals compared to chelates.

Certain complexing agents include citric acid, tartaric acid, gluconates, functional amines and some phosphates. These chemical complexes are somewhat affected by solution pH and concentration. An example of a complexation structure to a heavy metal - Copper Gluconate (from the reaction of Gluconic Acid and soluble Copper ion).



Applications in metal finishing, as just described for chelating agents, include mass finishing, passivation of stainless steel, surface preparation (cleaning and activation), and as plating additives. Complexing agents also positively affect descaling and derusting, water softening, and plating bath purification, as well as inhibiting attack on sensitive metals and protecting against corrosion.

3. Deflocculants

Deflocculants are organic and inorganic agents that specifically prevent minute particles that have been removed from a metal surface in cleaning from redepositing on that surface by holding those particles in suspension. Examples of deflocculants are alkaline lignosulfonates (a byproduct of cellulose manufacturing), sodium and potassium carbonates, sodium silicates, phosphates and polyphosphates.

If not treated properly, bound metals pose big problems in wastewater treatment. Inadequate precipitation and removal of metal from the waste water can result in halting the metal finishing process, perhaps triggering fines, citations and possible legal action as a result. However, like metal chelate bonds, the proper addition of metal precipitants is very effective to break bonds in metal to complexing agents as a first step in wastewater treatment.

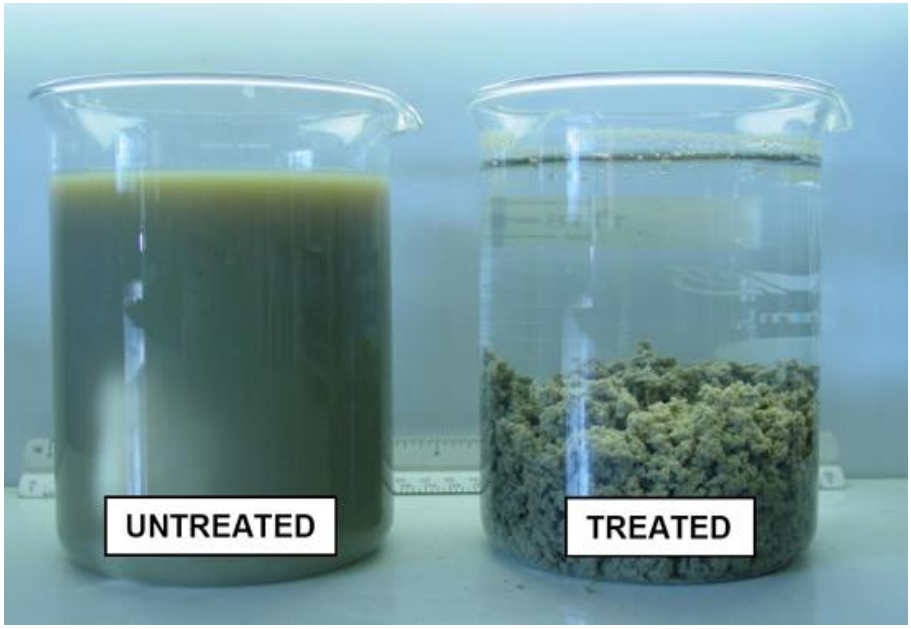
4. Coagulants & Flocculants

- Coagulation is a physical process and does not involve neutralization of charge.
- Flocculation is a chemical process that involves neutralization of charge,

In wastewater treatment, coagulation and flocculation involve adding polymers that clump the small, destabilized particles together into larger aggregates so that they can be more easily separated from the waste water. Larger particles will, thanks to gravity, settle faster, thus clarifying the water. These particles are the precipitated metals which are to be removed from water in the treatment process. Coagulants increase the particle sizes. Flocculants induce a space charge attracting particles to form larger aggregates.

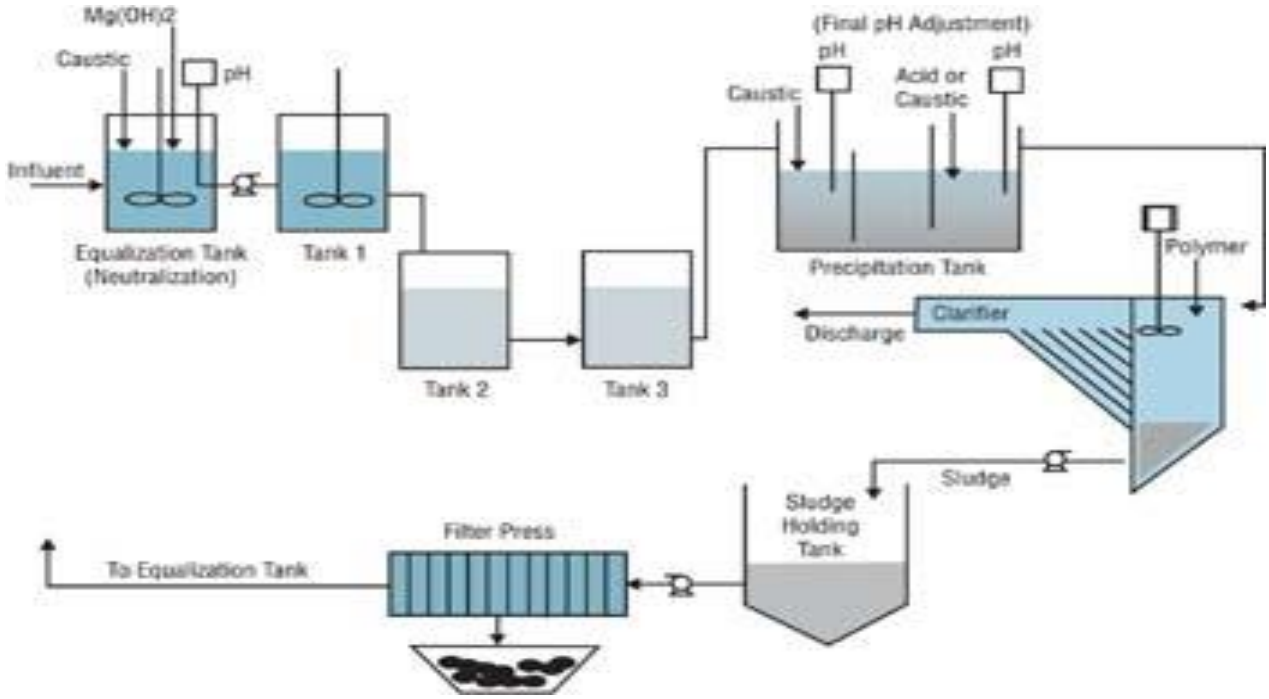
The coagulation-flocculation process is used as an intermediary to the finishing step in the wastewater treatment prior to filtration and sedimentation. Iron and aluminum salts are examples of compounds formulated in coagulants. Flocculants consist of specialty polymers, which can be anionic (negatively charged) or cationic (positively charged). Flocculants vary in molecular weight and charge densities to optimize application to specific wastewater treatment needs. The flocculant is a polymer, effective in bridging the unstable colloidal particles. Coagulants and flocculants are normally dosed in very small quantities, and are effective additions to treat the waste water.

The following picture demonstrates the effect of proper treatment of metal finishing waste water



Picture of a typical wastewater treatment system in a metal finishing installation.

Schematic of the wastewater treatment system.



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SINCE 1849

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1-800-648-3412
or techservice@hubbardhall.com