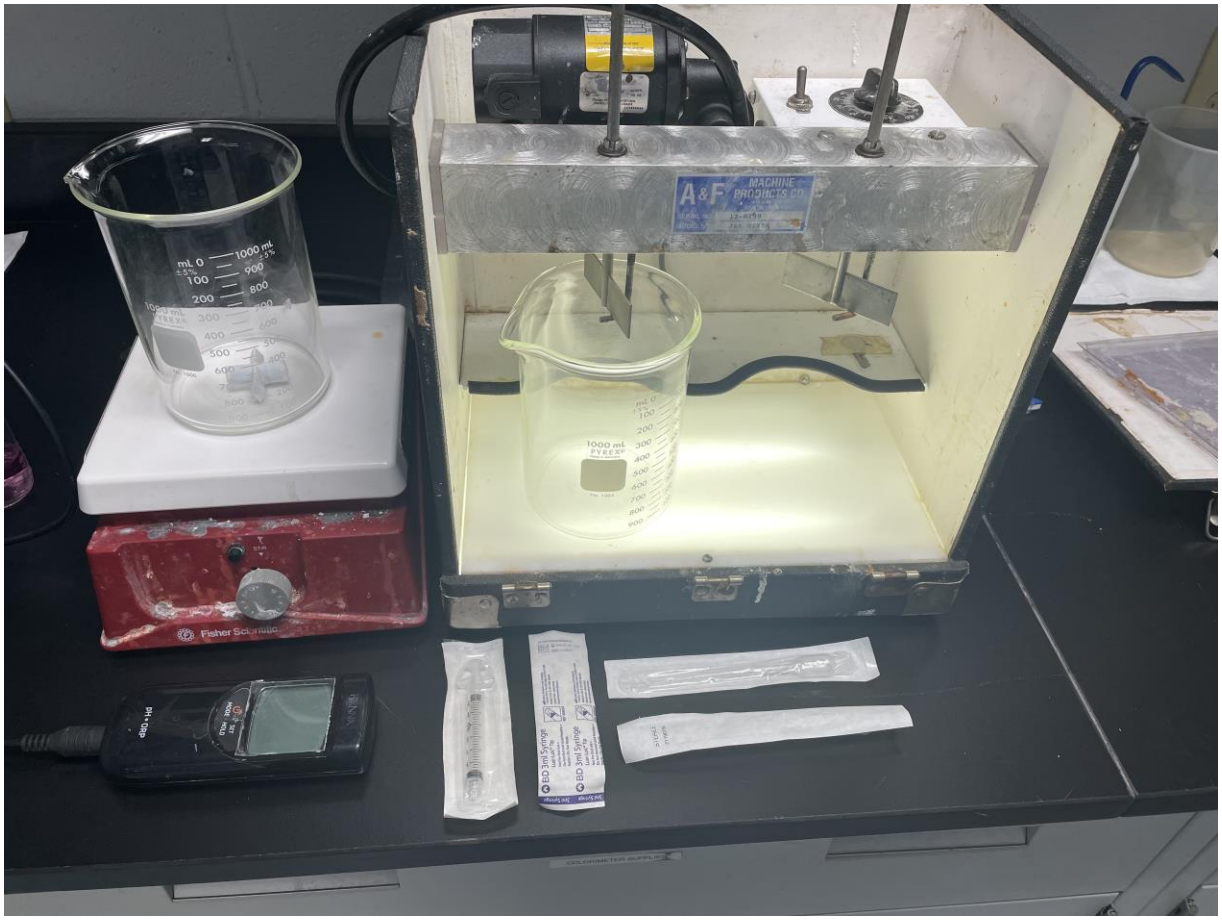
BENCH TESTING INSTRUCTIONS

In wastewater treatment, the number one tool available for ensuring the wastewater systems are running effectively is a bench test. Bench testing is used to verify chemicals needed to remove contaminants, check chemical dosing, determine correct pH ranges, and determine the amount of solids that can be produced from the treatment process. To bench test a wastewater sample certain equipment is needed:

- Mixing device, preferably a gang stirrer, but if not available a magnetic mixing plate
- Magnets if a magnetic mixing plate is used
- Sample Containers, such as glass beakers or jars
- Syringes or pipettes
- Calibrated pH meter, and ORP meter if possible
- Timer
- Chemicals needed (Coagulant, sodium hydroxide, sulfuric acid, flocculant, metal precipitant)
- Wastewater to be tested
- Notebook to record observations in

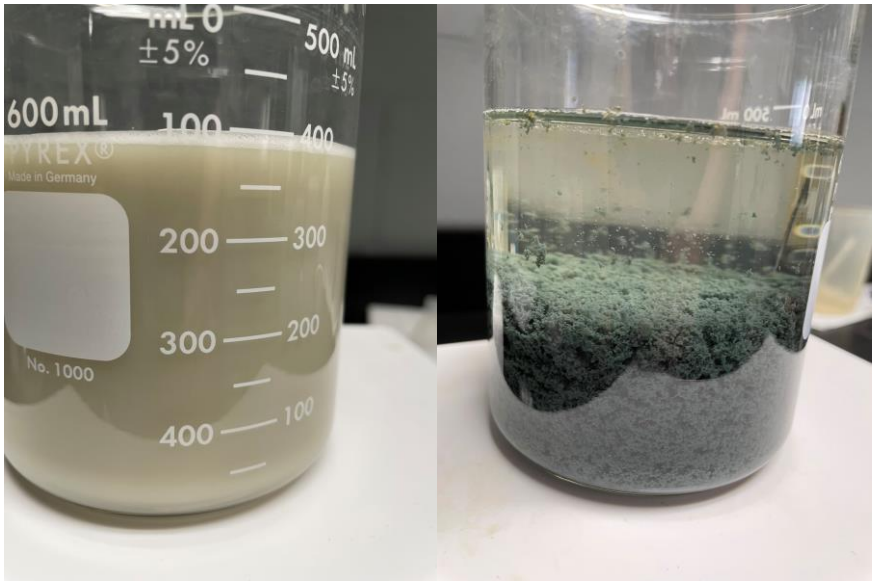


Manufacturing facilities who treat wastewater for discharge have either a NPDES discharge permit or a Pretreatment Permit. These permits outline what the facility is allowed to discharge in the wastewater effluent. Bench testing helps determine if the wastewater treatment system can meet the discharge requirements outlined in the discharge permits. Information for these permits can be found in the Code of Federal Regulations title 40, Chapter I, Subchapter N, Part 400.

When setting up for a bench test, have clear goals for treatment established before the test begins. The goals may be to ensure the wastewater is treated to below the permitted discharge numbers for the contaminants of concern, or to reduce sludge production by a certain percentage. There can be a variety of wastewater goals to look at when bench testing.

Bench (Jar) Test Steps:

1. Ensure the wastewater sample is fully mixed.
2. Fill the bench test beaker to the desired amount for the bench test, the most common amount for testing is 1000mLs, and place in the gang stirrer or on the magnetic stir plate.
3. Start the sample stirring at a slow to medium speed.
4. Check the pH with the calibrated meter and record in the log. If ORP is available, record that as well.
5. Start with a low dose of coagulant. 0.1mls for the first test, with each subsequent test seeing an increase of 0.1mls per test.
6. Adjust pH to the desired range for optimal contaminant removal. Use the Hydroxide or Sulfide Solubility Curve Charts to help determine the pH range if removing metals.
7. Log chemical usage and visual observations of the sample at this point. Note if pin floc is formed or if there is a color change.
8. Add prepared flocculant at a dose of 0.2mLs to start. Increase dosing if floc formation is not noted.
9. Once floc forms, blend for 90 seconds at a rapid speed before slowing down to half the speed. Blend for an additional 90 seconds then stop the unit and allow solids to settle.



Once the solids have settled and there is clear Supernate, pull a sample from the clear line and test for the contaminants that were removed. If not enough was removed to meet the goals of the bench test, repeat the test with additional chemistry. If it is determined the coagulant used was not optimal to meet the goals, try a different coagulant. If solid floc does not form with the first flocculant, try a different charged flocculant.

How To Use Metal Precipitants

Metal precipitants, otherwise known as metal scavengers, are used when metal bearing wastewater is chelated. These products can be DTC, Sulfide, Carbonate, or a combination of products. They all have a high pH and a bad smell.

Chelation can come from cleaners and plating baths, among other processes. Common chelators in the metal finishing industry can be citric acid, EDTA, ammonia, or cyanide. (See attached List)

Chelation ties up the metals in wastewater making hard to break complexes. This prevents the wastewater system from removing the metals causing the discharge to be non-compliant in some cases.

When a metal precipitant is needed bench testing is the best way to determine which one will work best for the wastewater. When possible, due to the odor of metal precipitants, working under a hood or in a fully ventilated area is recommended.

Bench (Jar) Testing using Metal Precipitants:

1. Ensure the wastewater sample is fully mixed.
2. Fill the bench test beaker to the desired amount for the bench test, the most common amount for testing is 1000mLs, and place in the gang stirrer or on the magnetic stir plate.
3. Start the sample stirring at a slow to medium speed.
4. Check the pH with the calibrated meter and record in the log. If ORP is available, record that as well.
5. Start with a low dose of coagulant. 0.1mls for the first test, with each subsequent test seeing an increase of 0.1mls per test.
6. Adjust pH to 8 and record the ORP readings.
7. Add Metal Precipitant 1 drop at a time while watching the ORP. When there is a 50-point drop in the ORP this indicates enough Metal Precipitant has been added. Record the ORP and pH with the amount of Metal Precipitant used.
8. Adjust pH to the desired range for optimal contaminant removal. Use the Hydroxide or Sulfide Solubility Curve Charts to help determine the pH range if removing metals.
9. Log chemical usage and visual observations of the sample at this point. Note if pin floc is formed or if there is a color change.
10. Add prepared flocculant at a dose of 0.2mLs to start. Increase dosing if floc formation is not noted. Using Metal Precipitants can make floc formation smaller and harder to note in bench testing.
11. Once floc forms, blend for 90 seconds at a rapid speed before slowing down to half the speed. Blend for an additional 90 seconds then stop the unit and allow solids to settle.

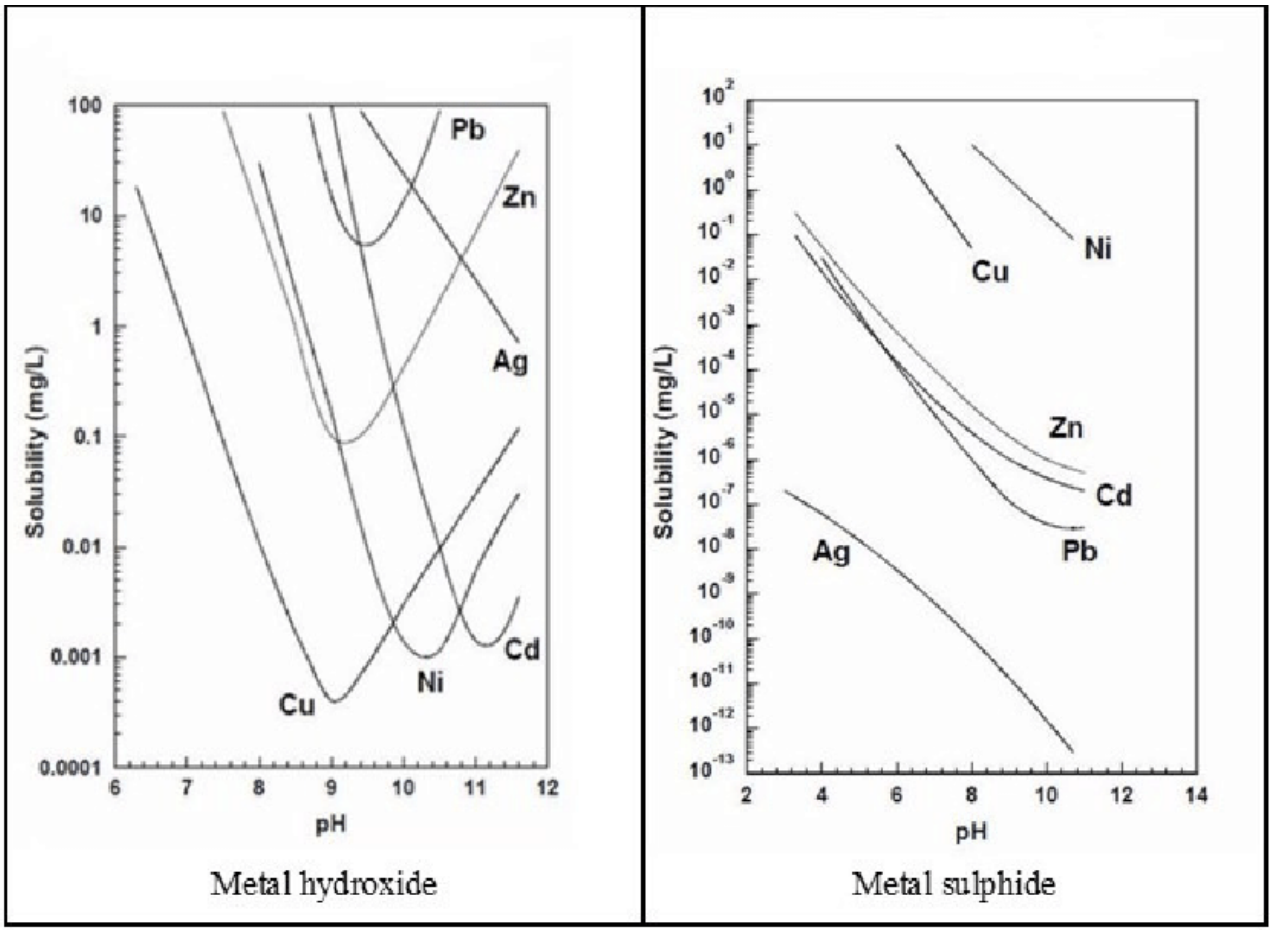
Bench testing is not an exact science. Each test can produce slightly different results because every wastewater sample is slightly different. By using bench tests to help determine the best chemicals for the wastewater system, you can eliminate weeks of trial and error on a large scale. You will still need to adjust the wastewater system while the water flows to dial in chemical feeds, but bench testing gives you an idea starting point. When there is going to be a change to the chemicals used in production, bench testing the new chemicals will give an indication of how the wastewater system will respond to the new additions. Having all wastewater operators know what a bench test is and how to conduct one will save countless hours of down time when a system upset occurs. They can quickly determine the best course of treatment using bench testing and then scaling the results up to the system versus making blind adjustments to the system trying to get it running correctly.

Common Chelators in Metal Finishing

Ammonia
Ammonium Chloride
Ammonium Hydroxide
Ammonium Bifluoride
Acetylacetone
Citric Acid
Chromotropic Acid (DNS)
Cyanide
DTPA
Diethalamine
Dipyridyl
Disulfopyrocatechol (PDS)
Dimethylglyoxime
Disalicylaldehyde 1,2-propylenediimine
Dimercaptopropanol (BAL)
Dithizone
Diethyl Dithiophosphoric Acid
Ethylenediaminetetraacetic Acid (EDTA)
Ethylenebis (hydroxyohenylglycine) (EHPG)
Ethylenediamine
Ethylenediaminetetra (methylenephosphoric Acid) (EDTPO)
Glyeric Acid
Glycolic Acid
Gluconic Acid
Hydroxyethylethylenediaminetriacetic Acid (HEDTA)
Hydroxyethylidenediphosphonic Acid (HEDP)
HEDDA
Lactic Acid
Malic Acid
Monothanalamine
Monosodium Phosphate
Nitrilotriacetic Acid (NTA)
N-Dihydroxyethylglycine
Nitrilotrimethylenephosphonic Acid (NTPO, ATMP)
N-Hydroxyethylethylenediamine
O-phenanthroline
Oxine, 8-Hydroxyquinoline (Q)
Oxinesulphonic Acid
Phthalocyanine
Potassium Ethyl Xanthate
Phosphoric Acid
Polyethyleneimine (PEI)

Common Chelators in Metal Finishing

Polymethacryloylacetone
Poly (p-vinylbenzyliminodiacetic Acid)
Rochelle Salts
Sodium Gluconate
Sodium Pyrophosphate
Succinic Acid
Sodium Tripolyphosphate
Sulphosalicylid Acid (SSA)
Salicylaldehyde
Salicylaldoxime
Sodium Hydroxyacetate
Sodium Citrate
Sodium Fluoride
Sodium Malate
Sodium Amino Acetate
Tartaric Acid
Trisodium Phospate (TSP)
Trifluoroacetylacetone
Thenoyltrifluoroacetylacetone (TTA)
Triethylenetetramine
Trieminotriethylamine
Triethanolamine (TEA)
Tetraphanylporphin
Toluene Dithiol
Thioglycolic Acid
Thiourea



The solubility of metal hydroxide and metal sulphide on different pH [3].