

Chemical Precipitation

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Hydroxide Precipitation

- Soluble heavy metal ions are converted to relatively insoluble metal-hydroxide precipitates by adding an alkali-precipitating agent.
- Most common hydroxide precipitating agents are:
 - Caustic soda (NaOH)
 - Hydrated Lime (Ca(OH)_2)
 - Magnesium Hydroxide (Mg(OH)_2)



Chemical Equation

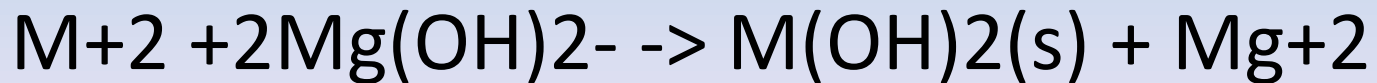
1. For Hydrated Lime



2. For Caustic Soda



3. For Magnesium Hydroxide



The solubilities of the Metal Hydroxide

- Most of Metal Hydroxides precipitate's solubilities decrease with increasing pH .
- Chelating agent: EDTA, citrate, tartrate, gluconic acid, cyanide, or ammonia
- Additional chelating agent with metal will not decrease solubilities with increasing pH number.

Removal Metal ions via hydroxide precipitation

- Effectively removed metal ions are:
 - Cadmium
 - Copper,
 - Trivalent chromium
 - Iron
 - Manganese
 - Nickel
 - Lead
 - Zinc

Advantage of Hydroxide Precipitation

- Simple technology
- Relatively inexpensive.
- Easy to achieve regulatory effluent limits
- Well suited for automation.
- Hydroxide precipitation can remove heavy metal and non-metal pollutants such as soaps and fluorides.

Advantage of Hydroxide Precipitation

Continue-----

- Ease of automatic pH control
- Relatively simple operation
- Well proven and accepted in industry.
- Relatively low cost of precipitant.

Disadvantage of Hydroxide Precipitation

- Some metal need extra reduction-oxidation process to precipitate as hydroxide metal.
- Reduction process:
 - $\text{Cr}^{+6} \rightarrow \text{Cr}^{+3}$
 - $\text{Sr}^{+6} \rightarrow \text{Sr}^{+4}$
- Oxidization Process:
 - $\text{Ar}^{+3} \rightarrow \text{Ar}^{+5}$
 - $\text{Fe}^{+2} \rightarrow \text{Fe}^{+3}$

Chelating agent,organo-metallic complexes and metal-cyanide complexes inhibit the formations of the hydroxide precipitate.

Comparison of Hydroxide Reagent Properties

Property	NaOH	Ca(OH) ₂	Mg(OH) ₂
Molecular weight	40	74.1	58.3
Hydroxide contents %	4.5	45.9	58.3
Heat of solution kg-cal/mole	9.94	2.79	0
Solubility (g/100 mL H ₂ O)	42.0	0.185	0.0009
Max. pH	14.0	12.5	9.0
Weight equivalent	1.47	1.27	1.0
Freezing point	16.0	0	0
Solids content of sludge (%)	30.0	35.0	55.0
Sludge density kg/m ³	1300	1400	1600-1750
Filtration time (hr)	7 – 8	7 – 9	1.5 – 2.0
Sludge volume (m ³)			

Coagulation

- Specific chemicals such as aluminum sulfate (alum), ferric sulfate, ferric chloride, calcium chloride, calcium oxide (lime) are added to the wastestream to neutralize the electrical charge and cause very fine particles (floc) to clump together into larger particles

Flocculation

- Through long-chain molecules synthetic polymer with very specific characteristics (electrical charge, alkalinity, pH, chelating agent, oxidizers, reducers etc.) to gather very fine and small particles together and form floc, and then settle out of the solution in a quiescent environment which tends to promote settling.

Chemicals used in wastewater treatment

Lime (CaO): acts as a coagulant for hardness and particulate matter, often used in conjunction with other coagulants.

Ferrous Sulfate(Fe(SO₄)₃): Used with Lime to soften water. Wastewater must contain dissolved oxygen for reaction to proceed successfully.

Alum or Filter Alum (Al₂(SO₄)₃.14H₂O)

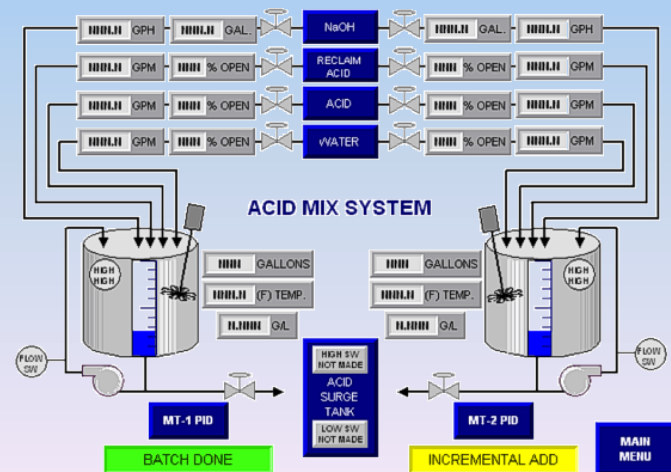
Used for water softening and phosphate removal. Reacts with available alkalinity (Carbonate, bicarbonate and hydroxide) or phosphate to form insoluble aluminum salts.

Chemicals used in wastewater treatment Continue ---

- **Ferric Chloride (FeCl_3)**
 - Reacts with alkalinity or phosphates to form insoluble iron salts.
- **Polymer:** High molecular compounds which can be anionic, cationic, or nonionic.

Automatic Acid Mixing & Batching

Controls designs and builds complete chemical process systems and chemical mixing & delivery systems. Skid-mounted systems come complete and fully tested. Flow meters are wet calibrated and I/O tested. All software is fully debugged.



Sewer Discharge System

Clay System FLOK Continuous Flow

- FLOK is a blend of enhancement
- polymers and clay for most
- contaminants found in waste water. FLOK normally passes the federal



pH Adjustment Product System

- All kinds of wastewater treatment, pH adjustment is used to achieve the desired set point. After any necessary pH adjustment, addition of flocculants and mixing of flocculants is utilized to precipitate liquid/solid separation. These flocculants will envelop most suspended solids reducing them to non-hazardous waste.



