Removal of Precipitates

- Coagulation (Rapid Chemical Mix)
  Destabilization of Suspended Particles

- Flocculation (Slow Mix)
  Particle Collision and Growth

- Settling  Removal of Settleable Solids
Solids Removal Process

- Coagulation
- Rapid Mix
- Flocculation
- Settling
Flumes

- Flow Diversion
- Polymer Addition
- Rapid Mixing
- Flocculation
Polymeric Coagulant Feed

Polymer diluted to 0.1 percent (1,000 ppm)

Polymer Dose: 1 - 3 ppm
Wastewater Coagulants

- **Inorganic:** Ferric, Aluminum Sulfates

- **Natural Polyelectrolytes:** Bentonite Clay, Starch, Guar Gum, Sodium Alginate, Sodium Carboxymethylcellulose

- **Synthetic Polymers:** Polyacrylamide, Polyacrylonitrile, Polyamine, Carboxyl, Ethylene Oxide Polymers
Synthetic Polyelectrolytes

- Anionic (Negative)
- Cationic (Positive)
- Nonionic (Both)

High Molecular Weight
- ~ 1,000,000 amu
Dosage < 1 ppm

Interparticle Bridging
Flocculation

- Three Baffled Partitions
- Paddle Flocculators
- Tapered Energy Input
- Detention Time: 30 to 60 minutes
Settling Test - 1 minute

Flocculator Turned Off

Flocculator Operating
Settling Test - 5 minutes

Flocculator Turned Off

Flocculator Operating
Settling Test - 15 minutes

Flocculator Turned Off

Flocculator Operating
Settling Test - 20 minutes

Flocculator Turned Off

Flocculator Operating
Settling Test - 1 hour

Flocculator Turned Off

Flocculator Operating
Jar Testing Demonstration

- Dose - Response
- Energy Input
  - Rapid Mix
  - Slow Mix
- Settling Rate
- Alternate Coagulants
Removal of Skimmings
Solids Return

Return flow displaces oil layer
Settling Tanks

- Retention Time: > 2 hours
- Surface Loading Rate: < 1,000 gpd/sf
- Sludge Storage Hoppers
- Sludge Rake Mechanisms
Rising Solids

- Surfacing of Oil
- Turbulence due to Sludge Raking
- Gas Formation in Sludge Blanket
- Wind Stirring on Open Basins
- Temperature-Induced Density Currents
Sludge Removal Mechanism

- Chain-Driven Flights
- Continuous Raking
- Intermittent Solids Removal
Effluent Weirs

- V-notch weirs to minimize effect of wind set-up and turbulence
- Serpentine to attain > 20,000 gal/foot/day
Settling Tank Detention

Ideal Tank

3 mgd flow in 0.9 mg tank: 0.3 days

Deviation from Ideal

- Inlet, Outlet and Sludge Storage Zones
- Variations in Flow, Uneven Distribution
- Temperature (Density), Dead Spots
- Wind Stirring, Set Up, Seiches
- Turbulence, Sludge Blanket Upsets