

# Understanding Pretreatment

WesTech Engineering, Inc.  
Salt Lake City, Utah, USA

# Industrial Water Usage

- Water is required in almost every industry

For:

- Cooling
- Boiler feed
- Process
- Drinking
- Cleaning



In 2005 it is estimated that USA industrial raw water consumption will exceed 2 million Mega-liters per day (500 billion gallons per day)

# Water Quality

- Raw water contaminants include:
  - Dirt and sediment
  - Hardness (dissolved Ca & Mg)
  - Heavy metals like Pb, Zn, Cd, Hg, As, Fe etc.
  - Salts
  - Organics
  - Color





# Water Quality

- Each industrial application requires a different level of finished water quality.
- Understanding the condition of the raw water and the finished water quality requirements enables us to configure the right equipment for the specific application.

SiO<sub>2</sub> Pt/Co  
KMnO<sub>4</sub> Ca as CaCO<sub>3</sub>=120mg/l SO<sub>4</sub> NTU  
pH °C TSS E.coli Pb MgOH BOD<sub>5</sub><20 FOG  
NaCl SDI<3 VOC Fe<sup>+3</sup> TOC COD  
HCO<sub>3</sub>  
NaOH

# Equipment & Process Selection

- Solids removal
  - Screening
  - Sedimentation
  - Flotation
  - Filtration
- Oily materials
  - Flotation
  - Sedimentation
  - Filtration
- Hardness removal
  - Chemical reaction
  - Sedimentation
  - Filtration
- Heavy Metals
  - Precipitation
  - Flotation
  - Sedimentation
  - Filtration

# Solids Removal

- Screening
  - Remove coarse material, wastes and debris.
  - Protects down stream pumps and equipment
  - Typically for material larger than 3mm





# Solids Removal

- There are many kinds of screening products WesTech can offer to meet a project need.



# Solids Removal

- Sedimentation
  - Grit separators
  - Clarifiers
  - Thickeners

## Stokes Law

$$V = \frac{gD^2(\delta - \rho)}{18\eta}$$

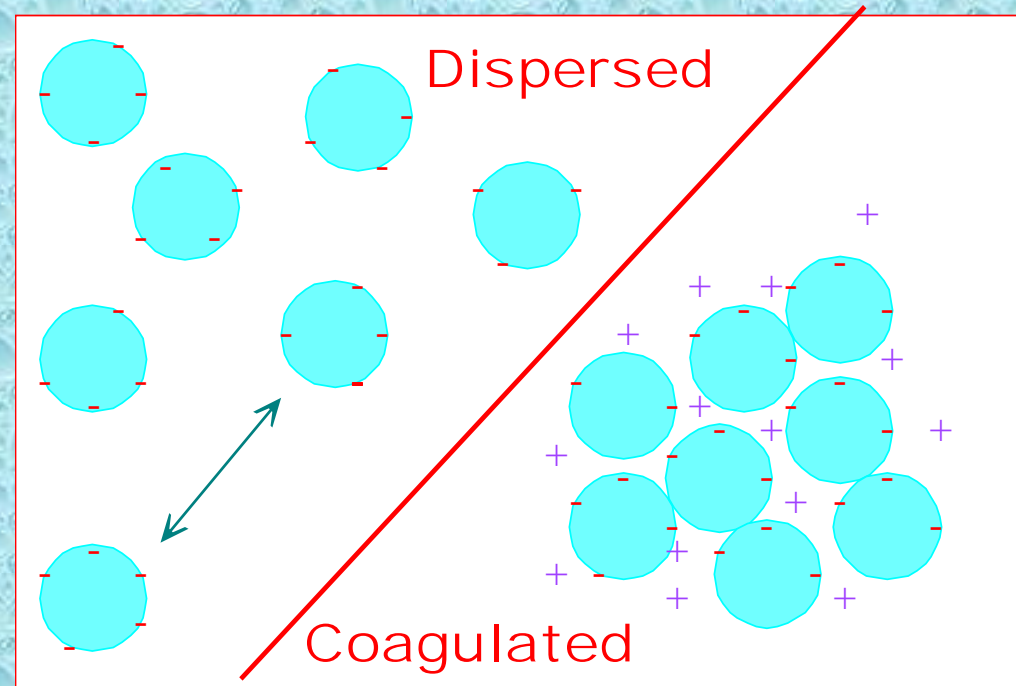
From Stokes law we see that under the force of gravity a particle's velocity in a fluid is proportional to its diameter and its density. The bigger the particle (or the bigger we can make it), the faster it will settle.



# Solids Removal

- Coagulation

- Most particles carry some amount of surface charge.
- Charges of like pole tend to repel each other.
- Coagulation is the conditioning of the particle surface and environment

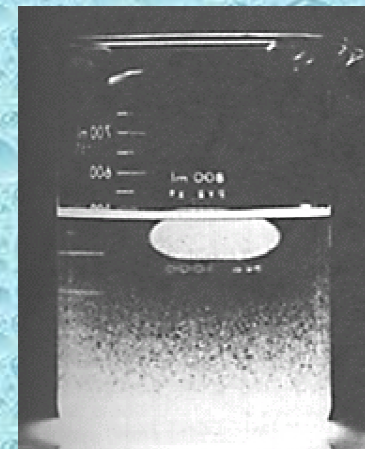
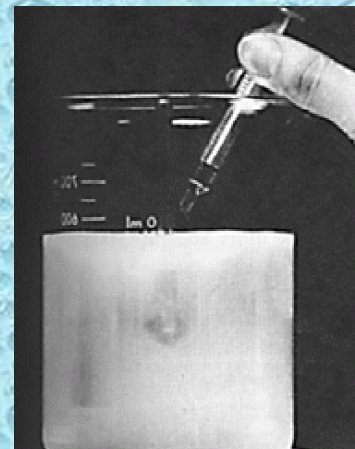
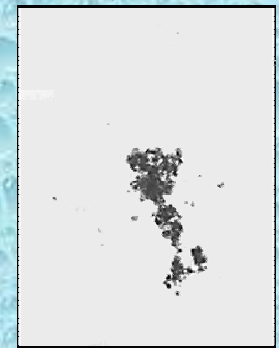
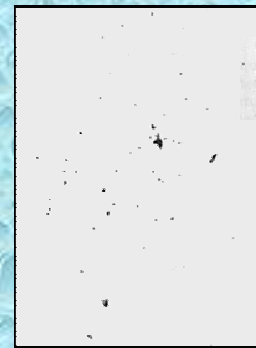
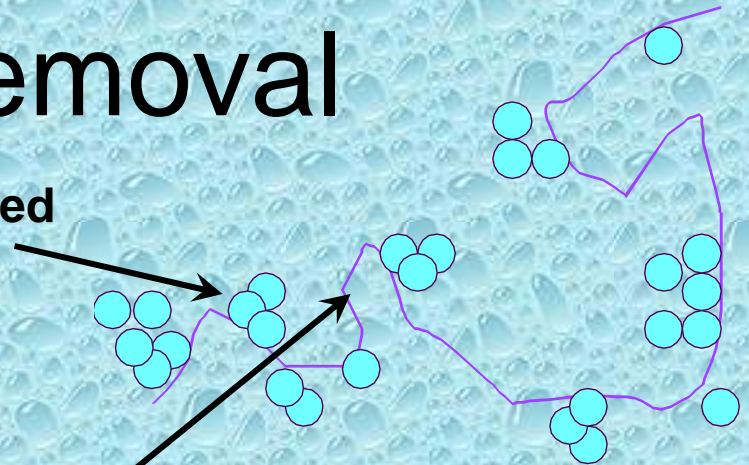


# Solids Removal

- Flocculation
  - Is the means by which we can make large particles from small ones.
  - This is particularly important when we have very fine particles that settle very slowly.

Coagulated particles

Long chain polymer strand





# Solids Removal

- Sedimentation
  - Grit separators
  - Clarifiers
  - Thickeners



# Solids Removal

## Flotation

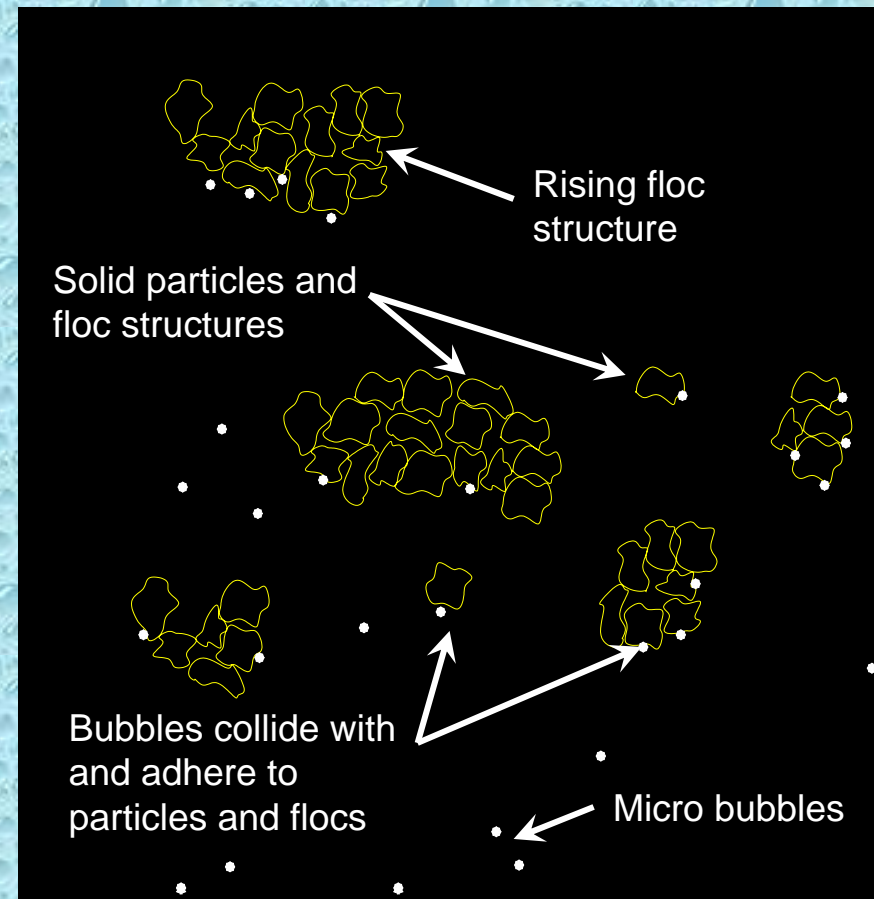
- Fats, oils, grease, emulsions and other materials that have low specific gravities or are so finely divided that they are difficult to settle, can be removed with dissolved air floatation.





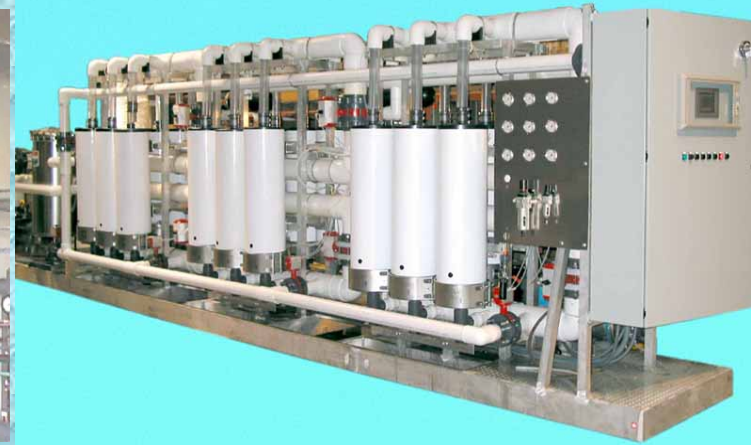
# Solids Removal

- Flotation
  - Microscopic size bubbles are created by dissolving gas into the feed under pressure. When the pressure drops the dissolved gas comes out of solution as very small bubbles which attach to and “float” the “solid” material to the top.



# Solids Removal

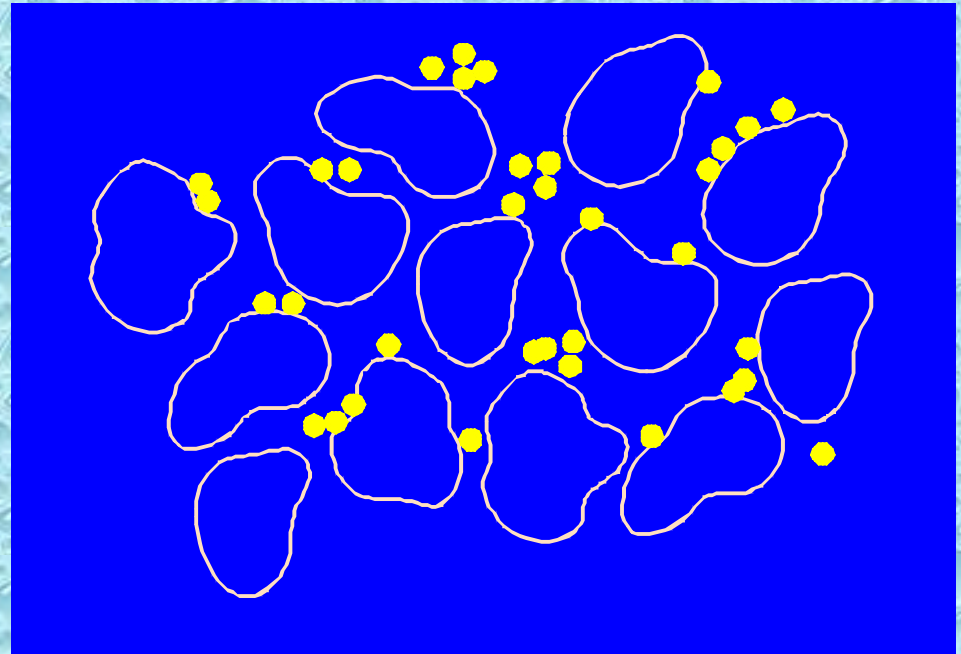
- Filtration
  - Granular media
  - Membrane





# Solids Removal

- Granular Media
  - Sand
  - Anthracite
  - Garnet
- Depth filtration
  - Function of flocculation
  - Particle collisions
  - Interstitial spacing



# Solids Removal

- Types of granular media filters
  - Conventional
    - Gravity
    - Pressure
  - Multi-media
  - Self stored backwash
  - Continuous backwash
  - TechnaSand™





# Solids Removal

- Membrane
  - Polymem™ Ultra filter
  - Physical barrier filtration at 0.01 micron size
  - Produces low SDI water which improves RO performance.



# Hardness Removal

- Chemical precipitation
  - Cold lime softening
  - Warm lime softening
  - Caustic softening
  - Lime / soda ash

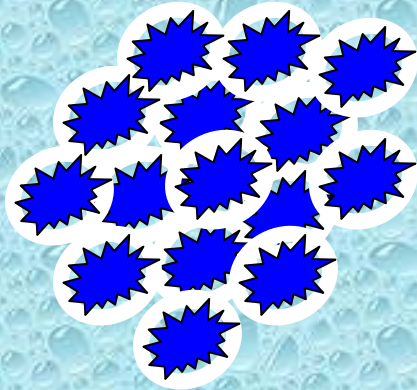
***Converting highly soluble materials to less soluble forms that can be removed by techniques of liquid solid separation***





# Hardness Removal

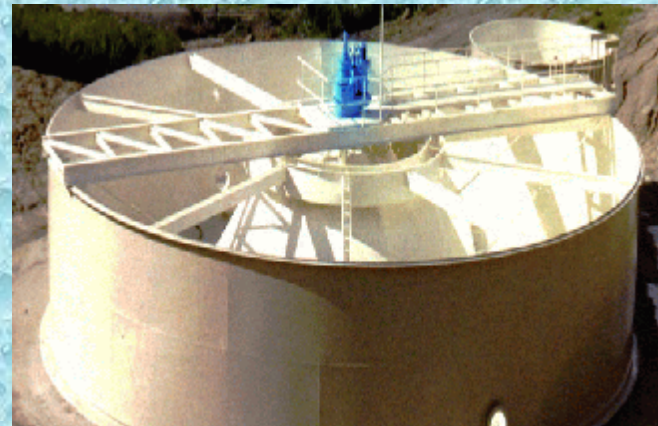
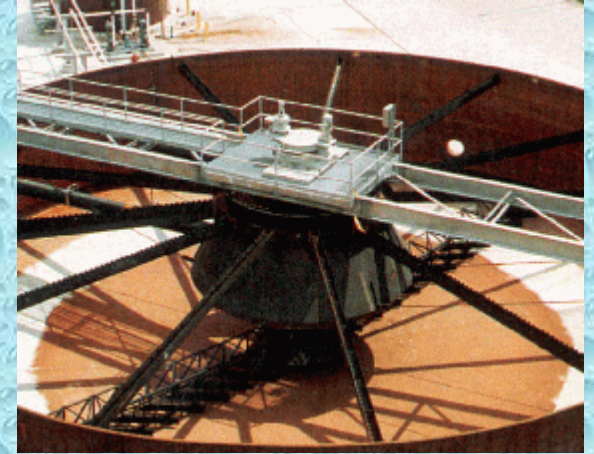
- Solids recirculation
  - Solids Contact Clarifiers
  - External recirculation
  - External reactors



Spontaneous formations of precipitates are most often very fine and settle poorly. Once through reactions are prone to develop precipitates on equipment surfaces (scaling) because it is easier to propagate crystal growth.

# Hardness Removal

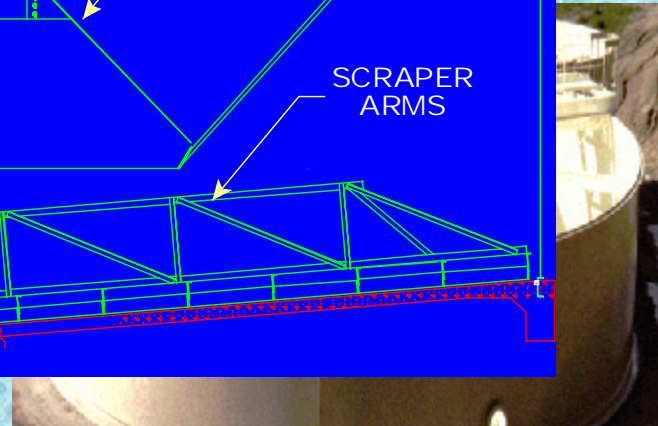
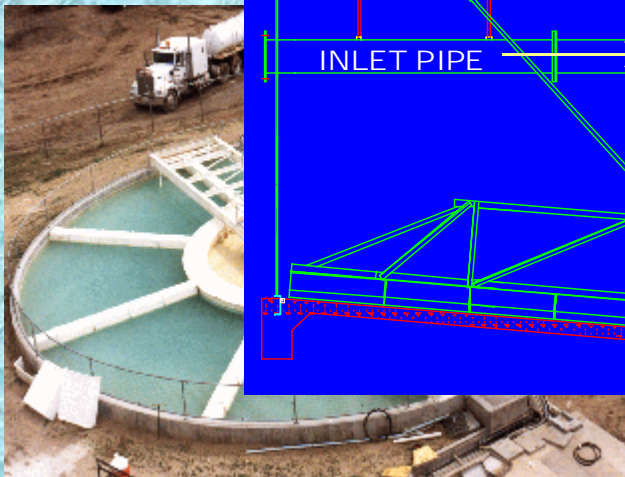
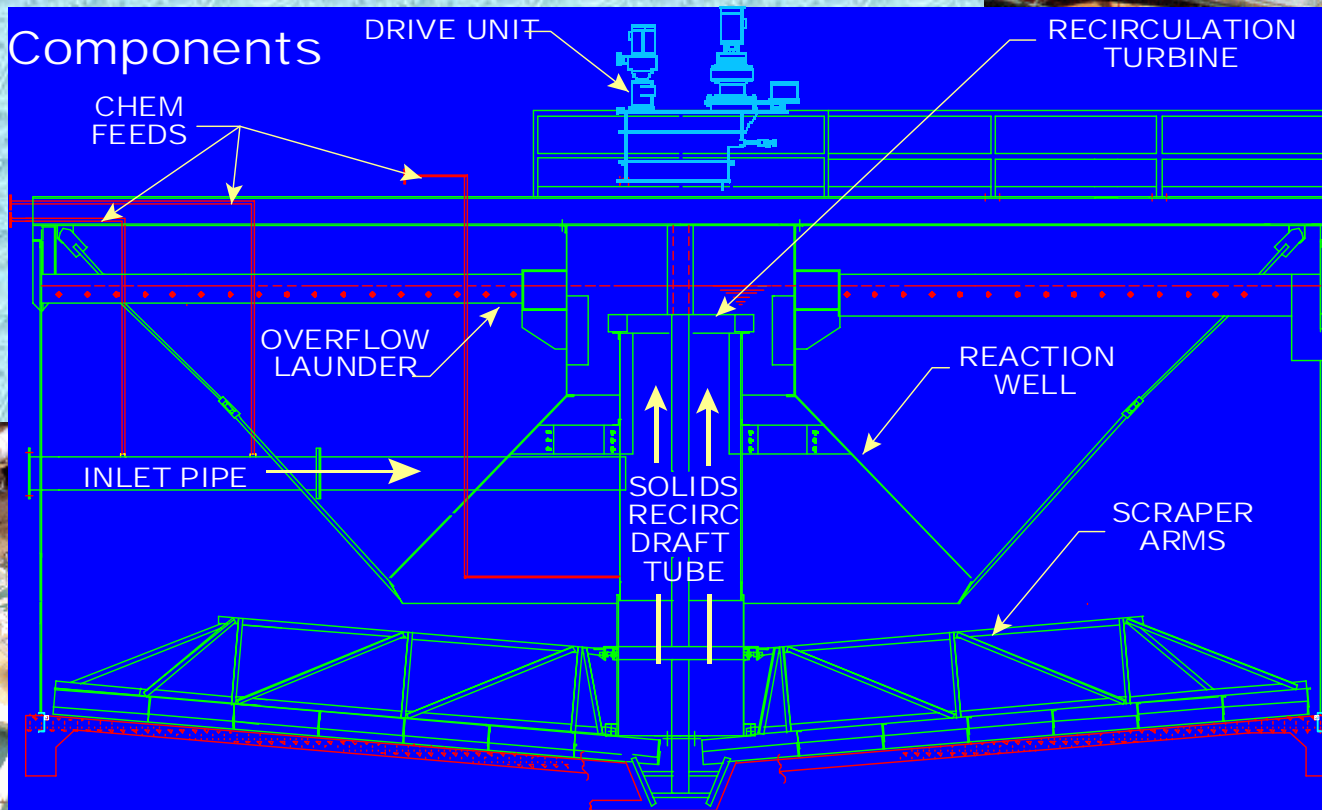
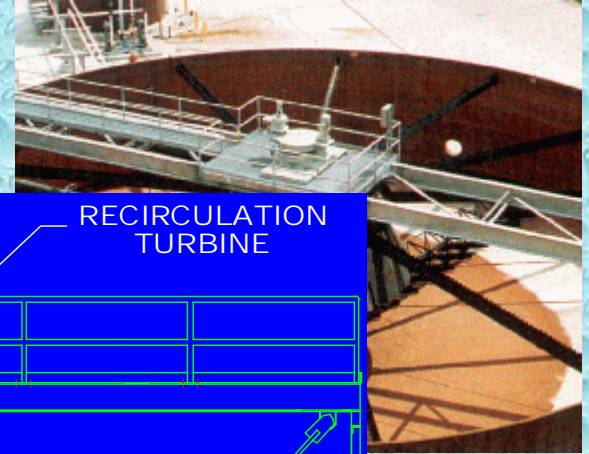
- Solids Contact Clarifiers





# Hardness Removal

- Solids Contact Clarifiers



# Metals Removal

- Oxidation
  - Iron, manganese
- Reduction
  - $\text{Chrome}^{+6}$  to  $\text{Chrome}^{+3}$
- Precipitation
  - Hydroxides
- Ion Exchange

Depending on the demands of the application, it may be necessary to combine chemical process and perform multi step reactions.



# Systems

- Systems
  - Many applications will require multiple unit processes to achieve treatment. A systems approach in equipment is often needed.
  - Combining unit processes for raw water pretreatment is one of WesTech's strengths.



The background of the slide is a light blue surface covered with numerous small, clear water droplets of varying sizes. The droplets are scattered across the entire frame, creating a textured, fresh appearance. The lighting is soft, highlighting the rounded tops of the droplets and their reflections on the surface.

Questions?